Document of
The World Bank

Report No.: 41122

PROJECT PERFORMANCE ASSESSMENT REPORT

PEOPLE'S REPUBLIC OF CHINA

SECOND LOESS PLATEAU WATERSHED REHABILITATION PROJECT (LOAN 4477 & CREDIT 3222)

AND

XIAOLANGDI MULTIPURPOSE PROJECT I & II (LOANS 3727 & 4200)

AND

TARIM BASIN II PROJECT (LOAN 4341 & CREDIT 3093)

October 4, 2007

Sector, Thematic, and Global Evaluation Division
Independent Evaluation Group (World Bank)

Currency Equivalents (annual averages)

Currency Unit = Yuan (Y or RMB), 100 fen = 1 Yuan = 1 RMB

1994	US$1.00	Y8.70
1997	US$1.00	Y8.30
2000	US$1.00	Y8.27
2004	US$1.00	Y8.26
2006	US$1.00	Y7.83

Abbreviations and Acronyms

AAA	Analytical and advisory services
BLM	Basin Level Model
GoC	Government of China
EPH	Electric Power of Henan
ESW	Economic and sector work
IBRD	International Bank for Reconstruction and Development
ICR	Implementation Completion Report
ID	Institutional development
IDA	International Development Association
M & E	Monitoring and evaluation
M & I	Municipal and industrial
MWR	Ministry of Water Resources
NDRC	National Development and Reform Commission
O & M	Operations and maintenance
PPAR	Project Performance Assessment Report
SAR	Staff Appraisal Report
SLCP	Sloping Land Conversion Program
VAT	Value Added Tax
YRCC	Yellow River Conservancy Commission
YRWHDC	Yellow River Water and Hydropower Development Corporation
GWh	gigawatt-hour (1 million kWh)
TWh	terawatt-hour (1 billion kWh)
MW	megawatt (1000 kilowatts)

Fiscal Year

Government: January 1 – December 31

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IEGWB Mission: Enhancing development effectiveness through excellence and independence in evaluation.

About this Report

The Independent Evaluation Group assesses the programs and activities of the World Bank for two purposes: first, to ensure the integrity of the Bank's self-evaluation process and to verify that the Bank's work is producing the expected results, and second, to help develop improved directions, policies, and procedures through the dissemination of lessons drawn from experience. As part of this work, IEGWB annually assesses about 25 percent of the Bank's lending operations through field work. In selecting operations for assessment, preference is given to those that are innovative, large, or complex; those that are relevant to upcoming studies or country evaluations; those for which Executive Directors or Bank management have requested assessments; and those that are likely to generate important lessons.

To prepare a Project Performance Assessment Report (PPAR), IEGWB staff examine project files and other documents, interview operational staff, visit the borrowing country to discuss the operation with the government, and other in-country stakeholders, and interview Bank staff and other donor agency staff both at headquarters and in local offices as appropriate.

Each PPAR is subject to internal IEGWB peer review, Panel review, and management approval. Once cleared internally, the PPAR is commented on by the responsible Bank department. IEGWB incorporates the comments as relevant. The completed PPAR is then sent to the borrower for review; the borrowers' comments are attached to the document that is sent to the Bank's Board of Executive Directors. After an assessment report has been sent to the Board, it is disclosed to the public.

About the IEGWB Rating System

IEGWB's use of multiple evaluation methods offers both rigor and a necessary level of flexibility to adapt to lending instrument, project design, or sectoral approach. IEGWB evaluators all apply the same basic method to arrive at their project ratings. Following is the definition and rating scale used for each evaluation criterion (additional information is available on the IEGWB website: http://worldbank.org/ieg).

Outcome: The extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently. The rating has three dimensions: relevance, efficacy, and efficiency. *Relevance* includes relevance of objectives and relevance of design. Relevance of objectives is the extent to which the project's objectives are consistent with the country's current development priorities and with current Bank country and sectoral assistance strategies and corporate goals (expressed in Poverty Reduction Strategy Papers, Country Assistance Strategies, Sector Strategy Papers, Operational Policies). Relevance of design is the extent to which the project's design is consistent with the stated objectives. *Efficacy* is the extent to which the project's objectives were achieved, or are expected to be achieved, taking into account their relative importance. *Efficiency* is the extent to which the project achieved, or is expected to achieve, a return higher than the opportunity cost of capital and benefits at least cost compared to alternatives. The efficiency dimension generally is not applied to adjustment operations. *Possible ratings for Outcome:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Risk to Development Outcome: The risk, at the time of evaluation, that development outcomes (or expected outcomes) will not be maintained (or realized). *Possible ratings for Risk to Development Outcome:* High Significant, Moderate, Negligible to Low, Not Evaluable.

Bank Performance: The extent to which services provided by the Bank ensured quality at entry of the operation and supported effective implementation through appropriate supervision (including ensuring adequate transition arrangements for regular operation of supported activities after loan/credit closing, toward the achievement of development outcomes. The rating has two dimensions: quality at entry and quality of supervision. *Possible ratings for Bank Performance:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

Borrower Performance: The extent to which the borrower (including the government and implementing agency or agencies) ensured quality of preparation and implementation, and complied with covenants and agreements, toward the achievement of development outcomes. The rating has two dimensions: government performance and implementing agency(ies) performance. *Possible ratings for Borrower Performance:* Highly Satisfactory, Satisfactory, Moderately Satisfactory, Moderately Unsatisfactory, Unsatisfactory, Highly Unsatisfactory.

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This report was prepared by George T. K. Pitman (Task Manager) and Sunil Mathrani (Consultant) who assessed the projects in October/November 2006. Soon-Won Pak provided administrative support.

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PRINCIPAL RATINGS

	*ICR**	*ICR Review**	*PPAR*
Second Loess Plateau Watershed Rehabilitation Project (Loan 4477/Credit 3222-CHA)			
Outcome	Highly satisfactory	Highly satisfactory	Satisfactory
Institutional Development Impact**	High	High	———
Risk to Development Outcome	———	———	Moderate
Sustainability***	Highly likely	Highly likely	———
Bank Performance	Highly satisfactory	Highly satisfactory	Satisfactory
Borrower Performance	Highly satisfactory	Highly satisfactory	Highly Satisfactory
Xiaolangdi Multipurpose Project I (Loan 3727-CHA)			
Outcome	Satisfactory	Highly satisfactory	Highly satisfactory
Institutional Development Impact**	Substantial	Substantial	———
Risk to Development Outcome	———	———	Significant
Sustainability***	Likely	Likely	———
Bank Performance	Satisfactory	Highly satisfactory	Highly satisfactory
Borrower Performance	Satisfactory	Highly satisfactory	Highly Satisfactory
Xiaolangdi Multipurpose Project II (Loan 4200-CHA)			
Outcome	Highly satisfactory	Highly satisfactory	Highly satisfactory
Institutional Development Impact**	Substantial	Substantial	———
Risk to Development Outcome	———	———	Significant
Sustainability***	Highly likely	Highly likely	———
Bank Performance	Satisfactory	Satisfactory	Highly satisfactory
Borrower Performance	Highly satisfactory	Highly satisfactory	Satisfactory

	*ICR**	*ICR Review**	*PPAR*
Tarim Basin II Project (Loan 4341-CHA and Credit 3093-CHA)			
Outcome	Highly satisfactory	Highly satisfactory	Satisfactory
Institutional Development Impact**	High	High	———
Risk to Development Outcome	———	———	Moderate
Sustainability***	Highly likely	Highly likely	———
Bank Performance	Highly satisfactory	Highly satisfactory	Highly Satisfactory
Borrower Performance	Highly satisfactory	Highly satisfactory	Satisfactory

* The Implementation Completion Report (ICR) is a self-evaluation by the responsible Bank department. The ICR Review is an intermediate IEGWB product that seeks to independently verify the findings of the ICR.
**As of July 1, 2006, Institutional Development Impact is assessed as part of the Outcome rating.
***As of July 1, 2006, Sustainability has been replaced by Risk to Development Outcome. As the scales are different, the ratings are not directly comparable.

KEY STAFF RESPONSIBLE

Project	*Task Manager/Leader*	*Division Chief/ Sector Director*	*Country Director*
Loess Plateau Watershed Rehabilitation Project (Loan 4477-CHA and Credit 3222-CHA)			
Appraisal	Juergen Voegele	Geoffrey Fox	Yukon Huang
Completion	Josef Ernstberger and Anis Wan/ Achim Fock	Mark Wilson	David Dollar
Xiaolangdi Multipurpose Projects I (Loan 3727-CHA)			
Appraisal	Daniel Gunaratnam	Joseph Goldberg	Nicholas Hope
Completion	Daniel Gunaratnam	Mark Wilson	Yukon Huang
Xiaolangdi Multipurpose Projects II (Loan 4200-CHA)			
Appraisal	Daniel Gunaratnam	Geoffrey Fox	Yukon Huang
Completion	Daniel Gunaratnam/ Xiaokai Li	Mark Wilson	Yukon Huang
Tarim Basin II Project (Loan 4341-CHA and Credit 3093-CHA)			
Appraisal	Douglas C. Olson	Geoffrey Fox	Yukon Huang
Completion	Geoff Spencer and Jiang Liping	Mark Wilson	David Dollar

PREFACE

This is the Project Performance Assessment Report (PPAR) for four projects that cost US$3.2 billion and included four loans and two credits to the People's Republic of China over the period 1994-2005.

The Xiaolangdi Multipurpose Project was designed as a two-phase operation. The initial Xiaolangdi Multipurpose Project (Loan 3727), estimated to cost US$2,294.0 million at completion of the second phase, was approved in April 1994 for a loan of US$460.0 million and was closed on schedule in December 2000 fully disbursed. The Xiaolangdi Multipurpose Project II (Loan 4200) was approved in June 1997 for a loan of US$430.0 million at which time total project costs had decreased to US$2,855.8 million. The project was closed as scheduled in December 2003 when US$80.5 million was cancelled. Total project cost at closing was US$2,688.8 million.

The Tarim Basin II Project (Loan 4341 and Credit 3093), estimated to cost US$ 272.6 million was approved in June 1998 for a loan of US$ 90.0 million and a credit of US$65.6 million. US$2.67 million of the loan was cancelled in September 2001. It closed in December 2005 one year later then planned, and was fully disbursed. Total project cost at completion was US$287.8 million.

The Loess Plateau Watershed Rehabilitation Project, estimated to cost US$252.4 million, was approved in May 1999 for a loan of US$100 million and a credit of US$50 million. The project closed after a six month extension in June 2005 and was fully disbursed. Total project costs at completion were US$240.2 million.

This report is based on the various Memoranda and Recommendations of the President, a Staff Appraisal Report and Project Appraisal Documents, loan documents, project files (both at the World Bank headquarters and in the China Country Office), Implementation Completion Reports and discussions with Bank staff. An Independent Evaluation Group (IEG) mission visited China in October-November 2006 to discuss the effectiveness of the Bank's assistance with the central government agencies, development partners, representatives of projects' implementing agencies in the provinces and governorates, and stakeholders and farmers in the field. The cooperation and assistance of central government officials, management and staff of the implementing agencies, other stakeholders and project beneficiaries is gratefully acknowledged.

This PPAR is part of a series of assessments of water and environment projects in China that were selected for detailed evaluation to inform IEG's Country Environmental Case Study that is a key input to IEG's global evaluation to determine the *Effectiveness of World Bank Group Assistance for the Environment*. The global study is due for completion in early 2008.

Following standard IEG procedures, copies of the draft PPAR will be sent to the borrowers and agencies for their review and comments. However, no formal response was received.

SUMMARY

The four projects assessed in this report provide a great range of experience central to the Bank's assistance for sustainable land and water planning and development in China during the period 1994-2005. Each of the projects had two phases; however, this assessment includes both phases of the Xiaolangdi Multipurpose Purpose Project, the Second Loess Plateau Watershed Rehabilitation and the Tarim Basin II Projects. The Xiaolangdi Resettlement Project that resettled 184,000 people is the subject of a separate IEG assessment.

The four projects were designed to provide integrated management of land and water resources within two of China's 9 major river basins. They addressed the issues of water allocation and water use efficiency for agricultural and non-agricultural uses, flood, sediment control and salinity management, and institutions for operations and management of infrastructure. The Loess Plateau II project and the Xiaolangdi Projects are both situated in the Yellow River Basin and the benefits of both phases of the Loess Plateau Project directly accrue to the Xiaolangdi dam located downstream. The Tarim Basin is located in the far northwest in Xinjiang Autonomous province and is the only large river basin completely within a single province.

The Second Loess Plateau Project's objectives, to help achieve sustainable land development by increasing agricultural production and incomes and improving ecological conditions in the tributary watersheds of the Yellow River, were fully achieved with few shortcomings. Relevance of the objectives was high. However, the design that uses afforestation as a secondary instrument for sediment control (after terraces) may not be wholly appropriate given the increasing shortages of water in the Yellow River Basin. Replicating the experience of the first project, the second project terraced sloping land and afforested heavily eroded slopes, installed check dams and successfully imposed bans on grazing. In compensation farmers were helped to attain more productive and profitable agriculture including forest products, orchards and forage for a substantially increased number of livestock enterprises. While farmers' incomes increased, the extent to which this is the result of the project is difficult to discern due to problems with the design and implementation of the monitoring and evaluation system. However, more efficient and sustainable use of land and water resources reduced sediment inflows to the Yellow River by an estimated 53 million tons during the life of the project, and this is projected to continue at a slightly lower rate indefinitely.

Overall economic rates of return (ERR) varied from 18 percent to 21 percent, close to the appraisal estimate of 21 percent. The slightly higher values include the benefits from sediment reduction and carbon sequestration. Although the methodology used to calculate the ERR is exemplary, this assessment believes that production costs are underestimated and benefits are overestimated due to the presence of other donor and a substantial number of Chinese-financed local developments that fostered increased productivity and incomes. In addition many rural roads benefiting the project were constructed by other agencies. This not only changed market opportunities but also provided improved access to off-farm employment, better education and health.

The outcome of the project is rated as satisfactory. Bank performance is rated as satisfactory and Borrower performance is rated as highly satisfactory. Risk to development outcome is rated as moderate. There are few local level funds to repair extensive storm damage to terraces and farmers' incentives to maintain terraces at their own expense may be jeopardized by the availability of substantial subsidies for this purpose in adjacent areas under centrally-funded programs.

The Xiaolangdi Multipurpose Projects' objectives in both phases were fully achieved with cost savings. Flood protection was provided to Henan and Shangdong provinces downstream and included productive infrastructure, towns and 103 million people mainly in the rural areas of the North China Plain. Sediment accretion in the 800 km lower reach of the Yellow River has been halted and the river bed has been lowered through the planned release of artificial floods from the reservoir. The Yellow River now flows continuously to the sea, unlike the late 1990s when the downstream reaches were dry for up to seven months a year. Water supply to several large and medium cities, major industrial centers and downstream irrigation are effectively regulated by the dam. Much needed hydropower to meet the peak power requirements in the Henan Grid was supplied, albeit slightly behind schedule – but generation now exceeds appraisal estimates.

Although water supply for irrigation has been improved, it is below targeted levels because of overall water shortages induced by water tariffs that do nothing to reduce consumption, and upstream water diversions in the Yellow River Basin. In addition the provincial government failed in the second phase to increase power tariffs according to covenants and full-cost pricing of water released for downstream use has not been implemented by the Yellow River Conservancy Commission.

Overall efficiency of the project is assessed as substantial. The ERR at completion was 13 percent compared with 20 percent at appraisal. The primary reason for the reduced ERR is that the volume of dry season flow and sediment in the Yellow River has declined since appraisal in response to growing upstream withdrawal and increasing frequency of droughts. This, in turn, has lowered benefits from hydropower, agriculture and sediment control. Even so, the benefits from power and urban water supply are probably underestimated because water and energy are under priced and none of the benefits from the improved ecological conditions downstream and in the delta are included.

The outcome of the first phase project that focused on construction is rated as highly satisfactory. The outcome of the second phase that focussed on facility management is highly satisfactory. Bank performance is rated as highly satisfactory for both phases. Borrower performance is highly satisfactory for the Phase I that focused on construction management, financing and application of safeguards. Phase II performance is rated as satisfactory because of slow progress on institutional reform and water pricing. Because of water allocation and pricing issues, Risk to development outcome is rated as significant. This is due to increasing water shortages in the river basin, an administrative water allocation process that takes no account of the economic value of water and is subject to political manipulation, and water pricing that substantially undervalues water and distorts its utilization.

The Tarim Basin II Project successfully contributed to increasing incomes of poor farmers through development of irrigated agriculture and drainage infrastructure and establishment of institutions to ensure sustainable use, development and management of water resources and land in the Tarim Basin. The extent farmers' incomes were improved by the project is uncertain due to attribution issues not captured by the monitoring and evaluation system. The downstream effects of integrated land and water management and the resulting water savings may have assisted the resumption of flow in the lower Tarim River that had been dry for the last 30 years. The uncertainty is because the impact of secular changes in climate and rainfall in the region were not considered by the monitoring and evaluation system. Even so, restored river flows rejuvenated the natural riverine forests with substantial ecological benefits. While mechanisms were put in place to regulate water tariffs, lack of political will frustrated needed increases.

The ERR for the overall project was 19 percent at completion compared to 14 percent estimated at appraisal. This assessment believes the actual ex-post economic rates of return using the same economic and financial models could be closer to the appraisal estimate. This is because the cost stream for the ex-post ERR only captured costs directly attributable to the project and fully attributed all benefits to these inputs alone. Yet we know that other international sources of funding supported development inputs which directly or indirectly benefited the project, as did China's own regional investments. In addition, there were many regional, prefectural and country inputs that also benefited the project – such as China's own comprehensive agricultural development program.

Project outcome is rated as satisfactory. Bank performance was highly satisfactory and Borrower performance is rated as satisfactory. Risk to development outcome is rated moderate. Agriculture in the basin is heavily reliant on cotton and grains and their price is subject to marked annual fluctuations due to global factors. Continued provincial government subsidies keep water prices low. This could undermine the water conservation efforts promoted by the project as well as the financial sustainability of water user groups set up to manage local operation and maintenance of project infrastructure.

These projects provide three main lessons:

- **The Bank needs to elevate its engagement in China's water resources policy discussions above the provincial level to emphasize the perverse incentives that are created by extensive agricultural water subsidies.** Subsidies for irrigation and land management jeopardize water conservation effort, longer term sustainability of irrigation and land reclamation projects and water availability for towns, cities, industry and environmental management. Despite more than two decades of Bank partnership and several state-of-the art projects piloting new approaches these tend to be enclave projects. While Chinese senior planners and politicians at the center acknowledge that pricing should play a role in ensuring more efficient and rational allocation and use of water this is still as at an early stage of application and far from politically acceptable in the provinces. Without such

a change in the near future water shortages and environmental consequences of resource mismanagement will continue to grow to crisis proportions.

- **Monitoring and Evaluation requires capacity building and reorientation to measure outcomes and impacts.** There is little virtue in implementing development models for reclaiming degraded lands or for river basin management if impacts on welfare, incomes and the economy cannot be accurately measured. While this is less of a problem for physical achievements it is a major problem for measurement of socio-economic outcomes and impacts. Much more attention has to be given to understanding the appropriate counterfactual and ensuring unbiased sampling. There is also an issue around selection of the most effective M&E model considering the outcomes expected and the cost of the projects. Appropriate training to redress the problems found in M&E is clearly indicated. In addition, more attention should be given to fully utilizing existing Chinese resources. The Ministry of Finance has indicated that it has a national network of monitoring that include socio-economic indicators and that consideration should be given to working with them to triangulate evaluative findings.

- **Much greater care is required in dealing with issues of attribution when estimating ex-post economic rates of return.** Specifically this means clearer definition of the project counterfactual and a systematic accounting of the effects of exogenous actors and investment on project impact. Without such attention to these exogenous factors there is a danger that estimated ERRs give a false impression of project impacts. This, in turn, may lead to incorrect lessons on development effectiveness and the efficacy of policy, institutional and engineering measures utilized to achieve development objectives.

Vinod Thomas
Director-General
Evaluation

1. BACKGROUND AND STRATEGIC CONTEXT

1.1 After the establishment of the Peoples' Republic of China in 1949 government put flood control and the planned utilization of its water and land at the top of its agenda. Together these would build food security and contribute to China's industrialization. Great importance was attached to establishing river basin agencies for the Yangtze, Yellow and the Huaihe rivers and in the 1960s three more were added – the Haihe, Pearl and Songliao river basins. Subsequently groups of smaller rivers were classified in the Southwest, Southeast and Inland river basins bringing the total to nine. Early efforts focused primarily on large-scale, multi-purpose infrastructure development programs aimed at flood prevention, waterlogging control, irrigation, hydropower, navigation, and industrial and urban water supplies. Thus for example in the Yellow River basin 156 Sino-Soviet projects were outlined by 1952 and the First People's Assembly approved in 1955 the first comprehensive and capital intensive utilization plan for the whole basin that focused on power generation and flood control through the construction of 46 large dams.[1] Similar multi-purpose master plans were developed for the Huaihe (1956), Haihe 1957), Yangtze (1958), and Pearl (1959).

1.2 Although the capital intensive approach waned during the 1960s, subsequent water development proceeded under reduced central government support using lower cost, locally-funded projects. The start of de-collectivization and the Household Responsibility System in the 1980s greatly increased farmers' incentives and productivity but also led to a marked reduction in state and local government funding for routine operation and maintenance of large irrigation infrastructure as demand for municipal and industrial investment grew. With the increasing maintenance backlog many irrigation projects became unreliable, water use efficiency declined and national irrigation area contracted even with new construction.[2] Despite yield improvements, by the mid-1980s grain production had stagnated as the area sown decreased by nearly 20 percent. Subsequently this was redressed by greater investment in the agricultural sector and water management, and introduction of the Provincial Governor's Responsibility System in the 1990s.[3, 4] By the mid-1990s agricultural productivity rose to meet government's targets.

1.3 Despite these set-backs, between 1949 and 1990 the number of large and medium dams grew from 23 to over 3,000, over 200,000 km of flood embankments were constructed and China's irrigation area expanded from18 million to 48 million ha or about

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1. Guordano, M. et alia. 2004. Water Management in the Yellow River Basin: Background, Current Critical Issues and Future Research Needs. Comprehensive Assessment Research report 3. Colombo, Sri Lanka. Comprehensive Assessment Secretariat of the CGIAR.
2. Lohmar, Bryan et alia., 2003. China's Agricultural Water Policy Reforms – Increasing investment, Resolving Conflicts and Revising Incentives. Agricultural Information Bulletin No. 782. Economic Research Service. USDA.
3. Provincial governors were required from 1995 to take responsibility for the grain balance in their jurisdictions in order to raise local self-sufficiency. Yang, Hong. 1999. Growth in China's Grain Production 1978–1997: A Disaggregate Analysis. World Development Volume 27, Issue 12 , 1999
4. Irrigated area was 45.6 million ha in 1980 and 44.6 million ha in 1986. Irrigated area growth resumed in 1990 and by 2004 the area is estimated to be about 54 million ha.

20 percent of the world's total. As stated by He Changhui, Assistant Director General of FAO in 2005:[5] "*China has made the greatest achievements in water resources development and conservation. Feeding 22 percent of the world's population with only 6 percent of the world's water resources and 7 percent of the world's arable land – as well as lifting 200 million people in rural areas out of poverty in the short time span of 20 years – is a testimony to its success. The contribution of China to world poverty alleviation and food security is remarkable.*" These remarkable achievements, however, came at considerable cost to the environment.

Environmental impacts were large

1.4 Ownership of water is deemed to be the property of all citizens and the state. Under such a property regime water was exploited as an open-access resource on a first-come, first served basis. While more rationally planned centrally-funded projects led development up to the 1970s, thereafter the provinces, municipalities and town ships increasingly utilized local water resources for their own benefit using mainly their own resources, be it free labor and/or local finance. A consequence of this was the declining quality of management and stewardship of the nation's water and land resources.

1.5 Between 1949 and 1998 per capita water use increased 130 percent and total water use by 430 percent. Demand for industrial and municipal water grew more than three times faster than that for agriculture.[6] The uneven geographical distribution of water resources in China compounded the problem; the six northern river basins contain 44 percent of China's population, two-thirds of its cultivated area but only 13 percent of its water resources. Thus in the north water availability, increasingly reduced by droughts and upstream diversions for agriculture and industry, is a major constraint to economic development although this has not always been the case.[7, 8] Management of floods and water pollution are among the major challenges in the south-east.

1.6 Over-exploitation of water resources in the Tarim Basin in the arid northwest led to the loss of land resources.[9] Until the late 1990s desertification had increased by about 7,000 km^2 a year primarily because dams and barrages had diverted almost all surface water and considerable amounts of groundwater for agricultural use. As a result of inadequate leaching and salinization of soils some 370,000 km^2 of farmland were abandoned and the

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5. He, Changhui. 2005. Water Resources Conservation and Saving. Speech delivered to the Special Session of the China Development Forum: Building a Resource Efficient Society. June 2005. Beijing.
6. Lohmar, Bryan et alia., 2003. op., sit.
7. Overall runoff from the Yellow River basin declined by a third between 1956 and 2000: from 65 billion m^3 in 1956-70 to 43 billion m^3 in the period 1991-00. Yellow River Conservancy Commission. Personal communication. November 2006.
8. A similar period of reduced discharge affected the Yellow River in the period 1922-32 when the average annual flow was 24 percent less than normal. MOWR October, 2006.
9. Qi, Feng and C Chen. 1998. Current situation, problems and rational utilization of water resources in arid north-western China. Journal of Arid Environments. 40. 373-382.

Tarim River ceased to flow with considerable adverse impacts on ecology and regional biodiversity.[10]

1.7 The adverse effects of generations of poor upland management amplified by population pressures have also seriously affected China's land resources. Nationally about 5 billion tons of soil is eroded each year from an area of about 3.6 million km2 or about one-third of China's territory. Over half of all erosion is attributed to poor water management in upland areas augmented by overgrazing and loss of native vegetation.[11] Worst affected areas include the loess plateau and the red and black soil areas of northeastern and southern China. About half of all soil erosion is in the Yangtze River Basin, and a third in the Yellow River Basin. The impacts are substantial. Flashier monsoonal runoff increased flood hazards and sediment inflow into major rivers. Reduced soil water storage affects dry-season vegetation and agriculture.

1.8 Farmers' coping measures such as increasing rangeland livestock have only exacerbated the problem. In Gansu, for example, overgrazing of grasslands and desertification has reduced the Maqu Wetlands along the Yellow River from 70,000 to 20,000 ha.[12] Since the 1960s, increased soil erosion has reduced reservoir storage by about 10% and reduced navigable waterways from 172,000 to 108,000 km. And the bed of the Yellow and many other rivers are elevated above their floodplains because of excessive deposition of sediments that greatly increases the risk of flooding. There is also a very high correlation between the 217 counties with a high incidence of rural poverty and dwindling soil productivity – 87 percent of these counties suffer from soil erosion.[13] Restoring degraded lands and their vegetation also provides a cost-effective tool for carbon sequestration of a scale that could have significant global benefits.[14] Thus tackling the causes of soil erosion not only reduces the risk of floods and extends the life of expensive hydraulic infrastructure but also benefits China's poorest farmers.

1.9 The Yellow River is hugely important to China. One in nine (over 130 million) Chinese live within the Yellow River Basin, and most of these people depend, directly or indirectly, on the river for their livelihood. The river descends 4,450m over its length of 5,500 km, draining an area of 800,000 square km and traversing nine provinces and/or autonomous regions en route to the Yellow Sea in the Gulf of Bohai. A large area of the North China Plain outside the Basin also depends on the Yellow River for water supply.

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10. Yang, Xiaoping, J Dong and P.D. White. 2006. The Key Role of Water Resources Management in the Ecological Restoration in Western China. Geographical Research. 44(2) 166-154. June 2006.
11. Liu, Zhen. 2004. Soil and Water Conservation in China. Proceedings of the 9th International Symposium on River Sedimentation. October 18-21. Yicang, China.
12. Xinhua News Agency. 2004. Sand Chokes Yellow River's Cistern. China Internet Information Centre July 20, 2004.
13. Ning, Datong. 1997. An Assessment of the Economic Losses Resulting from Various Forms of Environmental Degradation in China. http://www.library.utoronto.ca/pcs/state/chinaeco/land.htm
14. Parham, W. 2001. Degraded Land: South China's Untapped Resource. Grown in blocks, trees can sequester 15 tons of carbon per hectare. The Chinese government launched the Sloping Lands Conversion Program in 1999 and pays farmers to plant and conserve trees in watershed protection areas. The program is ambitious: a target of about 15 million hectares by 2010 and a total budget of about $40 billion

1.10 The Yellow River contains the highest sediment concentration of any river in the world - at times and in places it can resemble a mud slide a mile or more in width. Violent storms in the middle reaches of the river can lead to sediment concentrations of more than 400 kg per cubic meter. The middle reach includes the Loess Plateau which contributes 90 percent of the river's sediment load.

1.11 The aggraded lower reach is already dangerously elevated, in places more than 10 meters above the surrounding plain. Silt accumulation causes the river bed to rise inexorably and as a result flood embankments have to be raised at the rate of one meter every 10 years. There are 1400 km of dykes along the banks of the lower reaches of the Yellow River. The lower reach contains most of the irrigated land in the basin and is the most productive in terms of agricultural output. However the lower reach suffers from three handicaps: in periods of shortage it is last in line to receive water; it is most prone to flooding; and it must deal with most of the silt deposited in the river from upstream regions.

1.12 Since the start of recorded history, floods along the Yellow River have killed millions, disrupted the lives of tens of millions, and have caused incalculable property and economic losses. Efforts to control it go back 4,000 years. Since the founding of the PRC, extensive systems of dams and dykes have been built to prevent floods, and there has not been a single serious breach in the past 50 years. But these defences would have been insufficient to contain really major floods, such as that of 1843, which is estimated to have produced a peak flow of 35,000 cubic meters a second at Xiaolangdi. Floods may strike virtually anywhere in the basin, both in late summer as the result of intense rainstorms, or even in the dead of winter as ice formations dam the northern reaches of the river in Inner Mongolia and lower reaches near delta. Flood and sediment control are closely linked and without sediment control, effective flood control may be impossible.

1.13 Of the total historical average[15] annual runoff of 58 billion cubic meters in the Yellow River basin, about 30 billion cubic meters are drawn off for various uses, including transfers to cities outside the basin. There has been a water supply shortfall of about 3 billion cubic meters in recent years, compared to total demand, despite the additional supplies made available as a result of the construction of the Xiaolangdi reservoir. About 6 million hectares are irrigated by the Yellow River and its tributaries, of which 2 million ha are in the lower reaches which are the most productive due to the temperate climate that allows year-round cultivation.[16]

1.14 Earlier concerns that Yellow River floods would be the dominant management challenge in the north also appear misplaced. A series of seven large dams has effectively provided protection against the 60-year flood. Even so, excessive sedimentation has seriously reduced flood storage capacity. The Soviet-designed Sanmenxia dam designed for hydropower and flood control was effectively abandoned in the late 1980s as most of its storage capacity had been filled by sediment – the new Xiaolandgi dam downstream has now taken over these functions.

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15. In the last decade, the runoff has been under 50 billion m3.
16. About a third are located in Henan province and two-thirds in Shandong province.

1.15 Droughts have recently been a greater problem than floods. While the seasonal drying of the lower reach of the Yellow River in the period 1972-1990 occurred for an average of 50 days in 21 of 27 years, by 1997 the lower 704 km below Kaifeng was dry for over 226 days. Outflow to the Bohai Sea occurred for only 27 days. Low flow, for example, in 1995 reduced water availability to Dezhou city by almost half forcing limited production or suspension of 139 industrial enterprises. Reduced availability of surface water and low levels of irrigation efficiency in the north increased the demand on groundwater that has yielded substantial economic benefits given its greater reliability more efficient use. In some areas of the north China plain, however, this has led to resource mining as demand exceeded natural replenishment, especially in urban areas. In the past 20 years groundwater levels have fallen typically by 10 to 50 meters causing land subsidence, saline water intrusion in coastal areas, and disrupted drainage systems.[17]

1.16 Although the issue of flood management appears to be no longer a major problem in the north, this is not the case in the south and central parts of China. Excessive rainfall over the Yangtze River basin in 1998 caused the worst floods of the century killing 3,000, making 14 million homeless and costing China $24 billion in economic losses. Although 1999 was not as wet, further extensive flooding occurred as stressed levee systems failed. The subsequent official enquiry attributed the impact to the loss of flood plain storage due to development and sediment infilling, reduction of upstream forest cover by half since the 1950s and a marked increase in soil erosion.[18] Indeed, some experts fear that short-sighted economic exploitation of the land resources within the Yangtze River basin could cause it to become another Yellow River as 41 percent of the Yangtze basin's area suffers from sever soil erosion problems.[19] Some of the economic loss and human suffering was because encroachment on the floodplain following removal of flood levees by local government. [20] And 960,000 people at risk in four provinces within the basin have been removed from flood diversion and retention areas since 1998.

1.17 The pollution from increased agricultural production, domestic and industrial use also reduces the availability of good quality water. More than a third of China's lakes are highly polluted. In 2004 only a quarter of China's rivers were in the highest water quality category; conversely a third were classified as highly polluted. Although industrial discharges are large and highly polluting, this has been effectively regulated since 1998[21] but severe problems remain, particularly for drinking water sources.[22] Pollution is worst in the north and east especially in cities due to lack of urban waste water treatment. Agriculture is a close second to municipal areas as a source of pollution, specifically the difficult to treat non-point source pollution from fertilizer and pesticide runoff and livestock waste.[23]

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17. MOWR. 2005. Evaluation Results of National Groundwater and Environment Investigations.
18. U.S. Embassy, Beijing. After the Floods: Water Control in the Yangtze. November 1999.
19. People's China Daily. Soil Erosion Endangers China's Longest River. July 30, 2001.
20. For example, in May 1992 Huarong County, Hunan Province, removed one km of flood dyke to open 80,000 ha to agriculture: as a result 700,000 people lost their flood protection.
21. SEPA. 2004. Report on the State of the Environment.
22. Liu, Yingling. 2006. China's Drinking Water Situation Grim; Heavy Pollution to Blame. WorldWatch Institute. August 3, 2006.
23. World Bank. 2006. China Water Quality Management – Policy and Institutional Considerations.

1.18 **China's Rehabilitation Measures Preceded Bank Involvement**. Since the 1970s the objective of land management has changed from a primarily productive focus to one in which it is recognized that they also provide environmental services – particularly for water management and reduction of desertification. According to MWR by the end of 2005 almost one million ha of erosion mitigation had been implemented including 0.4 million ha of watershed improvement and 0.6 million ha of ecological restoration.[24] China implemented two complementary approaches to reducing erosion: (a) reducing the causes of erosion by halting the loss of upland vegetation and forests and (b) restoring degraded landscapes.

1.19 Starting in 1978, the government of China launched massive forestry and agroforestry programs to reverse deforestation and land degradation, including the "Three North" project, located in the arid and semi-arid zone of the northwest, north central, and northeast China. Thanks to these large investments in tree plantation and shelterbelt development and a natural forest logging ban managed by the State Forestry Administration, China has successfully turned the tide of formerly rapid deforestation. Even so, regulation and enforcement remain problematic because of perverse local incentives associated with the Provincial Governor's Responsibility System.[25]

1.20 On a much smaller scale, integrated watershed management was specifically targeted by the MWR since the early-1990s. Implemented through its Department of Water and Soil Conservation activities include participation of rural households in afforestation, small dam construction and terracing of land to reduce water erosion.

1.21 In view of problem discussed above there were six broad issues needing urgent attention where the Bank's global experience was relevant:

1. Water resources planning and allocation using economic criteria and instruments;
2. Flood, drought, irrigation and sediment management;
3. Rehabilitation of water infrastructure, particularly irrigation and drainage, and institutions to improve operation and maintenance;
4. Introduction of measures to reduce poverty in degraded land areas;
5. Land and soil conservation, salinity control and watershed management; and
6. Pollution control and management.

The Bank's China Strategy

1.22 Improving China's environmental and water management was an important component of the Bank's Country Assistance Strategies (CASs) from 1995 to 2006. Initially these CASs envisioned environmental improvements as a result of the broader, market-oriented reforms, more efficient infrastructure and improved institutions. It was expected that these reforms would bring price changes to reflect the true cost of natural resources and encourage greater resource use efficiency. Later CASs aimed to improve the

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24. MWR. 2006. op cit.,.
25. Rozelle, S, J. Huang, S.A. Husain and A. Zazueta. 2000. From Afforestation to Poverty Alleviation and Natural Forest Management. Operations Evaluation Department. The World Bank.

environment by helping to shift China from its dependence on industry, which has been the main source of pollution during China's growth over the last three decades, by encouraging the growth of service sectors, enhancing market efficiency and improved institutions for water management and utilization.

1.23 The 1995 CAS sought to assist China's sustainable growth challenge through "easing long-standing constraints to growth by alleviating infrastructural bottlenecks, particularly in the energy, transport, water, and communications sectors; and curbing the spread of environmental problems amidst rapid urbanization and the flurry of development activities." Specifically, the Bank Group's objectives and assistance strategy were to assist China achieve macroeconomic stability while maintaining rapid and more efficient growth, and sustain this growth by shifting resources toward priority areas, including environmental protection and poverty reduction. Assistance for the rural sector focused on sustainable land use, including the development and management of forest resources, improved land use on degraded and marginal soils, development of new watershed management and protection models, and safer drinking water.

1.24 The 1997 CAS maintained the same objectives but shifted the emphasis. Responding to increasing pressures on the environment from the rapid industrial, urban growth and increased agricultural intensification, the Bank continued with a strategy of financing investments for near-term environmental quality improvements. But it also aimed to strengthen China's institutions, namely the SEPA and its policies. New objectives for rural investments were introduced such as integrated coastal zone management and pollution reduction were added to the older ones, such as irrigation and water management, forest conservation and biodiversity.

1.25 What distinguished the 2003 CAS from earlier ones was that more innovative instruments and a wider range of them were needed to assist China meet its objectives, particularly because the 10th Five-Year Plan (2001-05) gave special attention to environmental issues. Environmental deterioration and the declining productivity of many natural resources were associated with poverty and unsustainable production practices, especially in the environmentally fragile and poorer central and western provinces. While the CAS's first pillar was growth-oriented and sought to improve the business environment and help to accelerate the transition to a market economy, its second pillar addressed concerns about regional imbalances and poverty. Poorer and disadvantaged people and lagging regions were to be addressed through investment lending in rural development, infrastructure and social sectors. These included improvements to water, land and natural resource management.

1.26 The maturing of the Bank Group's relationship with China is reflected in the 2006 Country Partnership Strategy (CPS). In addition to continuing the Bank Group's assistance on reducing poverty and mitigating rising inequality between coastal and inland provinces, the CPS aims to deepen assistance for financial intermediation and improvements in public and market institutions to facilitate China's integration into the world economy. On the environment, increasing the efficiency of energy generation and water use and reducing pollution were seen as priority issues.

1.27 **Bank Strategy for Land and Water was formalized in the mid-1980s.** The Bank's first agriculture sector review drew attention to the problems of China's degraded land and the need for complementary approaches to land and water management. In that sense it laid the foundation for the Bank's investments in the Loess Plateau and the Tarim Basin.

1.28 The Bank's 1985 *China - Long-term Issues and Options* evaluated key issues facing China and made recommendations for the Bank's future engagement over the period 1985-2000. The overriding concern was to achieve China's ultimate economic objective of catching up with developed countries while ensuring that the benefits of prosperity are widely shared within the socialist system. While agriculture would continue to be largest and most important sector of China's economy in the short to medium-term, the report clearly saw the general direction of development as a shift away from activities that are constrained by fixed resources (land and water) and a shift into improving human capital for modern agriculture including agro-industrial production.

1.29 Even so, investment in irrigation and drainage was suggested to increase production and offset the high loss of cultivable land converted to non-farm uses. Drainage improvement was seen as a priority activity in the North China. Expansion of irrigated area was seen as less important than improved water management in existing irrigation systems, a high proportion of which lacked adequate facilities for distribution to the farm level. Such an approach recognized that competition for available water in some parts of China between agriculture, industry and human consumption will increase and make agricultural expansion more difficult.

1.30 Based on the results of Chinese pilot studies the Bank recommended that the productivity of up to 20 m ha of loess soils might be substantially improved if economically justified after further study. Major elements in the improvement of such lands include the conversion of the most erosion-prone croplands to grass and trees, control of grazing particularly by sheep and goats, and the planting of better adapted crop varieties.

1.31 In the poorest provinces agricultural development was seen as possibly the only way to increase incomes where degraded land reduced production capacity and made livestock production unprofitable. Thus the Bank's recommendations targeted both likely interventions and regions- but with reservations. The typically resource-poor areas of extreme poverty in the northwest and southwest were a priority but it cautioned that investment may not be justified on economic grounds alone. Development constraints to address were lack of irrigation, salinization, depleted pasture and harsh climate in the northwest, poor soil and inadequate drainage in the southwest and weak transport infrastructure in both regions. In the worst-off areas, the Bank identified out-migration as potentially one of the only feasible policy measures.

1.32 **The Bank introduced integrated river basin planning.** The Xiaolangdi multipurpose dam project was the logical outcome of the Bank's first major piece of analytical and advisory work aiming specifically at water and sediment management: the 1993 *Yellow River Basin Investment Planning Study*. The study, using a simulation model and non-linear optimization techniques, determined planning priorities for the basin, identified which of the government's proposed investments totaling US$10.8 billion were

economic, and proposed an economically viable development program covering the period to 2010.

1.33 Unlike the earlier planning exercise carried out by Yellow River Conservancy Commission (YRCC) in 1988,[26] it brought all available data together in a consistent framework and put economic, rather then engineering viability as the decision variable. The multivariate simulation model developed by the study team was subsequently mainstreamed by YRCC. The results it produced challenged YRCC's ambitious plans to increase irrigation in the basin by 40 percent. It found that only half of the proposed area of 1.7 million ha was viable given the water required for sediment flushing and meeting a doubling of municipal and industrial demand. And even the smaller expansion of irrigation would be jeopardized if there were no improvements to agricultural water use efficiency on the existing irrigated area of 2.9 million ha. The study also revealed that China's basic water, land and agricultural planning date was or poor quality, piecemeal and sometimes inconsistent.

1.34 The Bank undertook a major environmental sector review in 2000, *Clear Water, Blue Skies*, and produced a *Country Water Resources Assistance Strategy* (CWRAS) and an *Agenda for Water Sector Strategy for North China* in 2002. Together their findings and strategies affirmed the continued relevance of the development objectives of the three assessed projects and the Bank's water and land development portfolio of projects.

1.35 *While Clear Water, Blue Skies* (2001) focused primarily on air and water pollution and their relation to economic growth, it produced recommendations for action on water that support the objectives of the river basin management aspects of the projects. Notably, the report highlighted the mutually reinforcing nature of higher levies and economic reforms in controlling pollution. Specifically, in the short-term it recommended strengthening river basin management by consolidating government agencies and allocating responsibilities to fewer institutions; providing technical and financial assistance to disseminating water-saving technologies for agriculture and industries; and to protect water resources from overexploitation, introduction of regulation and a water extraction tax. In the medium-term it recommended price adjustment to encourage water conservation.

1.36 The *Agenda for Water Sector Strategy for North China* and the *CWRAS* are less sanguine. They found that the traditional water management practices will not support continued sustainable growth in the 21st century. They predicted that acute water shortage and pollution in North China will soon become unmanageable unless more significant, comprehensive and sustained commitments are made to implement strategies and initiatives to bring water resources utilization back into a sustainable balance. While supply augmentation is probably necessary, this cannot be achieved without pricing, management and regulatory reforms in all areas of water resources management.

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26. YRCC. 1988. Revised Summery of the Report on Yellow River Harnessing and Development Planning.

Bank Assistance for Land and Water Management

1.37 In response to China's needs the Bank started lending in 1981 and since then total lending across all sectors has exceeded US$39 billion.[27] About a quarter of this was for rural development and 17 percent – US$6.65 billion – was to assist improved management of land and water.

1.38 Lending for agricultural water management started in 1982 and a series of 23 projects has enabled the Bank to assist most regions of China. The majority of this assistance was for province-specific area development projects that initially focused on extending and completing irrigation infrastructure in existing projects. And since the early 1990s institutional development became increasingly important. Similarly, lending for land management started in 1983 through a series of ten projects, each covering several provinces in a region, focusing on areas needing better land and watershed management to alleviate poverty, conserve water and reduce erosion and flooding.

1.39 The three projects that are the subject of this assessment spanned the period from 1994 to the end of 2005 and embodied important new initiatives and more comprehensive and multi-sectoral approaches to land and water management. All three projects deal with different aspects of river basin management in central and western China. The Loess Plateau Project addresses the issue of sustainable land and watershed management in the Yellow River Basin. The other two projects support introduction of integrated river basin management to the Yellow River and Tarim River Basins. Each of three projects had two phases. In addition, the Xiaolangdi Project included involuntary resettlement of over 184,000 people that was assessed at the same time and this is reported separately.[28]

1.40 **Rationale for the Loess Plateau Projects**. Initially, the Bank provided its support to mitigate the poverty impacts resulting from land degradation in the relatively poor red soils areas in southeast China through its two Red Soils projects. The first Red Soils Project was largely successful in demonstrating the state-of-the-art technology for watershed management on especially favorable sites. Emboldened by the success of this approach in 1994 the Bank embarked on a second-phase Red Soils Project (a typical Red Soils watershed included the steeper sloping, shallower soil areas of the upper area, where the role of forestry would be more important, as well as the gentler sloping, terraced land more typical of the first Red Soil Project areas.) At the same time the government expanded the watershed management portfolio to tackle a more challenging area – the Loess Plateau that covers 640,000 square kilometers of the upper and middle parts of the Yellow River Basin.[29] This follows the recommendation of the 1993 Yellow River Basin Investment

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27. Over the period 1981-2005 the IDA Credits were US$29.13 billion and IBRD Loans were US$9.95 billion.

28. IEG. Project Performance Assessment Report: CHINA Xiaolangdi Resettlement Project. Report No. June, 2007.

29. The Loess Plateau, named after the yellowish soil that covers the area, is the biggest such region in the world. Bounded by the Qinling Mountains and the Weihe Plain in the south, the Great Wall in the north, the Taihang Mountains in the east and the Taohe River and Wuxiao Mountains in the west, it covers all of Shanxi Province, the northern part of Shaanxi Province, most of the Ningxia Hui Autonomous Region, central and eastern areas of Gansu Province and western section of Henan Province. Comprising 400,000 square kilometers and rising 800 to 2,000 meters above sea level, it is China's third-biggest plateau. Except for a few

Planning Study (1.41.) These second generation projects introduced a small watershed approach that encompassed a broader range of site conditions and proven environmental protection methods.

1.41 **Rationale for the Xiaolangdi Multipurpose Project**. The Bank's *Yellow River Basin Investment Planning Study* demonstrated that only some of the major infrastructure projects envisaged by YRCC were economically viable. By carefully examining the seasonally variable value of water for agriculture and sediment control the study determined that construction of the Xiaolangdi multipurpose dam and expansion of sediment control efforts in the upstream loess plateau was required and that both would be economic. The study also demonstrated that water was priced far below its opportunity cost – agricultural water prices were one hundredth of the marginal value. Within the basin the price elasticity of water was estimated to be close to -1.0. [30] Thus the study recommended that raising water fees should be a major part of the government's strategy to conserve water and maximize economic returns.

1.42 **Rationale for the Tarim Basin Project.** Situated in the border of northwest China, the Tarim Basin forms the southern half of Xinjiang Uygur Autonomous Region. With an area of slightly over half a million square km and a population is about 7 million this closed basin is surrounded by mountains on three sides. Traditionally, agriculture on the piedmont margins of the basin centered on oases fed by these rivers or from *Kerezes*.[31] The total population in the project area in 1998 was 4.7 million people of whom 3.6 million lived in rural areas. The agricultural labor force was 0.94 million and they managed a cultivated area of about 0.56 million ha. By completion the total project population had increased by 50,000 people and the agricultural labor force by 4,000.[32]

1.43 Annual precipitation ranges from 1000 mm over the mountains to less than 20 mm in the center of the basin. The Tarim River - China's longest inland river (1300 km) - drains the basin eastwards around the Taklamakan Desert into Taitema Lake. Numerous smaller rivers run off the mountains but most disappear into the desert. Prior to the start of reservoirs and irrigation works (1957) the Tarim's waters reached Lop Nor (now a salt-encrusted lake bed). Historical annual flows average over 5 billion cubic meters.[33] Subsequent upstream diversions caused the river to become dry over the 300 km reach upstream of Taitema Lake since 1972.[34] This 300 km reach – referred to as the "*green corridor*" – supported a forest of poplar and Chinese tamarisk and related flora that formed

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highlands and large river valleys, it is covered with a layer of loess 100 to 200 meters deep. According to historical records, most of the plateau was covered with dense forests, lush grasslands and fertile soil. But predatory reclamation, indiscriminate felling of trees and overuse of grasslands as well as destruction by frequent wars stripped the area of nearly all its forests. Each year, more than a billion tons of mud and silt are swept from the plateau into the Yellow River, the cradle of the Chinese civilization.

30. Price elasticities to demand: domestic water -0.3 to 0.6; industry -.045 to -1.37; irrigation -.037 to -1.5.

31. The traditional irrigation supply in the Tarim basin is the Kerez system. Gently sloping tunnels collect ground water from the piedmont areas and provide oasis irrigation via shallow wells or small reservoirs. These tunnels were excavated over 2,000 years ago and the total length is about 5,000 km.

32. Minority ethnic groups in China are not subject to the "one family, one child" rule.

33. Zhao Sonqiao and Xucheng Xia. 1984. Evolution of the Lop Desert and Lop Nor. The Geographical Journal. 150 (3), pp311-321.

34. Taitema Lake is located about 160 km southwest of Lop Nor.

a barrier to the northward expansion of the desert.[35] In addition biodiversity was significantly reduced. Over-irrigated areas upstream became salinized and this produced poorer quality inflows to the river downstream. Together they reduced agricultural productivity and adversely affected farmers' and pastoralists' livelihoods. These problems and the gradual loss of the *green corridor* also focused national and international attention on the consequences of environmental mismanagement. Thus recreation of the lower Tarim River to sustain the green corridor became a national policy issue. Its recreation also became a key outcome indicator of the integrated effects of efforts to upgrade irrigation engineering, agricultural practices and institutions in the context of river basin management.

1.44 These projects were relevant to the Bank's global and country objectives and their objectives and components were closely matched to China's development needs, Table 1.

Table 1: The Assessed projects address most of China's land and water problems

Development issue	Loess Plateau	Xiaolangdi	Tarim Basin
1. Water resources planning and allocation using economic criteria and instruments		●	●
2. Flood, drought, irrigation and sediment management	●	●	●
3. Rehabilitation of water infrastructure, particularly irrigation and drainage, and institutions to improve operation and maintenance		●	●
4. Introduction of measures to reduce poverty in degraded land areas	●		●
5. Land and soil conservation, salinity control and watershed management	●	●	●
6. Pollution control and management			●

2. PROJECT EVALUATIONS

2.1 This chapter systematically evaluates how effectively each project met its objectives and rates its outcome. Following a review of the relevance of project design and implementation experience, the efficacy and efficiency of each project is assessed and outcome determined. Findings and lessons drawn are presented in Chapter 3.

35. Between the 1950s and 1980s the area of *Populus Divesifolia* shrank from 54,000 ha to 16,400 ha and 132,000 ha of farm land were desertified along the Tarim river and Kinqi river.
Source: www.unu.edu.unupress/unupbooks/uu02fe/uu02feb0b.htm

SECOND LOESS PLATEAU WATERSHED REHABILITATION PROJECT

2.2 **Second Loess Plateau Watershed Rehabilitation Project**. Early efforts to treat the Loess Plateau included nationally-driven top-down campaigns to terrace slopes, plant trees and shrubs, and build dams in the gullies to intercept sediment runoff. While broadly successful in reducing erosion these interventions were not integrated with efforts to raise agricultural productivity and farm incomes. The major issue was the poor linkage between land conservation and income-generating activities. Subsequently the Government's development strategy for the Loess Plateau changed in response to successful pilots in small watersheds (para 1.40) where it was demonstrated that a comprehensive approach involving beneficiaries could tackle both soil erosion and raise farm incomes. This approach was implemented with considerable success on over 700,000 ha of land in the Bank's first Loess Plateau Watershed Development Project (1993-2000) that covered three provinces.[36] The second project extended the geographic scope in the original three provinces (Shanxi, Shaanxi and Inner Mongolia) and replicated it in a fourth: Gansu province.

OBJECTIVES

2.3 The two objectives of the project were to help achieve sustainable development in the Loess Plateau by (a) increasing agricultural production and incomes and (b) improving ecological conditions in the tributary watersheds of the Yellow River. These were to be achieved through the introduction of more efficient and sustainable use of land and water resources, and the reduction of erosion in, and sediment flows from, 12 tributaries of the Yellow River over an area of 19,500 square kilometers. Of the 39 counties in the project, 19 are officially classified as among the poorest in China, and it was expected that the project would directly benefit 2 million people. In addition it was expected to produce substantial benefits downstream as a result of reduced sedimentation, and globally through carbon sequestration. There were three main components: crop-land improvement, slopeland protection and support services and training. Details of objectives, components and costs are summarized in Table 2.

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36. Loess Plateau Watershed Rehabilitation Project. Costing US$ 248.7 million it was approved in 1993 for a IDA loan of US$150 million (Credit 3540-CHA.) The project closed in 2002.

Table 2: Second Loess Plateau – Objectives, components and costs

Objectives	Components	Costs (US$ million)	
Help achieve sustainable development in the Loess Plateau by:		Planned	Actual
	Crop land improvement	***119.0***	***114.9***
	• Terraces	84.2	
	• Silt retention structure	17.3	
	• Irrigation including water cisterns	17.5	
(a) increasing agricultural production and incomes	***Slopeland protection***	***83.3***	***94.0***
	• Affrostation and vegetation cover	38.5	
	• Livestock	5.0	
(b) improving ecological conditions in the tributary watersheds of the Yellow River	• Horticulture	36.3	
	• Nursery	3.4	
	Project support costs	***25.6***	***18.3***
	• Research, training and study tours	5.2	
	• M&E and survey and design	12.5	
	• Operations and Management	7.9	
	• Equipment, vehicles and buildings	7.9	
	Contingency and fees	***25.5***	***13.1***
	Total Costs	252.4	240.2

DESIGN

2.4 Within the Loess Plateau about 1,100 small watersheds were targeted as the basic planning unit for improvement. A typical watershed contained several villages and ranged in size from 1,000 to 3,000 ha. Crop-land with slopes less than 25 degrees covering about 88,900 ha around 3,464 villages was to be improved through terracing, sediment control structures and provision of irrigation. The wide and level terraces created from slopelands and old degraded terraces would enable improved agriculture and easier management. Sediment control structures were designed to control flooding, create usable land and store water for irrigation and village water supply. Irrigation works included the construction of about 30,000 small water cisterns to catch run-off (mainly from roads), small surface-water diversion structures, and small-sized irrigation schemes to serve 4,100 ha mostly in Inner Mongolia. Most of the land leveling and terracing work was to be undertaken though individual contracts with local operators of small bulldozing equipment, communities and, occasionally, with individual farmers. Arbor trees and shrubs were provided by specialist forestry teams under contract to communities; orchards and grasses were planted by individual farmers.

2.5 Slopeland protection was intended to reduce erosion and water loss and allow farmers to increase their income through diversification of their production systems. This included 90,000 ha of afforestation and 91,000 ha of shrubs on land too steep for trees. Pasture grasses to support livestock development would cover 56,000ha, and horticulture – mainly fruit and nut-bearing trees – would cover another 72,000 ha. Most of this work was to be done through contracts with community groups similar to that for terracing.

2.6 Training was to finance human capacity development through research and extension, training and study tours, survey and design work and monitoring and evaluation activities. In addition the project financed vehicles, office upgrades and equipment, and project operation and management costs.

2.7 To increase ownership of the project's conservation focus, the project demanded various kinds of obligations such as significant restrictions on farmers' production practices in return for local investment (e.g., stopping free grazing or cropping on slopes.) For other activities where farmers provided free labor, the project provided trees and shrubs free of costs but required signature of "use and management" contracts to ensure sustainability. Project investment in orchard trees on terraces, irrigation, grass and livestock, was to be on the understanding that beneficiaries repaid the principal plus an interest rate of between 4 and 6 percent. In most cases the counties provided loans to farmers for this purpose. The cost of inputs that provided public goods, such as dams and roads, was to be repaid by the counties.

2.8 Quality at entry is rated as satisfactory. Given the physical coverage of the project (para 2.10) the decision not to load the components with new institutions or reform existing ones was pragmatic, as was excluding support for secondary activities such as improving extension services, rural credit, agro-processing or marketing. There was no independent review by the Bank's Quality Assurance Group.

IMPLEMENTATION

2.9 The central Ministry of Water Resources (MWR) had overall responsibility for the project that was implemented through the Yellow River Basin Commission based in Zhenzhou, Henan province and its Upper and Middle Reach Bureau based in Xian, Shaanxi province. Policy and coordination at the central, provincial, prefectural and county levels was through Project Leading Groups (PLGs). The central PLG was headed by a vice minister of the MWR, and includes representatives from the Ministry of Forestry, one vice governor from each of the project's provinces, several directors of YRCC, MWRs' Foreign Affairs, Planning, Water and soil Conservation, Water Resources, and Finance bureaus and representatives from the our provincial Project Management Offices. The PLG's at the provincial level have the same structure and were headed by the vice governor in charge of agriculture assisted by the local representatives of the central ministries and the Agricultural Bank of China. Prefectural and county level PLGs had similar structure and responsibility. A central Project Management Office (PMO) was located in the YRCC offices and with the regional governments looked after day-to-day management of all aspects of the project, including international procurement and training. Provincial and county PMOs managed implementation at those levels and worked through the village level committees.

2.10 The scale of the project was extremely challenging with as much as 1,000 km between project watersheds that included detailed terracing and planting of trees, shrubs and grasses over an area of 400,000 ha. The overall management structure had units in 264 *xiangs* (township), 37 counties and 12 prefectures in Shaanxi, Shanxi, Gansu and Inner Mongolia. Work was implemented in 3,350 administrative villages.

2.11 The project became effective in September 1999 but got off to a slow start because it overlapped the last three years of the first Loess Plateau Project and several new national policy initiatives and programs for reclaiming degraded lands became operational (para 2.13). Together these increasing demands stretched local resources. Thus insufficient counterpart funding was a major problem at all levels throughout implementation and carried reputational risks for the project's environmental focus due to delayed payment of suppliers, contractors and farmers. This shortage was accentuated by unfamiliarity with Bank reimbursement procedures at the township and county levels, overloaded accountants, significant processing delays within provincial Finance Bureaus and unwillingness (driven by prefectural and county poverty considerations) to recover costs from beneficiary farmers. Several PMOs diverted or withheld Bank funds disbursed for physical works to cover operating and management costs, raising objections from auditors. Despite all these problems, physical progress was extremely well managed and met most output targets.

2.12 Dissemination of the project concept and obtaining local buy-in was made more onerous by exogenous factors. Severe droughts in late 1999, 2000 and 2001 made establishment of trees and shrubs difficult and required much replanting leading to higher costs.[37] Over the same period, sharply lower global prices for agricultural commodities reduced farmer's profits from planting grains on the newly constructed terraces lowering interest in the project – short-term gains from annual crops were an essential stop-gap while farmers waited for the harvest from trees and orchards to mature. In addition the dissemination and adoption of grazing bans on steeply sloping lands cut income from sheep and goats. To compensate, targets for terrace construction were slightly reduced and more project funding was allocated to livestock at mid-term review. This, in turn, put a greater emphasis on forage crops and creation of grasslands, and led to increased tree planting in gullies instead of less-profitable shrubs.

2.13 A number of new national projects and programs influenced project implementation. While almost all reinforced the conservation objectives of the project, their top-down approach and liberal use of grants undermined Loess II's participatory and self-reliance approach that did not include subsidies (para 2.7.) The major programs included the 'Returning Slopeland to Forest', the 'Returning Slopeland to Grassland', the 'Ecological Reconstruction' and the 'Sandstorm Prevention' programs. While supporting activities similar to those in Loess II, most of these interventions focused primarily on resource conservation with little concern for local livelihoods. Even so, their similarity to Loess II activities created misunderstanding at the local level and confused project beneficiaries. The new national programs also provided grant funds for activities that Loess II expected local beneficiaries to pay for in kind or cash (tree and grass planting on slopes, water cisterns, and small-scale irrigation). [38]

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37. This trend was later reversed as wetter then normal weather in the last 2 years of the project greatly increasing successful planting.

38. Under *The Sloping Land Conversion Program* the annual grain subsidy for farmers is 1,500 kg/ha in upper reaches of Yangtze and 2,250 kg/ha in upper/middle reaches of Yellow River. Cash subsidy for farmers' health, education and other needs is RMB 300/ha annually for same duration as grain subsidy. Subsidy for seeds and saplings is RMB 750/ha. Income form forests and grasses is tax exempt. Farmers are also given 30-

2.14 Repayment obligations of the Bank-financed investment transferred to farmers were handled by the counties who tried with varying success to balance cost-recovery obligations between private beneficiaries and the public sector. This was strongly influenced by the political climate that increasingly aimed to lower the burden on farmers by increasing grant-aided programs and eventually abolishing most fees, levies and agricultural taxes. Often the counties were left with unforeseen obligations that further exacerbated their cash-flow and slowed progress. For example, because key dams and warping dams[39] generated significant downstream benefits, YRCC, provincial and county officials argued that the cost should be borne by central government, not by them. In consequence, at mid-term review, only 15 percent of physical targets for these dams had been achieved. Subsequently, after failure to obtain a central government policy directive, each structure was paid for according to local agreements. In most cases the counties ended up paying for those that were built.

2.15 Adequate and timely supply of high quality tree and shrub seedlings, a vital component of the project, was hindered by continued public ownership of project-financed nurseries that were seen as "cash-cows" by the Forestry Departments and county officials. As the mid-term review noted: "*The less than satisfactory nursery outputs are caused by inadequate supervision of project nurseries and their outmoded management and planting practices. Many procedures are conservative and out of date... Their planting regimes are haphazard and in most cases they are rarely integrated with the actual needs of the treatment areas. Managers are often administrators with no fundamental understanding or knowledge of technical issues and most of them have only received minimal training in nursery management. Downstream training for the out-reach farmer nurseries is also haphazard and, in many cases, non-existent.*" And to make matters worse, the lack of independent oversight created a conflict-of-interest for state nurseries thus ensuring that all seedlings regardless of quality were transplanted. As a result, they were less able to survive the drought years and about a third required replanting. This marginally improved towards the end of the project when the entrepreneurial skills of the private sector were unleashed by the agricultural reforms of 2002 and some private nurseries were established. Farmers and officials interviewed by IEG four years later confirmed that the supply of high quality seedlings remains a problem for many of the same reasons.[40]

2.16 Project closing was extended for 6 months to mitigate crop failure caused by drought and the loss of a construction season incurred by an outbreak of SARS. Reduced interest payments during construction led to project cost savings of US$12.2 million. The IDA credit and IBRD loan were fully disbursed.

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year contracts for planting and caring for trees and grasslands. Farmers receiving subsidies are also be responsible for planting grass/trees on two or more mu of barren land. Farmer's subsidy packages have duration of five years, but are adjustable. Since 2005 all subsidies were lumped under a single payment: RMB 2,400/ha in the Yellow River basin, RMB 3,450/ha in the Yangtze River basin. ***Source:*** Bennett, M and J. Xu. 2005 op cit.,

39. Key dams are located close to the outlet of watersheds that have areas of 3-5 km^2. Key dams (earth dams 10-20 m in height) retain sediments thus creating land, and in the interim function as small flood control and water supply reservoirs. Warping dams are smaller dams (3-10 m high) and their sole purpose is to intercept sediment and create flat land in gullies.

40. IEG field interviews in Gansu, Shaanxi and Shanxi provinces October 28-November, 2, 2006.

Monitoring and Evaluation

2.17 **Design.** Robust monitoring indicators were developed at appraisal and fully implemented using existing M&E systems developed under the first Loess Plateau Project. Progress, input, output and outcome indicators were clearly specified as were targets and milestones. Quality of design is rated as high.

2.18 At appraisal it was stated that "the project will be monitored through a set of indicators that take into account the four key elements of a sustainable development strategy: productivity, stability, resilience and equity. Specifically, project staff will monitor impacts on crop yields, household production and incomes, grazing policies and practices, long-term land use rights, and integrated watershed planning." The Project Appraisal Document (PAD) gives a very clear statement of desired project outcome and outputs and how these performance indicators were to be measured. The primary instruments would be surveys of household incomes, production with and without the project and sediment monitoring in one watershed per county. The design of the detailed relationship between project components, their linkages, the economic benefits generated and how these were to be monitored and quantified for economic appraisal and evaluation is rated by this assessment as best practice.[41]

2.19 **Implementation.** Outcome and impact monitoring for ***physical*** accomplishments benefited from training and was satisfactory. But reporting of incomes and economic benefits is not reliable for several reasons. First, the methodology used to establish "without project" control areas is unclear (except in that they were not random) as it was subordinated to each province and subsequently down to county level. Second, the methods used to select individual households were subjective and not random, and depended almost entirely on the understanding and knowledge of the local official monitors. Third, no attempt was made to account for spillover effects from parallel projects on either project samples or their controls. Fourth, there were no strict guidelines to assist baseline household selection or ensure a standard process and conformity in reporting. Fifth, the interpretation of indicators showed wide variation as did how the indicators should be calculated. Random checks by the Bank's monitoring specialists in 2000 revealed a whole range of problems.[42] However, this was their final input to the project and it is not known if their concerns were addressed.

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41. The PAD overviews indicators in Annex 1and details expected outcomes and impacts in Annex 4: Economic and Financial Analysis.

42. "Unfortunately some counties have selected households from the very top of each grouping. This means that in many cases the richest families in the village are included in the sample, and the sample does not include any poor families. Counties should delete these unrepresentative households from the sample and instead make sure that households typical of each grouping are chosen. For some counties, this may mean the entire sample should be reevaluated and perhaps redrawn. On the Northern route, the mission checked the accuracy of the household monitoring data in almost all counties. Regrettably, major differences were often apparent between the monitoring data collected and the actual situation in the households. Common errors included: i) recording data at mid-year and therefore not capturing the entire year's results; ii) including land invested under the project in the baseline data; iii) omitting large pieces of land; iv) inaccurately counting household members. Inconsistent treatment of some line items between counties was also quite common." Supervision Report Aide Memoire. September 2000.

2.20 **Utilization.** Effective M&E systems developed under the project for management of inputs and outputs were fully internalized and have been widely adopted in other national programs. The institutional development impact induced by good M&E practices for monitoring project progress and costs was substantial according to prefecture and local government officials interviewed by IEG. Local documentation of project processes is impressive. Transparent and effective accountability allowed evaluation of the effectiveness of public sector institutions, project management and individuals, and improved local implementation capacity. Local ownership is high and political leaders at various levels have taken personal responsibility for the project, exercising a tight system of control and self-evaluation. As far as IEG could determine routine process-related M&E at the county and prefectural level continues. It is not certain, however, if the results are used.

2.21 Of more concern is that the "impacts" of the project on incomes and economic efficiency may be misleading because of the questionable methodology and implementation. Given the widely geographic dispersion of the project sites a strong case could be made for a more experimental approach with a much greater degree of management by M&E specialists.

2.22 Because of the questions raised by the implementation and utilization experience of M&E, its overall quality is rated modest. This rating gives greater weight to satisfactory assessment of the achievement of the income improvement objective.

Safeguard Compliance

2.23 The project raised only one safeguard issue concerning small dams. While it was not raised at appraisal it was reviewed during the Bank's regular supervision and found to be of no concern.

Relevance

2.24 **Relevance is rated as high**. The project was relevant to the CAS objectives and for the agriculture sector in China. These called for assistance to promote better utilization of marginal land through sustainable techniques, and to develop new income-generation programs in poorer provinces. Environment objectives of the CAS include promotion of soil and water conservation that are the major components of this project.

2.25 China's Ninth Five-Year Plan (1995-2000) placed sustained and stable growth in agriculture and the rural economy at the top of its agenda, and its ambitious goals include major increases in grain production and farmers incomes particularly in the arid and semi-arid zones that account for 30 percent of the total arable land. Following the drought and flood events of the late 1990s, the central government initiated six large-scale forest conservation programs to restore forest and vegetative cover in upstream watersheds of the Yellow and Yangtze River basins. Two of these programs, the 1999 Sloping Land Conversion Program (SLCP) – also known as the Grain for Green Program – and the 1999

Ecological Forest Compensation Program began trial implementation in early 2000 with an overall budget of more than US$40 billion.[43]

2.26 In the Loess Plateau government strategy emphasizes the comprehensive and integrated planning of small individual watersheds in close consultation with the beneficiaries because land conservation is compatible with sustainable and productive agriculture and they are mutually reinforcing. This approach was piloted on over 700,000 ha of land in the highly successful first Loess Plateau Watershed Rehabilitation Project that overlapped this project and was completed in 2002. The devastating floods on the River Yangtze in 2002 also heightened the Government's concern to address the causes of the flooding, deforestation and erosion caused by decades of unsustainable land-use practices. Consequently the project enabled the promotion of integrated watershed development on a large scale in China.

2.27 Project design was and remains relevant because partnership between the public sector, local governmental institutions and farmers is essential for sustainable development of watersheds. The Bank's most recent global critique of watershed management reaches the same conclusion.[44] The comprehensive approach adopted correctly promoted integrated watershed management that included forestry, soil and water conservation, agriculture, and livestock sectors. Its reliance on the public sector for implementation was relevant because at the time of design the private sector was unwilling to provide financing for these types of investments, particularly in the poorer areas targeted by the project. At evaluation, extensive public sector involvement make remains relevant because of the strong public good element of the objectives and the few private rural and agricultural enterprises able to participate on ventures of this scale.

Efficacy

2.28 Efficacy is rated as substantial and is discussed below.

Agricultural production and incomes increased

2.29 The targeted 1.9 million people benefited from the project, 80 percent of whom were directly involved in project activities.[45] About 89,600 ha of new farmland were created by terracing and the per capita area increased from 0.11 ha to 0.14 ha. The area of farming on unstable sloping lands fell from 451,000 ha to 278,000 ha.[46] Orchards and wheat replaced corn and the flatter land decreased unit labor requirements and encouraged greater use of fertilizer and other inputs. According to project monitoring data agricultural

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43. This covered a total of 174 pilot counties spread over 13 provinces in the upper and middle reaches of the Yangtze and Yellow Rivers. In the first four years 15 million farmers entered the program. It expanded to 2,000 counties in 25 provinces and by 2004 had converted 7.2 million ha of cropland and afforested 4.9 million ha of wasteland. ***Source:*** Bennett, M.T. and J. Xu. 2005. China's Sloping lands Conversion program: Institutional Innovation or Business as Usual? Workshop on "Payment for Environmental Services – Methods and Design in Developing Countries." Beijing.

44. The World Bank. 2007. *Watershed Management Approaches, Policies and Operations: Lessons for Scaling-Up.* The Water-For-Food team, Energy, transport and water Department. April 20, 2007.

45. Population in the project area increased from 1.988 million to 2.138 million between 1998-2004.

46. MWR. 2005. Ecosystem Benefit Monitoring and Evaluation Report. Page 41.

production has changed from generating a narrow range of food and low-value grain commodities to higher-value products, as the example (Box 1), and summary data indicate (Figure 1.) Incrementally the largest changes were to the other category (livestock, forest products and other related outputs), forestry and orchards.

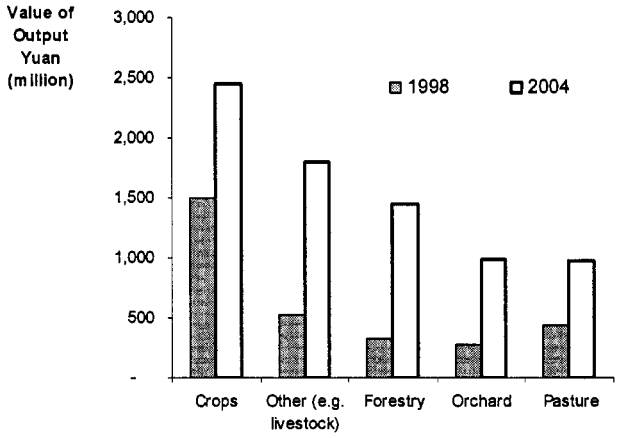
Box 1: Improved Incomes – Waijau Watershed, Hoglin Village, Jining County, Gansu Province

This village has 97 households and a population of 500 and is at an elevation of about 2,200 m. The project terraced the whole area but the new road was financed by the county. The village headman farms 15 mu (1 ha) and supports a family of 5. When asked to state the factors that most explained his improvements in income he put the impact of the new road as being most important. The primary reason given was that surplus family labor could easily and quickly access the job market in the nearest town, formerly a two-hour journey by bicycle considering the steep uphill homeward path. He could also take goods to market cutting out the middleman; similarly agricultural inputs became more accessible and cheaper. He also put a high premium on the new primary school and the clinic with a resident para-medic.

Agriculture productivity has risen appreciably over the last 6 years. Wheat yield grew from 100 kg/mu to 350 kg/mu; corn from 150 kg/mu to 400 kg/mu. Potatoes were less than 250 kg/mu and are now greater then 400. He has livestock but it is used for milk and draught power. Family per capita annual incomes have risen from the range RMB 400 -500 to RMB 1,200-1,300; half is from off-farm income.
Source: IEG interview October 29, 2006.

2.30 Incremental per capita incomes in the project area were estimated at completion to be 58 percent higher than in non-project control areas (Figure 2.) Given the M&E and attribution problems this estimate of incremental incomes is not robust (cf. footnote 42.) The project contributed – the exact extent is not certain – to the restructuring of the agricultural sector in the Loess Plateau, the adjustment to a market-oriented economic environment and created conditions for sustainable soil and water conservation.

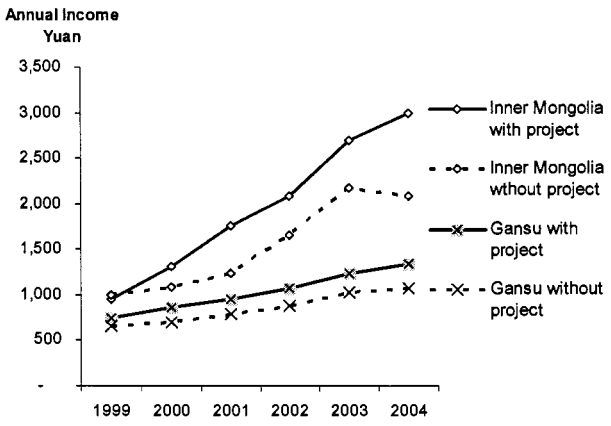
Figure 1: Productivity of land increased



Source: Loess Platueau II M&E database

2.31 Terraces have significantly reduced labor inputs and, together with road access to the terraced fields, have allowed for mechanization and better communication to markets. The resulting labor savings have permitted many farmers to pursue new income-earning activities, such as off-farm jobs, livestock production and high-value fruit and nut tree production. Increased income and the prospect of a sustainable natural resource base have allowed farmers to invest in a wide range of enterprises and social programs which have benefited the communities as a whole.

Figure 2: Farmers gross per capita incomes increased



Source: Loess Platueau II M&E database

2.32 Some 80,832 ha of terraces (91 percent of the appraisal target) were constructed and provide the basis for annual and perennial crops produced on terraces, including food grains, vegetables, fodder crops (e.g., maize and legumes) and fruit trees. Conversion of slopeland to leveled fields increased moisture retention, reduced soil erosion and led to higher crop yields (50-100 percent higher than on the previously sloped land) and more diversified cropping. Along with the terracing of slopeland, some 24,000 water cisterns were constructed (79 percent of the appraisal target) and are successfully mitigating adverse effects of frequent periods of drought. Most investments in irrigation were made in Inner Mongolia where the extremely low rainfall means that terracing alone would not sufficiently raise yields to bring about a sustainable agricultural system.

2.33 Farmers established about 57,000 ha of forage that not only reduced soil erosion of sloping lands but also provided fodder for pen-fed animals thus reducing grazing pressure. All project counties have now adopted and enforce grazing bans, and the provincial authorities have extended this practice to most other counties in the four project provinces – this now covers about 85,300 ha. After the widespread adoption of grazing bans, the growing of forage was successfully practiced on a large scale in most project areas. Along with the grazing ban, the project successfully provided investment in livestock production to help farmers to cope with the effects of the ban, support the transition into sustainable production systems and make full use of incremental fodder and crop residues produced by other activities to support over 38,000 head of incremental stock. The introduction of new breeds of sheep and goats suitable for pen-feeding, such as Cashmere and Boer goats and Shandong small-tailed sheep, rapidly replaced local breeds and their improved productivity made livestock production a major contributor to household incomes, particularly in the drier northern counties.

2.34 About 63,000 ha of "economic trees" and orchards were planted under the project (87 percent of the appraisal target of 72,000 ha). Continuously improving road network and information access has enabled these plantations to generate attractive financial returns on domestic and export market. Over 1,100 fruit stores were built (103 percent of the target) and allow farmers to capture additional benefits from selling off-season.

Ecological conditions in the tributary watersheds of the Yellow River improved

2.35 This project established 109,000 ha of forest trees (121 percent of the appraisal target) in contour trenches or in pits on wastelands. In areas less suitable for trees, some 71,000 ha (78 percent of the appraisal target) of drought-tolerant shrubs have been planted.

Some 57,000 ha of slopeland were closed and protected for the purpose of natural regrowth of vegetation. An ecological survey of one catchment where grazing was banned indicates a modest increase in biodiversity: from 107 to 112 varieties of plants and from 36 to 38 families.[47] The same evaluation report estimated that the total area of new vegetation produced by the project can absorb 1.48 million tons of carbon dioxide each year.

2.36 The 2,100 small sediment control structures built are estimated to divert or capture about 25 million tons of sediment per year, of which some 45 percent is retained by the dams and the remainder is retained by the terraces and the various vegetative measures. To date project works retained an estimated total of 53 million tons of sediment.

Efficiency

2.37 Project efficiency is rated as substantial but with some shortcomings.

2.38 Overall ERRs varied from 18 percent to 21 percent, close to the appraisal estimate of 20.9 percent. The slightly higher values include the benefits from sediment reduction and carbon sequestration. Although the methodology used to calculate the ERR is exemplary, this assessment believes that production costs are underestimated and benefits are overestimated due to the presence of other donor and a substantial number of Chinese-financed local developments that fostered increased productivity and incomes. In addition many rural roads were constructed by other agencies and this not only changed market opportunities but also provided off-farm employment access, and better education and health.

OUTCOME

2.39 **The outcome of the project is rated as satisfactory.** Relevance was high, while efficacy and efficiency are rated as substantial. Table 3 summarizes the results by objectives discussed in previously.

2.40 IEG's field visits and interviews confirmed that substantial economic development had occurred at sites visited. However, it was also clear that there had been many inputs in these areas that complemented those of the project. Because of the difficulties with the implementation of the M&E system a robust counterfactual could not be determined. In consequence attribution of observed benefits is difficult and, at best, IEG can only confirm that the efficacy and efficiency of the project are substantial and this leads to a rating of outcome as satisfactory. If a robust counterfactual had been available and had been monitored correctly, the ICR's highly satisfactory outcome rating may have been confirmed.

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47. Ecosystem Benefit Monitoring & Evaluation Report. Water and Soil Conservation Research Institute. August 2005.

Table 3: Factors Determining Project Outcome

Objective	Relevance	Efficacy	Efficiency	Outcome
Help achieve sustainable development in the Loess Plateau by:				
(a) increasing agricultural production and incomes	High	Substantial		
(b) improving ecological conditions in the tributary watersheds of the Yellow River	High	Substantial		
Overall	***High***	***Substantial***	***Substantial***	***Satisfactory***

RISK TO DEVELOPMENT OUTCOMES

2.41 **Risk to development outcome is rated as moderate**. The main risk factors are institutional and environmental.

2.42 **Institutional risk** arises from continued local government willingness to enforce the grazing ban and assist with future operation and maintenance of terraces should they be damaged by extreme weather events. There is a risk that farmers will not remain willing to forgo income for 4-10 years while their economic trees mature and bear fruit, or remain willing to repay their share of project investment and look after the reclaimed slopes that have sub-marginal returns when opportunities for off-farm employment look increasingly favorable. This risk is enhanced because non-project land conservation activities in the Loess Plateau area are fully subsidized though centrally-funded programs.

2.43 The SLCP has stated environmental goals of reducing water and soil erosion and increasing China's forest cover and area by retiring steeply sloping and marginal lands from agricultural production. Farmers are compensated with grain and cash subsidies for taking sloping land out of agricultural production, and provided with seedling and management subsidies for planting and cultivating trees and grassland on converted land. The program was designed to convert 14.67 million hectares of cropland (including a target of afforesting 4.4 million ha of land with gradients of more than 25 degrees) in 23 provinces to forest by 2010 and has an overall budget of more than US$40 billion. In addition, it had a soft goal of afforesting an equivalent area of wasteland.[48]

2.44 Trial implementation of the policy began in early 2000 in a total of 174 pilot counties spread over 13 provinces in the upper and middle reaches of the Yangtze and

48. The annual grain subsidy for farmers is 1500 kg/ha in upper reaches of Yangtze and 2250kg/ha in upper/middle reaches of Yellow River. Cash subsidy for farmers' health, education and other needs is RMB 300/ha annually for same duration as grain subsidy. Subsidy for seeds and saplings is RMB 750/ha. Income from forests and grasses is tax exempt. Farmers are also given 30-year contracts for planting and caring for trees and grasslands. Farmers receiving subsidies are also be responsible for planting grass/trees on two or more mu of barren land. Farmer's subsidy packages have duration of five years, but are adjustable. Since 2005 all subsidies were lumped under a single payment: RMB 2,400/ha in the Yellow River basin, RMB 3,450/ha in the Yangtze River basin. ***Source:*** Bennett, M.T. and J. Xu. 2005. China's Sloping lands Conversion program: Institutional Innovation or Business as Usual? Workshop on "Payment for Environmental Services – Methods and Design in Developing Countries. Beijing

Yellow rivers. In the first four years 15 million farmers entered the program. It expanded to 2,000 counties in 25 provinces and by 2004 had converted 7.2 million ha of cropland and afforested 4.9 million ha of wasteland.

2.45 There is a modest risk also that government's current focus on conservation and "grain-for-green" philosophy may be jeopardized.[49] Earlier government policies towards restoring degraded land were a response to the growing stockpiles of grain in the late 1990s. However, now that water shortages are reducing grain output in the north there is a risk that food production concerns may override those for conservation and thus jeopardize the "grain-for-green" philosophy. If so, central funding could dry up and farmers could abandon marginal land that is not cost-effective to nurture.

2.46 **Environmental risk.** Large expanses of trees and brush under drought conditions pose a high fire risk. As far as IEG could determine this has not been a concern of local government even though the Bank has raised this with central government.

2.47 The increasing water shortages in the lower Yellow River basin poses a risk that there will be sustained objection from lower riparians to increasing water retention and use in the Loess Plateau area as a result of greatly increased deep-rooted vegetation and check structures and small dams to retain runoff. Current water retention due to the project is relatively small (it is estimated to be 130 million cubic meters a year) so this risk is probably small.[50] This implicit transfer of property rights (to water) implicit in the greening of the Loess Plateau is not acknowledged by the Chinese government or taken into account in the inter-provincial water allocation procedures (paras 2.107-2.113.)

BANK PERFORMANCE

2.48 **Overall Bank performance is rated as satisfactory.** The project preparation process was short because it built on the knowledge, experience and lessons of the first Loess Plateau Project and had the same task team leader. The institutional, safeguard and fiduciary aspects were well understood as was the need to have improved arrangements for monitoring and evaluation. In retrospect, the familiarity with the Chinese institutions involved in the first project may have caused underestimation of the difficulties encountered in new counties and prefectures. Feedback for the Borrower put a very high emphasis on the Bank's comprehensive approach that successfully married conservation practice with income-generating opportunities for farmers. Similarly, the consistent application of rigorous procurement and fiduciary policies, while at first being seen as onerous, was later fully accepted and mainstreamed in the more progressive provinces.

2.49 Bank supervision is rated as satisfactory but with some shortcomings. Supervision of such a large and diverse project area was hugely challenging and the Bank team used innovative methods to maximize field presence and coverage – but only supervised once a year. Problems were jointly identified, and solutions were discussed and agreed between the Bank and the Borrower and quickly implemented. Continuity of task management and

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49. Hong Yang. 2004. *Land Conservation Campaign, Integrated Management And Local Participation In China.* 13th International Soil Conservation Organizations Conference. Brisbane. July 2004.
50. Loess Plateau II- M&E Results. 2006. Evaluation of water and soil conservation benefits.

maintaining a core supervision team composed of a broad mix of international and local professionals throughout the project's life greatly helped to develop and maintain a healthy and trustful cooperation between the Bank and the Borrower. This continuity and trust allowed true sharing of supervision responsibility and problem solving in a consistent and persistent way. However, the single annual mission was inadequate given the reported problems with counterpart funding and audits at the local level, and the concerns raised about the understanding and implementation of the M&E program. There should have been more specialized follow-up on M&E, as acknowledged in the ICR. This has now been addressed in partnership with the United Kingdom's Department for International Development (DFID) to help upgrade M&E and impact assessment through parallel financing.

BORROWER PERFORMANCE

2.50 **Overall Borrower performance is rated as highly satisfactory.** Borrower ownership was high. Preparation was highly satisfactory. The MWR/Yellow River Conservancy Commission put in place a strong national preparation team that was formed of experienced project staff and external experts on agriculture, water resources management, forestry, and institutional and social development and this enabled the project to be completed within a year. The project preparation work, adopting a fully participatory approach, covered major technical, institutional, economic and environmental aspects of the project design, and the views of all stakeholders at central, provincial and local level were reflected in the process.

2.51 Implementation was highly satisfactory. The Central PLG was effective at coordinating the project and ensuring a standardized approach to planning and management among the participating provinces. They were proactive in supporting new initiatives learned from project feedback and demonstrated strong leadership backed up by significant policy and operational support. The extensive promotion and enforcement of grazing bans and long-term land-use contracts have significantly contributed to the achievement of project objectives. The only real problem was the difficulty of getting a continuous flow of adequate counterpart funding, particularly from the lowest administrative levels who had to pay for the project. It is remarkable testament to the good Chinese project management skills that, given this problem, the work was completed on schedule and there were no slippages.

SUMMARY OF ISSUES RAISED BY THE LOESS PLATEAU PROJECT

2.52 The project experience raises four issues:

- The importance of a soundly designed M&E system is particularly important given the number of other development initiatives and projects that affect the project area;
- More attention should be given to building capacity for M&E at all levels that moves beyond the simple measurement of physical impacts and include socio-economic impacts, development of realistic counterfactuals and methods to deal with the problem of attribution of costs and benefits.
- Resolving the differing policies applied to financing and management of watershed conservation. The government's own watershed conservation projects remain public goods oriented and farmer's contributions are fully subsidized. This suggests that

the Bank's innovations (through several Bank-financed watershed conservation projects) in which beneficiaries are expected to contribute to private goods generated by watershed conservation project remain enclave activities and that the policies the Bank is promoting have not been mainstreamed in China.
- More attention needs to be given to the regional impact of revegetating the Loess Plateau to minimize consumptive use of scarce water resources.

XIAOLANGDI MULTIPURPOSE PROJECTS I & II

OBJECTIVES

2.53 Each project had the same objectives. There were five aimed at:

- providing flood protection for major infrastructure and 103 million people mainly in the rural areas of the North China Plain;
- controlling sediment accretion in the 800 km lower reach of the Yellow River for a period of about 20 years;
- supplying and stabilizing water to several large and medium cities and major industrial centers;
- providing reliable irrigation for some 2 million ha; and
- generating much needed hydropower to meet the peak power requirements in the Henan Grid.

2.54 Although the above objectives remained unchanged between Phase I and II of the project, urban water supply took on an increasing importance at the project progressed. Booming economic growth has translated into ever rising demand for municipal and industrial water supplies, and this trend is likely to continue. The Xiaolangdi reservoir is key to maintaining urban water supplies in north China during periods of drought, as eloquently illustrated in 2000-01. This key role was not anticipated at the time of project design and appraisal.

2.55 Overall project costs and phasing are summarized in Table 4. Costs classified as "other" were export credits from the American Import and Export Bank (US$55.8 million) and from the Tokyo Mitsubishi Bank (US$18.2 million.)[51] Total costs are related to objectives and components in Table 5.

51. The costs presented in the ICR differ from those in the Bank's Operations Portal and data from the latter are presented here.

Table 4: Xiaolangdi – Overall project costs and phasing

1994	1996	1998	2000	2002	2004		Total Costs, US$ millions				
							Planned	Actual	China	Bank	Other
■■■■■■ Xiaolangdi I ■■■■■■■							2,856	2,689	1,845	460	
			■■■■■■■ Xiaolangdi II ■■■■■■■■■							310	74
■■■■■■■ Resettlement ■■■■■■■■■■■■■■■■■■■■							571	841	728	113	-
						Total	***3,427***	***3,530***	***2,573***	***882***	***74***

DESIGN

2.56 The physical works consisted of the construction of a very large dam and power plant on the Yellow River in the transition zone between the middle and lower reaches, about 800km upstream from the delta. The dam was designed specifically to create a reservoir capable of storing both water as well as 0.5 billion cubic meters of sediment that was expected to accumulate in it over 20 years. [52] This would not interfere with water storage, for which there would be 5.1 billion cubic meters of capacity available.

2.57 Many technical and engineering studies were done in the decade-long period preceding construction, (including some by international experts). Geological investigations of the site go back as far as 1958. The Bank also provided some assistance in project preparation, via the use of the IDA Second TA Credit. This evaluation shares the view of the Bank's Quality Assurance Group that the project's quality at entry was highly satisfactory. The early completion of the project is an eloquent testimony to the thoroughness and high quality of all the preparatory work undertaken prior to construction.

52. 154m high, 1.7 km in length and with an underground powerhouse equipped with 6 X 300MW generators. It has created a reservoir about 140 km in length, with a maximum storage capacity of 12.6 billion cubic meters.

Table 5: Xiaolangdi I & II – Objectives, Components and Total

Objectives	Components	Costs (US$ millions) Planned	Actual
1. Introduce flood control in the lower reaches of the Yellow River Basin to protect major infrastructure and 103 million people 2. Control siltation in the 800-km downstream channel of the river and prevent further aggradation so that levee heights need not be raised further during a period of 20 years 3. Provide water for assured irrigation for 2 million hectares 4. Provide more stable water supplies for on stream cities and industries	• ***Dam Construction.*** Phase I: Build Xiaolangdi rockfill dam, 154 m high, with a crest length of 1,370 m; Phase II: extended the crest length to 1,667 m. • Construct a common intake structure, feeding nine large diameter tunnels and surface spillway for river diversion, flood handling and sediment management, discharging into a common plunge pool.	1,520.3	1,760.9
	• ***Facility Management.*** Phase I: training and technical assistance for YRWHC in contract management, project scheduling, cost control, claims management, financial management, management information systems, organizational support, corporate planning and personnel management. Phase II: technical assistance for training in operation and maintenance (O&M) of the dam, powerhouse and related facilities and planning and personnel training for operation of the project.	235.5	201.4
	• **Environmental Management.** To monitor, manage and offset any negative impacts of the project; and in Phase II to implement of the environmental management plan	5.1	4.6
5. Generate hydropower for supplementing the base load of thermal stations in Henan Province and the Central China Power Grid	• ***Power Development.*** Construct a power station with six associated power tunnels with turbine and generators with an installed capacity of 1,800 MW (6 x 300 MW) and associated switchyards, and transformers.	10.1	13.8
Institutional reform and capacity-building that applies to all 5 objectives	• ***River Basin Management.*** An institutional program for MWR and YRCC to support the reform process in the water sector, i.e., in adapting to international accounting procedures, sustainable resource mobilization for water resources projects, water pricing, water licensing, effective river basin organization, and water dispatching systems for basins.	462.7	256.0
	• Interest during construction	14.8	14.7
		607.4	437.4
		2,855.8	2,688.8

2.58 The first Bank loan funded a substantial amount of capacity-building and training for the staff of the Commission and the newly established (1991) River Water &

Hydropower Development Corporation's (the Corporation) both locally and abroad and provided technical assistance to the MWR as well. The focus of the second Bank loan was on transforming the Corporation into an operating rather than construction management entity, while also providing considerable institutional support to the Commission in water allocation and dispatch, reservoir operations and flood and sediment forecasting and management information systems. The current irrigation water dispatch system for the lower reach was set up with Bank assistance under the project

2.59 The emphasis on developing facility management and training for the staff of the new organization set up to build and operate the dam was appropriate. Training for the Yellow River Conservancy Commission (the Commission) was to enable them to undertake institutional reforms such as in the areas of water pricing and facilitate coordination and interactive management systems with the Corporation on the day-to-day regulation of water resources in the river basin and flood forecasting.

IMPLEMENTATION

2.60 By any international civil engineering standards, the Xiaolangdi project is a major accomplishment in terms of its scale and complexity. The technical challenges and difficulties in implementation were numerous, but as these have been described satisfactorily in the ICRs, they will not be repeated here. Nevertheless, the fact that the physical works were completed slightly below cost and a year ahead of schedule should be noted, as these are exceptional occurrences in the case of hydroelectric projects, regardless of where they are built. The first power generation unit went into service in late 1999. Downstream sediment flushing from the river bed has been carried out successfully since 2001 and continuous water flows to the river mouth have been maintained since then.

Monitoring and Evaluation

2.61 **Design.** The design of M&E in Phase I was appropriate even though it paid little attention to outcome indicators. This was because the focus was on the engineering construction that was managed by the Corporation whilst the downstream impacts were routinely monitored by either the Commission or the statistical departments of Shandong and Henan provinces. Thus Phase I focused on physical process indicators and reporting of physical progress and financial expenditures during construction. However, it did incorporate extensive arrangements for dam safety monitoring and flood forecasting in line with international best practice. This was independently overseen by an independent Dam Safety Panel that included leading Chinese and World experts.

2.62 The Phase II design of M&E was a marked improvement and clearly specified key performance, outcome indicators and targets. These were:

- Eliminate annual flood damages of US$91 million a year
- Increase farm incomes by about 15 percent in Henan and increase labor productivity in the farms by 20 percent. Increase grain yields by 20 percent from 4 tons/ha to 4.8 tons/ha and increase production by 0.515 million tons a year.
- Reduce industrial downtime due to lack of water to 2 days per year
- Between 200 and 2025 riverbed ceases to rise between 2001 and 2025 and Yellow River flood dykes do not have to be raised.
- Eliminate catastrophic flood damage and reduce flood damage within the dykes for a 2-year occurrence to a 7-year occurrence.
- Generate 2,400 GWh of peak power 2001-03 increasing this to 4,700 -5,400 GWh from 2004.

2.63 Apart from the monitoring of power generation, all the other indicators were expected to be part of routine monitoring carried out by the Commission and provincial agencies. This was true of the indicators related to water levels, sediment and river morphology but no arrangements were established to determine if the routine monitoring by other agencies was satisfactory or covered the expected outcomes and impacts. Although the expected outcomes were the result of the river basin modeling exercise (para 1.33), this was a deterministic mathematical model and represented only a simplified form of economic reality. No allowances were made for the many other factors – including changes to economic policy or the political economy – that would affect impacts on agricultural incomes and production or security and availability of downstream water supplies. For example, industrial downtime due to lack of water was also a function of many exogenous factors such as intra-basin or municipal water allocation within the provinces, the water conveyance system below the dam and increasing industrial water demand. In that sense there was no credible real time counterfactual against which to measure incremental economic impact.

2.64 While the improvements in flood conditions and sedimentation could be measured downstream, this would be the result of the cumulative impact of Xiaolangdi and changes upstream. As far as this evaluation can determine, no mechanism was designed to monitor the differential impacts of the dam and its operation. Overall quality of M&E design is thus rated as modest.

2.65 **Implementation.** Data on water inflows and outflows from the reservoir were collected and this continues. This is a *sine qua non* for decisions on reservoir management, water allocations and dispatch. Indicators of power operations are also recorded continuously. The Commission has an extensive network of hydrological stations on the Yellow River and has accumulated data over many years on water flows. These data provide the essential inputs for its analytical work. Data relating specifically to Xiaolangdi are therefore just one necessary element in the Commission's requirements for carrying out its mandate of water resource management in the Yellow River Basin.

2.66 The Commission monitors changes in the depth of the main channel of the river in the lower reach in order to assess the effectiveness of the sediment flushing operations. However, this evaluation was unable to ascertain if the Commission monitors ecological changes in the river or delta resulting from the restoration of uninterrupted year-round water flows.

2.67 **Utilization.** Monitoring data have been fully internalized and have been used to operate the dam effectively according to its operating rules and the requirements for sediment flushing, flood control and power generation. The efficacy and efficiency of dam operations is discussed below (para 2.76 et seq).

2.68 **Taking account of design, implementation and utilization, the overall quality of M&E is rated as modest.** The reason is that the claims for the project's outcomes and impacts on agricultural production are based upon modeled projections, not the results of field-level M&E. This is not to say it could not be done. Given the large capital investment less than 0.1 percent of project costs would have allowed a carefully designed and independently managed impact evaluation using an experimental (randomized) design.[53]

Safeguard compliance

2.69 The project raised three safeguard issues: dam safety, involuntary resettlement and cultural heritage. The dam lies in an earthquake-prone area and could be subject to an earthquake of magnitude 6.25 on the Richter Scale. Project design fully internalized this risk in the design of the dam and its embankments. A network of seismometers has been operational since 1995. A Dam Safety Panel has independent oversight of the facility. Satisfactory arrangements are in place for dam inspections and emergency preparedness. The project was less successful in imposing dam safety requirements on the Sanmenxia dam that lies upstream (the flood wave from the collapse or overtopping of this dam would threaten the safety of Xiaolangdi.) At completion this dam had problems with inadequate lifting capacity of the gantry cranes at the dam crest and this would significantly reduce its ability to control pool levels in a flood emergency. Additionally there is some risk that the dam would be unable to maintain pool levels above 335 m.

2.70 Resettlement of 184,040 people was subject to a stand-alone resettlement project that met the requirements of the Bank's policies on involuntary resettlement (OP4.12.) EG's recent evaluation of this rated it as satisfactory but with reservations on the cessation of M&E activities on credit closure. Without continued M&E it is impossible to monitor the longer term impacts of enforced resettlement on the welfare and incomes of affected people and host communities. Lack of knowledge precludes establishment of measures to mitigate hardship and accelerate a return to normality.

2.71 Cultural heritage was an issue because the dam was built in "the cradle of Chinese civilization." Extensive archeological investigations, classification and salvage programs were implemented and completed satisfactorily.

Relevance

2.72 **Relevance is rated as high.** This is based on strategic relevance to China's needs, to the Bank's strategy for China (para 1.21 et seq.,) and relevance of the project design.

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53. Such an exercise was extremely rare within the Bank at the time of appraisal and it is only applied to a small proportion of social sector projects today.

2.73 The choice of a multipurpose dam was highly relevant as it allowed flexibility of choice between various operational modes using an increasingly scarce resource – water. The choice of hydropower was appropriate given the need for alternative sources of clean energy.

2.74 Flood and sediment control are closely linked and clearly deserve top priority due to the risk of destruction of assets and loss of life and the heavy cost that this would impose on China. Meeting the water requirements of urban populations is rightly considered the next highest priority. Water requirements for irrigation and power are not necessarily exclusive, but water releases from the Xiaolangdi reservoir would differ in time and scale if power generation was to be given priority over irrigation. The priority given to agriculture is entirely justified given the large number of rural beneficiaries from irrigation and the fact that substitutes from other sources can be found for electricity supply.

2.75 The adoption of a two-phase approach primarily to reduce engineering risks and enable lessons from the first phase to be incorporated into the second phase was highly relevant.

Efficacy

Flood protection was provided

2.76 Preventing damage to life and property is the priority objective of the Xiaolangdi project. The Xiaolangdi dam and reservoir together now provide the population living downstream with protection against all floods with a one in thousand year probability. Prior to the project, the existing infrastructure of dams and dykes only offered protection against floods with a one in sixty year probability. By means of careful water flow regulation, Xiaolangdi has also successfully prevented the formation of 'ice dams' that used to cause flooding in winter when downstream sections of the river froze.

2.77 The efficacy of the dam was tested in 2003, the heaviest wet season in Northern China since 1981. The reservoir was able to contain the inflows and store 6.3 billion cubic meters of water and maximum downstream discharge was limited to 2,800 cubic meters per second. Without it, flows downstream at Huayankou would have reached 6,000 cubic meters per second with devastating consequences and danger to 18 million people. The Corporation cites a figure of Y 11 billion (US$ 1.3 million) as the avoided cost of flood damage that would otherwise have occurred. IEG could not find out what this figure includes or how it was calculated.

2.78 On the basis of experience to date this objective was fully achieved and its efficacy is rated "high."

Sediment accretion of the Yellow River was controlled

2.79 In some respects, the operational phase of the Xiaolangdi project has proved to be more complex than the actual construction of the project. The project design and hydrological studies were done in the 1980s (if not earlier) and nearly twenty years later, the actual hydrology in the immediate post-completion period has turned out to be quite

different to what was expected.[54] The effect of a series of three dry years (2000-02) immediately coinciding with the completion of the dam led to different reservoir operating rules having to be devised and adopted. The low water inflows also meant that the annual inflow of sediment into the reservoir was far less than expected: 0.4 billion tons on average, as against the predicted 1.3 billion tons.[55] Consequently the reservoir's capacity for flood control in the initial years was higher than predicted. This in turn allowed the lowest reservoir level prior to the rainy season to be 5 m higher than the design, which in turn meant that more water was available for supply to urban areas affected by drought. Reservoir modeling will continue to be of great importance because the past few years have shown that the rate of decline of its live storage capacity has been quite different to the initial planning parameters.

2.80 It was estimated at appraisal that the reservoir would trap 7.5 billion cubic meters over its first 10 years of operation. This target has not been reached primarily because of the reduced inflow of sediment to the reservoir. The true measure of the efficacy of the sediment management objective is that downstream flood embankments (dykes) have not had to be raised thus saving an estimated US$ 75 million a year.[56]

2.81 **Sediment Flushing Operations**. Managing the high sediment load of the Yellow River presents the Commission with complex and nearly unique challenges. The experience of the very rapid silting up of the Sanmenxia reservoir in the early 1960s provides valuable lessons for the design of Xiaolangdi.[57] The need to trap some coarser sediment while allowing finer silt to pass through the reservoir was explicitly incorporated in the design, which envisaged a progressive filling up of the lower levels of the reservoir, while always preserving a substantial amount of live storage for flood control and water supply.

2.82 Each year since 2002 in June/July, prior to the onset of the rainy season, the Corporation has carried out a controlled 'flood' in order to flush out sediment from the reservoir as well as to transport out to sea sediment previously deposited further downstream. A discharge of at least 2,600 cubic meters/second (m^3/sec) is drawn from the lower levels of the reservoir and the rip current created erodes deposited silt and transports it downstream. Each 1,000 cubic meters released removes about 1.5 tons of sediment and this is continued for periods of about 7-10 days lowering the lake level by about 10 meters

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54. The long-term hydrological series (1919-74) that was the basis for the planning and design studies may still prove to be valid since 2000-06 is a relatively short period.
55. As against predicted inflows of 25-28 billion m3, the actual inflows in the three years 2000-02 were about 13 -15 billion m3. Since the dam was closed total sediment inflows are estimated to be 2.6 billion tons, of which 0.5 billion tons have since been flushed out
56. Historically, between 300 and 400 million tons of sediment have been deposited on the riverbed along the lower reaches every year, resulting in a rise in the riverbed of 8-10 centimeters annually. Thus it was necessary every decade to raise 696 km of the main dikes at least 1 meter, to strengthen 969 km of levees, to raise or strengthen 5,395 spurs in vulnerable sites, and to reconstruct or complete 51 channel training works and 439 spurs totaling 40.8 km. The total present value of one of these decade-long comprehensive programs was estimated, at appraisal to be at least Y 4 billion ($755 million). These costs were expected to increase over time as the base of the dike was widened and as the integrity of dike foundations was threatened by seepage and salinity as the riverbed rises.
57. Upstream of Xiaolangdi in the middle reach of the Yellow River. Despite redesign, modifications and silt flushing, it now has a live storage capacity of under 2 billion m^3.

and thus creating more flood storage. When mixed with fresh water drawn from higher in the reservoir the high energy of the combined discharge and its large velocity enable the river to transport a higher sediment load than it carries and it thus also scours the river bed downstream.

2.83 The flushing operations have been remarkably successful. The flow capacity of the main channel of the river has been raised from1,800 m^3/sec to about 4,000 m^3/sec as a result of the deepening of the channel by about 1 m on average. Total silt transported out to sea has been estimated at about 260 million tons as a result of the flushing operations. The Commission's objective is to restore the river's flow capacity to that of the 1970s which was about 5,000 m^3/sec. Outside the rainy season, the average discharge rate downstream of Xiaolangdi is maintained at 800 m^3/sec with a minimum of 200 m^3/sec during droughts. If dry season discharge exceeds 800 m^3/sec there is a risk that sediment will be carried downstream from Henan province to Shandong province but not be flushed to the sea. If this did occur it would risk increased floods in those aggrading reaches.

2.84 Research is being undertaken by the Commission to improve sediment management in the Xiaolangdi reservoir and to achieve the downstream flushing effects with lower water discharges.[58] The sediment discharge ratio (the percent of incoming sediment flushed out) from the reservoir at 18 percent is already better than the design target of 14 percent and attempts are being made to raise this further in order to prolong the life of the reservoir. Tests are being undertaken with water releases carrying sediment loads one-third higher than the highest sustained to date. The combination of the lower sediment inflows in 2000-02 and the successful flushing operations means that an additional five years have already been gained before the reservoir's sediment storage capacity of 7.5 billion m^3 is entirely filled.

2.85 On the basis of the experience to date the sediment management objective has been fully achieved and efficacy is rated as "high."

Water supply to downstream cities and industries was delivered

2.86 Water shortages in the lower reaches of the Yellow River prior to the construction of the Xiaolangdi project were chronic. In the two decades prior to the project, it was not unusual for the river to dry up completely for weeks at a stretch (para 1.15.) Yet despite drought conditions in 2000-02, the water stored in the reservoir and controlled releases throughout the year have meant that, since 2000, water flow in the lower reaches of the Yellow River all the way to the sea, and has never been interrupted. The ecological benefits have been considerable: freshwater wetland areas have reappeared, as have fish species that have not been present since the 1980s. The availability of silt-free water downstream of Xiaolangdi is also beneficial as it reduces the cost of urban water treatment and sedimentation of irrigation canals diverting river water.

2.87 Supply to major cities such as Tianjin were maintained during one of the worst droughts of the past century – a 1 in 200 year event – despite the reduced water inflows to

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58. The reservoir had an initial live water storage capacity of 12.6 billion m3, which was expected to gradually fall to 5.1 billion m3 over 20 years. This level is to be preserved indefinitely thereafter.

the Xiaolangdi reservoir. Indeed, the reservoir proved to be the only dependable surface water supply for downstream towns and cities. Meeting municipal and industrial demand for water in dry years was not given major prominence at project appraisal, but is likely to play a bigger role in terms of water allocation issues in the coming years.

2.88 This achievement is partly the result of exogenous factors and not attributable solely to the project. It was also the result of *force majeure* by the lower riparian provinces at the highest political level. Without this intervention Xiaolangdi would have been unable to supply the demand because of the water allocation system. This was the result of the Yellow River Water Regulation Management Regulation Stipulation (1998) that was a response to the 1997 drying up of the river. Under this new mandate the Commission was authorized to conduct unified water resources regulation in the basin and reassign quotas to each province or autonomous region. Where possible this is achieved automatically by the Commission via telemetric control from Zhenzhou for 77 important water abstraction sites and key reservoirs. Quotas are proportionally increased or reduced based on the predicted total natural runoff modeled by Commission. As a result of these measures annual water diversions from the Yellow River were maintained below 30 billion cubic meters in the period 1998-2001.[59]

2.89 Controlling the water diversion from the Yellow River was, however, only a partial solution because demand continued to exceed supply. Thus emergency closure of upstream irrigation off-takes was required in 1999 to provide essential minimum flow at Sunkou and Lijin measuring stations downstream.[60] In 2000 an emergency release of one billion cubic meters of water stored for hydropower generation at Longyanxia dam was needed to alleviate that year's water crisis in Tianjin City on the east coast.[61] And in 2002 a special high-level delegation from Shandong province secured an additional 0.8 billion cubic meters from the State Council without any compensation for upstream users in Ningxia province and Inner Mongolia autonomous region.[62] These *ad hoc* adjustments took no account of the opportunity costs of water so these emergency allocations are not generally the most economically efficient solution. Clearly, effective and efficient institutions are at least as important as engineering in river basin management.

Irrigation water was supplied with increased reliability – but probably not for the whole of the targeted area of 2 million ha

2.90 To fully supply irrigable agricultural land in the two provinces of Henan and Shandong requires the annual diversion of about 23 billion m^3 from the river. Prior to Xiaolangdi total water availability for *all* end uses was only 32 billion m^3 with the result that water for irrigation was always below the biological optimum to maximize crop yields.

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59. Fu, Guobin, and Shulin Chen. 2006. Water Crisis in the Yellow River: Facts, Reasons, Impacts, and Countermeasures. Water Practice & Technology Vol 1 No 2. IWA Publishing 2006.
60. Zhu, Quingping. 2006. Preliminary Assessment on the Impacts of the Unified Water Regulations in the Yellow River. MOWR.
61. Embassy of the USA, Beijing. Managing the Upper Reaches of the Yellow River. April. 2003.
62. Wang, Yuhua. 2003. Water Dispute in the Yellow River Basin: Challenges to a Centralized System. Commentary. Woodrow Wilson Center. Washington. D.C. August 2003.

Even after construction of the project there is insufficient water to fully irrigate the total cropland in the lower reaches, given the need to supply cities and industries.

2.91 Despite the construction of the Xiaolangdi project and the additional water made available by it – 4.7 billion m^3 annually on average over the six years 200-2006 – it is estimated that there is still an annual average shortfall of 3 billion m^3 of water just in the Yellow River basin.[63] All indications are that this cannot be covered and the shortfall may even worsen despite measures to increase supply and use water more efficiently.

2.92 Thus this objective was partially achieved and its efficacy is rated as "modest" at best. Lack of evidence caused by inadequate M&E was a major constraint in judging achievement.

Hydropower generation exceeded expectations

2.93 It is one of the ironies of this multi-purpose project that the electricity production from it rates last in the order of priorities, while being the sole source of revenues to pay off the construction debts and cover the running costs of the entire operations of Corporation. At the same time the hydroelectric plant plays a vital role in the Henan provincial power supply system.

2.94 Xiaolangdi (1800MW) is the largest generation plant in Henan and accounts for almost three-quarters of all hydro in the province. Although its capacity exceeds the next largest (thermal) plants by a third and it has greater operational flexibility, it now accounts for less than 6 percent of the total provincial generation capacity. Xiaolangdi therefore plays a valuable role in meeting peak electricity demand and in 2005 its capacity represented over a tenth of the total demand of 17,600 MW on the Electric Power of Henan (EPH) system. Its size also makes it a key plant for EPH in frequency regulation and maintaining grid stability. The fast response time of hydro generation units gives it an important role in ensuring uninterrupted supply in the event of unplanned shutdowns by thermal plants. Annual generation plans take into account the water supply needs of urban and agricultural users and are jointly agreed between EPH, the provincial government and the Corporation. EPH is the Corporation's only client.

2.95 The first 300 MW unit went into service in late 1999 and the final one was commissioned two years later. Although total electricity generation by Xiaolangdi in the first three years was substantially below expectations, largely due to drought-induced low flow, it has exceeded 5,000 GWH in both 2004 and 2005 and is expected to continue at about this level in the next few years (Table 6). This exceeds the targeted energy production of 4,773 GWh in the period 2002-08. At the current average sales price of

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63. One billion m^3 could irrigate about 200,000 ha if it were all applied to a crop like wheat. However as about 50% or more will be lost in transit from the river due to seepage from canals actual coverage is more likely to be 100,000 ha. Thus the total incremental supply from Xiaolangdi could potentially provide about 0.5 million ha of surface water irrigation. In addition the water lost en route in seepage could be recovered from groundwater by tubewells perhaps adding up to 0.2 million ha.

about Y 0.32/kWh, this production gives the Corporation gross annual revenues of about Y1.6 billion (US$ 205 million).[64]

2.96 Since the project closed the Corporation has had approval to construct a small re-regulating dam, Xixiayuan, 16km downstream of Xiaolangdi. This will provide daily water storage to iron out spikes in downstream water releases resulting from surges in power generation. It will thereby give the EPH dispatch center greater operational flexibility and reduce the scope for conflicts between the use of water for power generation and non-power uses. The associated 140 MW power plant will also contribute modestly to electricity production to the tune of 500 GWh/year. The sale price of electricity has yet to be fixed. On the assumption that the tariff will be at least as much as that as for Xiaolangdi, the Corporation will earn an additional Y160 million annually (over US$20 million) from this investment. This Y2.2 billion project is again being funded predominantly by the central government on a grant basis. The Corporation will only be responsible for the debt service on a commercial loan of Y500 million, which funds the balance of the cost.

2.97 Despite the shortages of electricity in China during the past two years, the Corporation has not been able to obtain a significant increase in its power tariff. The price it is authorized to charge is the outcome of a process involving the buyer (EPH) the Henan provincial government pricing bureau, the NDRC[65] and its provincial arm, PDRC. Although the NDRC approved a tariff of 34.5 fen/kWh with effect from 1/1/2006, **the Corporation has not been permitted to levy this rate due to provincial objections to a price hike.**

2.98 **Electricity Pricing.** On the other hand, since mid-2004, the Corporation has been allowed to charge different prices for electricity according to the time of day. It has a peak tariff of 1.33 times the base rate of 31.7 fen/kWh and an off-peak rate of 0.55 times the base tariff during the night hours of 2300-0700.

2.99 The current level of tariffs is substantially less than was expected by the Bank at the time of project appraisal. Even after deducting VAT, the Bank's projections contained in the PAD for the second loan assume a power tariff almost twice that actually levied. The Bank also expected a two-part tariff to be introduced, with separate capacity and energy charges. This has not occurred.[66] Even so, the Corporation has earned an annual return of about 8.6 percent on fixed assets and this exceeds the Bank's stipulation of a 5 percent after 2007.

2.100 At the time of the first appraisal, the Bank's analysis of Xiaolangdi's power tariffs was based upon the cost of thermal equivalence: that of a coal-fired plant operating only four hours per day to meet peak load. With the prevailing capital costs and coal price of

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64. Including VAT, that is levied at 17%.
65. Being under the MWR, the Corporation is subject to NDRC's authority on power pricing.
66. The Loan Agreement stipulates in Section 4.07 "Immediately upon commissioning of the Xiaolangdi Dam, charge and collect from all said users, water tariffs sufficient to recover: (i) the costs of operation and maintenance of said dam in full as they are incurred; and (ii) the capital costs of said dam in full not later than December 31,2014."

1993, the resulting figure for the value of the firm energy to be produced by Xiaolangdi was estimated to be 52 fen/kWh. Although conceptually valid, this estimation was never accepted by EPH or the provincial government as the basis for pricing the power from Xiaolangdi. The initial power sales agreement between them [that the Bank required as a condition of proceeding with the second loan] merely stated that the price would be set at a level sufficient to enable the Corporation to fully recover all costs and earn a fair return on the invested capital.

Table 6: Xiaolangdi Electricity Production, Prices & Sales since 2000

	2000	2001	2002	2003	2004	2005	2006*
Estimated Output (GWh)							
Appraisal Phase I	2,507	3,760	3,947	4,875	4,875	4,875	4,875
Appraisal Phase II	2,275	3,679	4,231	5,115	5,115	5,115	5,115
Actual production	642	2,111	3,286	3,684	5,015	5,048	5,300
Actual / Planned (Phase II)	28%	57%	78%	72%	98%	99%	104%
Planned price (fen/kWh)							
Appraisal Phase I	27	30	35	37	38	49	51
Appraisal Phase II	52	52	52	52	52	52	52
Actual Average revenue							
Approved kWh (excl. VAT)	24	23	24	21	27	27	27
Actual / Planned (Phase II)	46%	44%	46%	40%	52%	52%	52%
Total Revenues (mn Y, excl. VAT)	150	483	778	770	1,370	1,367	1,436

Source: Yellow River Water & Hydropower Development Corporation 2006
* = estimated

Efficiency

2.101 Overall efficiency of the project is assessed as substantial. The EIRR of 13 percent as presented in the ICR is probably underestimated since it undervalues the economic benefits from power and urban water supply and does not include any benefits at all from the improved ecological conditions downstream and in the delta.

Outcome

2.102 The outcome of this two-phase project is rated as highly satisfactory for both phases. For both projects relevance and efficacy are rated as high and efficiency is rated as substantial. Table 7 summarizes the results by objective and outcome.

2.103 The Corporation is the first instance in China of a financially autonomous water resource entity, run on 'semi-commercial' lines (para 2.115) that is responsible for covering its full operating costs and repaying loans contracted for construction. At the same time, it is under the control of Commission regarding decisions relating to flood control, urban water supply and reservoir management policies. Equally for power generation, it is under the operational control of EPH for real-time decisions on generation levels.

Table 7: Factors Determining Project Outcome

Objective	Relevance	Efficacy	Efficiency	Outcome
1. Introduce flood control in the lower reaches of the Yellow River Basin to protect major infrastructure and 103 million people	High	High		
2. Control siltation in the 800-km downstream channel of the river and prevent further aggradation so that levee heights need not be raised further during a period of 20 years	High	High		
3. Provide water for assured irrigation for 2 million hectares	High	Substantial		
4. Provide more stable water supplies for on stream cities and industries	High	High		
5. Generate hydropower for supplementing the base load of thermal stations in Henan Province and the Central China Power Grid	High	High		
Overall	***High***	***High***	***Substantial***	***Highly Satisfactory***

2.104 Despite the commercial nature of its operations, the Corporation has very little autonomy since it has no control over the key parameters of its operations – decisions on water storage and releases as well as the price and quantity of the electricity it generates are all made by other bodies. This is understandable since the expertise on water resource management and the analytical skills for optimizing the use of the Xiaolangdi reservoir as well as in power operations and pricing are all located in other entities.

2.105 During the decade prior to the completion of the Xiaolangdi project in 2002, the Bank was heavily involved in assisting the Commission and in building up its analytical capabilities. Today it is evident that the Commission's technocrats have the full capabilities to analyze and manage the complex issues relating to the water resources of the Yellow River basin. With their access to the latest analytical tools as well as the possibility to seek advice from any international experts that they might wish to consult, it is clear that the Bank's institutional development and knowledge management role has been successfully completed.

RISK TO DEVELOPMENT OUTCOME

2.106 Overall risk is rated as significant primarily because of unresolved water allocation issues and under-priced water. Continued subsidies for capital investment risks misallocation of resources. While there are potentially high seismic risks, these have been mitigated in project design and operation. The sustainability of the Xiaolangdi project is assured from a technical and financial point of view because the project infrastructure is being well maintained and the Corporation is able to raise enough funds from its sales of electricity to meet its full O & M requirements. However, from an economic perspective, long-term sustainability is less likely. Continuing water shortages, the modest progress in addressing issues of inter-sectoral and regional competition for water use and the political reluctance to use water pricing as a tool for demand management all tend to undermine economic sustainability.

2.107 **Inter-**regional **equity and conflicts over water**. As pointed out as long ago as 1992 by the Investment Planning Study:

2.108 "*...the remote, heavily eroded Loess Plateau and the arid upper reaches of the Yellow River ...are the least efficient water users. Delivery and field losses are extremely high and many areas must be served by energy-intensive pumping schemes.* With *increasing frequency, Yellow River water will be in short supply, and the water used in these regions will have an ever higher opportunity cost downstream. Sooner rather than later, Yellow River planners w ill have to squarely face equity vs. efficiency issues."*

2.109 The differences in the need for Yellow River water by season and by reach create conflicts between upstream and downstream provinces, since their priorities over water use do not coincide with a basin-wide water allocation formula based on maximizing economic benefits. [67] The lower reaches are more productive in terms of the annual output of grains and their efficiency of water use, but farmers have to make do with what is left after the upper and middle reaches have drawn off their 'requirements'. Agricultural output could be raised further if more irrigation water was provided to farmers in Henan and Shandong provinces. The higher economic value of water in the lower reaches should also translate into a higher willingness to pay for additional irrigation water.

2.110 At present, provinces along the Yellow River are entitled to withdraw annual quotas of surface and groundwater that have remained unchanged since a State Council ruling in 1987, despite major shifts in population, urbanization and industrialization that has taken place in the past 20 years. While the Regulation Stipulation of 1998 allowed the Commission to *pro rata* the quotas to take account of annual variations in water availability, redistribution of the quotas is not allowed. Even so, upstream provinces tend to withdraw more than their full quotas every year, regardless of annual rainfall, which puts a disproportionate burden of the shortfall due to poor hydrology on the downstream provinces. Altering these provincial quotas and putting in place an enforcement mechanism is a political 'hot potato' for central government that needs to be addressed. And as noted earlier, downstream provinces are able to bypass official regulation making nonsense of the quota allocation system (paras 2.88).

2.111 Taking the Yellow River Basin as a whole, there seems to be scope for a rational reapportioning of provincial water offtake quotas in such as way as to raise overall net economic benefits. In a capitalist market system it would be possible to arrive at this end result by trading water rights. This is currently not feasible in China. But it is possible to envisage a government administered 'trading' scheme to value water, reapportion provincial quotas and financially compensate those upper and middle reach provinces that surrender a portion of their quotas to lower reach provinces.

2.112 An integral element of such a scheme would be the introduction of higher irrigation water charges and volumetric pricing in the lower reaches in return for guarantees of additional water supply in the growing seasons. The upstream provinces would receive an annual payment from the central government to invest in rehabilitation/upgrading of their

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67. In 1997 water use was 809m3/mu in the Upper Reach, but only 304 m3/mu in the Lower Reach (WB rpt # 22040, May 2002).

irrigation networks to cut water losses and cushion the impact of reduced water availability.[68] A panoply of accompanying measures would also be required to improve irrigation and cultivation techniques to raise the value added from irrigation water in the upper and middle reaches. Unlike lower reaches, water charges to farmers could be left unchanged until irrigation systems had been upgraded. From then on, higher charges would be needed to further encourage the economic use of water in agriculture.

2.113 Without such direct intervention by the central government more efficient inter-provincial water use allocations cannot emerge in the Yellow River Basin. Presently, the upstream provinces have no incentive to surrender any of their actual water quotas. The downstream provinces have to make do with what water remains in the lower reaches of the river and even if there was a readiness on their part to pay for higher volumes, no inter-provincial trading mechanisms exists to enable this to occur.

2.114 **Underpricing of water reduces return on investment and lowers water use efficiency.** The Xiaolangdi.project has not lived up to the expectations of the Bank as regards the commercialization of water supply. Contrary to expectations, the Corporation does not charge for water or receive any portion of the water charges levied by Commission. Furthermore, water tariffs, particularly for irrigation, remain far lower than the economic cost of supply, although at the time of appraisal by the Bank of the first phase, the Commission was supposedly already committed to full-cost recovery pricing.

2.115 Yet in the Project Agreements with the Bank for both Loans, the Corporation committed itself to setting water rates sufficient to cover the full O&M costs right after commissioning the dam and to achieve full capital cost recovery after 12 years from commissioning. These undertakings seemed feasible at that time, and were entirely consistent with the 1988 Financial Directive of the Ministry of Water Resources that endorsed marginal cost pricing for water and complete cost recovery pricing by 1997. But a decade later it is apparent that the target was overly ambitious and is unlikely to be met for quite some more years to come.

2.116 The Bank raised the bar even higher in its loan for Phase II. The PAD (section 14) indicated that the Corporation "*would initiate charges for flood and sediment control services, which would be applied as a surcharge on the bills for end users of* Commission - *supplied water.*" However no formal undertaking to this effect was included in the legal documents. The lack of action since then to introduce such charges is unsurprising, given that many view such services as public goods to be provided by the state.

2.117 On the other hand, the slow progress in raising user charges for irrigation water and the lack of any financial transfers to the Corporation for water from the Xiaolangdi reservoir is more difficult to defend. The new water law of 2002, in addition to authorizing full cost recovery, (including for flood and sediment control), also makes explicit provision for a resource cost element in water charges to reflect scarcity. Translating the law into

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68. This would reassure those provinces surrendering the water quotas that compensation would be paid. Initially the central government would probably need to allocate additional budgetary resources to cover the cost of the scheme, but it could equally oblige the downstream provinces to transfer some of the revenues from higher water charges to cover these payments.

higher tariffs is politically difficult. Although Corporation is an enterprise under MWR, approval of water tariffs is a provincial matter and apart from the political unpopularity it would face if it steeply raised water charges, the provincial government is also unenthusiastic about a measure that would transfer funds to a central government body.

2.118 In 2004 MWR introduced the regulations relating to water tariff setting that emanated from the State Council decision designed to promote water conservation. In July 2006, water prices in the lower reaches of the Yellow River were raised, but they still do not contain any element of cost recovery for the O & M or capital cost of the Xiaolangdi project. Current bulk water charges levied by the Commission on supplies delivered to the provincial river affairs bureaux are shown in the Table 8. Subsequently these bureaux retail the water to water user associations with an added management surcharge.

2.119 These charges, which produce revenues of about Y100 million annually for the Commission, do not even cover the full capital cost of investments in water distribution downstream of Xiaolangdi. Even allowing for retailers' mark-up it is apparent that the gap between the price and economic value of water is enormous, particularly for irrigation. The estimated economic value of water in the Yellow River basin in 2000 was in the range of Y1.4-1.7/m^3. Farmers currently pay only about 1-2 percent of this figure.[69] A similar disparity was seen in the Tarim Basin.

Table 8: Bulk water prices

YRCC bulk water supply charges (fen/m3)		
Price	April-June	July-March
Irrigation	1.2	1.0
M & I water	9.2	8.5

2.120 **Continued subsidies for capital investment give the wrong signals on fiscal responsibility.** Despite Xiaolangdi's lower than anticipated electricity tariffs and the absence of any revenues from water sales, the existing level of tariffs have proved sufficient since 2005 cover its O&M expenses, as well as pay the debt service on the loans contracted for the project (including the IDA credit for the resettlement program). The financial covenants in the loan agreement with the Bank have been met, with the exception of the rate of return on the Corporation's *total* revalued fixed assets, which with hindsight appears to have been overly ambitious, given the difficulty of imposing charges for flood control and sediment reduction.

2.121 Prior to 2005 the central government was obliged to cover part of the debt service on the IBRD loans as electricity sales were still rather low and central government only exempted the Corporation from VAT in 2006. Since 2005 the increase in electricity sales has allowed the total debt service relating to Xiaolangdi to decline steadily and in 2007 this is about Y 640 million (US$ 78 million), a third less than two years previously. The windfall from VAT exemption is worth about Y 70 million (US$ 8.5 million) a year. As a result, the Corporation will start to accumulate cash reserves that could be used in part to finance new investments and/or accelerate repayment of outstanding debts. Alternatively, as a wholly state-owned entity, the government could require the Corporation to pay it an annual dividend on the equity initially invested in the project. At present there is no

69. Source: Table 4.9, Agenda for Water Sector Strategy for North China (Rpt # 22040, May 2002)

government policy regarding the return on investments made by it in major infrastructure projects and these are treated as 100 percent capital grants. This seems an overly generous approach in the case of revenue-earning enterprises like the Corporation.

2.122 The obligation of the Corporation to provide a post-resettlement fund for the 184,040 people displaced by the project was taken over by the MWR due to the inadequate cash flows of the Corporation in the first few years of operation. Subsequently, central government has instituted a national subsidy for resettlers – about Y 600 per capita per year for 20 years – to assist them to enter the economic main stream. Now that the Corporation is financially healthy because of the large capital grant from central government there is a danger that Xiaolangdi could set a precedent that large public revenue-earning enterprises are not financially responsible either directly or through taxation for the longer-term negative social impacts they create.

BANK PERFORMANCE

2.123 Overall Bank performance on Phase I and Phase II is rated as highly satisfactory. Quality at entry: project design and appraisal were very thorough and of a high standard. Hence quality at entry is rated as high. Quality of supervision: the project benefited from frequent and regular supervision, and long continuity of Bank staff working on the project, particularly through preparation/appraisal and Phase I. The posting to the Bank's Beijing office of the project team leader during crucial years of implementation was also valuable in providing closer and easier contact with the project. Supervision quality is therefore rated as high.

2.124 In addition to direct project supervision, the Bank also provided the government with significant analytical and advisory services in the water sector. For example, the Bank carried out a comprehensive and wide-ranging study of water sector issues in North China in 2001-02. While it appears to have been influential in shifting the government's thinking at the highest levels, translating it into action seems to be proceeding rather slowly, given the urgency to address problems for which there are no quick fixes.

BORROWER PERFORMANCE

2.125 Borrower performance is highly satisfactory for the Phase I that focused on construction management, financing and application of safeguards. Phase II performance is rated as satisfactory based on the relative contributions of the project and governmental entities involved in the project – greater weight being given to slow progress on institutional reform and water pricing.

2.126 The main implementing agency successfully implemented a large and complex project with many engineering and management challenges. In addition, the project was completed under budget and ahead of schedule. Since completion the Corporation and the Commission have also demonstrated their capabilities to manage the Xiaolangdi project facilities to high standards. For these reasons implementing agency performance is rated as highly satisfactory.

2.127 Government Performance under the project is rated as satisfactory, albeit with some reservations. Despite the evident in-house expertise in the Commission and the

dissemination by them of advice and recommendations on addressing the tradeoffs in the use of Yellow River water and water pricing reform, it would seem that political will is lacking, particularly at the provincial level, to face up to the hard choices. Similarly for many of the same reasons electricity tariffs have been maintained at a low level. In addition, at the national level, it is unclear yet whether there is any appetite to face up to the difficult issue of intra-provincial water allocation quotas which have remained fixed since 1988. The problems are well understood and the solutions are clear.

SUMMARY OF ISSUES RAISED BY THE XIAOLANGDI PROJECT

2.128 The Xiaolangdi experience raised five issues:

- The importance of well designed M&E systems that clearly define the counterfactual and the means to monitor agricultural and socio-economic impacts in addition to the physical impacts.
- The correct pricing of water in its various uses in order not to distort its allocation
- The unwillingness of provincial governments to levy increased water and power tariffs according to national policies and approved by the central government
- The central government's unwillingness to recover capital investment from water and hydropower utilities that could be commercially viable
- The unwillingness on the Yellow River Conservancy Commission to use economic criteria for water allocation, raise water tariffs for agriculture and pay the Hydropower Corporation for the water it utilizes downstream.

TARIM BASIN II PROJECT

OBJECTIVES

2.129 The Tarim Basin II Project (Tarim II) aimed to build on and expand the achievements of the first Tarim Irrigation Project (Tarim I) that was completed in 1997. The Tarim I project marked a new direction in water management for the Bank in China in that it targeted the majority indigenous peasant populations and the irrigation systems which sustain the oasis in which they live. Its primary objective was to introduce some advanced technologies to detect and correct for alkalization in arid zone irrigation, improve soil and water management to prevent desert expansion, and control and mitigate hail damage to economically vital fruit and vegetables crops. At completion in 1997 the outcome of Tarim I was rated as Highly Satisfactory in the Implementation Completion Report (ICR). Subsequently IEG rated outcome as Satisfactory after a desk assessment in 2000.[70]

2.130 **Objectives of Tarim II.** Its three objectives were to increase incomes of poor farmers through irrigated agriculture development; establish systems to ensure sustainable use, development and management of water resources and land in the Tarim Basin; and

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70. IEG. Performance Audit Report. CHINA: Northern Irrigation Project, Shaanxi Agricultural Development Project and the Tarim Basin Project. Report No. 20683. June 29, 2000.

partially restore and preserve the natural riverine forests along the lower reaches of the Tarim River.

2.131 Tarim II effectively replicated the objectives of Tarim I in five new sub-basins thus extending modern water and agricultural management techniques to the whole basin.[71] In addition Tarim II objectives put far greater emphasis on institutional development. This included support to the Tarim Basin Water Resources Commission established in 1997, prefecture water resources bureaus, self-financing irrigation and drainage districts (SIDDs) and water user associations. In Tarim I less than one percent of project investment was devoted to institutions for integrated river basin management; in Tarim II this increased to 14 percent.

2.132 The project's three objectives were to increase incomes of poor farmers through irrigated agriculture development; establish systems to ensure sustainable use, development and management of water resources and land in the Tarim Basin; and partially restore and preserve the natural riverine forests along the lower reaches of the Tarim River.[72] These objectives were to be achieved through 16 components covering physical works and engineering, land development, voluntary resettlement, agricultural support services and institutional development. Table 9 summarizes objectives, components and costs.

2.133 The first objective – to increase incomes of poor farmers through irrigated agriculture development – would be the outcome of success in meeting the other two objectives derived from the synergy generated by the project components. For example, increased fresh water in the Tarim River would not only regenerate riverine forests but also forest products and grazing. The third objective – the restoration and preservation of the natural riverine forests in the lower reaches of the Tarim River – would be the result of reduced water use in the basin. This would be the outcome of more efficient agricultural water use and better water resources management brought about by improved institutions, planning and technology.

DESIGN

2.134 While the objective to increase farmers' incomes could be fairly easily achieved through a traditional combination of engineering upgrades to irrigation infrastructure, better operation and improved agricultural support services and market access, the other two objectives were far more challenging. Not only was the project to increase irrigated area by about 75,000 ha it also had to save sufficient water to rejuvenate the lower reaches of the Tarim River.

2.135 Ensuring sustainable use of land and water resources was addressed through building water planning knowledge bases and institutions for its improved management

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71. Tarim I covered three sub-basins: the Yerqiang Basin in Kashgar Prefecture, the Weigan Basin in Akesu Prefecture and the Tarim Basin, which falls in the Akesu and Bayingoleng Prefectures. Tarim II covered five sub-basins: the Hotan Basin in Hotan Prefecture, the Kashgar Basin in Kizilsu Prefecture, the Aksu Basin in Aksu Prefecture, and the Kaidu-Konque basin and the Tarim River mainstream in the Bayingol Prefecture.
72. These are the objectives stated in the Development Credit Agreement and, with very minor changes in wording, those in the SAR.

under the environmental protection and management component. First the hydrologic system – the dynamic relationships between annual river and groundwater inflows and usage, agricultural practices, water storage, system losses and the relationship to waterlogging, soil salinization and water quality variations – was investigated and understood. Second, this knowledge was incorporated into a fully calibrated mathematical model that identified the most critical system improvements needed to conserve water and augment the lower reaches of the Tarim River. Third, the appraisal team recognized that prefecture administrations needed an incentive to buy into water conservation, particularly as most prefectures wanted an increase in the area irrigated and more predictable irrigation supplies. To this purpose a Tarim Basin Water Resources Protection Fund was established to promote investments in sub-basin water resources management that would be implemented by prefectures.

2.136 The major institutional component – improvement of the current water allocation and licensing system and cost recovery –was to ensure that water saved could be reallocated elsewhere. At the apex level this involved building the planning, management and regulatory capacity of the Tarim Basin River Basin Commission (Commission) and the Tarim Management Bureau (Bureau). High-level study tours for senior Commission staff to river basin institutions in Australia and related technical assistance aimed at capacity-building were financed by AusAid. At prefecture and lower levels capacity-building was addressed through creation of Water Supply Corporations and pilot water user association (WUAs), attention to management of service delivery and better O&M.

2.137 Project design made explicit the relationship between improved service delivery, water conservation and mechanisms for water fee setting and collection through pilots in each prefecture. And these efforts were aided by extensive training and technical assistance and support in water resources management, irrigation and water conservancy, and agronomy. It was expected that all these efforts would produce a Tarim Basin Master Plan and a workable TBRBC with the participation and acceptance the prefectures by 2001

2.138 The project was not subject to a Quality Assurance Review by the Bank's Quality Assurance Group.

Table 9: Tarim II – Objectives, Components and Costs

Objectives	Components	Project Costs (US$ Million) Planned	Actual
1. Increase incomes of poor farmers through irrigated agriculture development	Project components listed below were to benefit existing farmers in the project area and in addition this included a program for the voluntary emigration and resettlement of about 10,000 people within the project area.	Included in sums below	Included in sums below
2. Establish systems to ensure sustainable use, development and management of water resources and land *and* *3. Partially restore and preserve the natural riverine forests along the lower reaches of the Tarim River*	***Institutional***		
	Strengthen the capabilities of the Tarim Basin Water Resources Commission and Regional Management institutions in planning and overall management of water and related natural resources including MIS and M&E.	12.3	6.5
	Institutional Development and Support to Improve prefecture and county level water resources management to ensure sustainability and self-financing of irrigated agriculture, improve irrigation system performance and effective decentralized irrigation services, cost recovery and farmer participation. This component also included applied research and development and a number of special studies.	15.2	17.5
	Strengthen agricultural support services to support agricultural development of reclaimed land improved yields on low-yield upgraded land.	16.8	21.1
	Improve Environmental Protection and Monitoring through development of a basin-wide water and salt balance model to test alternative management options for surface and groundwater.	17.7	16.9
	Physical		
	Water Conservancy investments to include river diversion head works, trunk and main canals, reservoirs, well fields, pumping stations and 2 hydropower stations and related distribution networks.	120.3	116.8
	Land Reclamation covering 75,400 hectares of non-irrigated wasteland located within or next to existing oases.	60.7	35.8
	Land Improvement covering 105,400 hectares of low-yield land through the construction of canals, drains, bridges, culverts, gates and farm roads, land leveling and planting of trees.	29.1	64.0
	River Engineering along the Tarim River to improve water management and delivery of water to the lower reaches of this river and replenish Lake.	7.4	9.2
	Total Cost	***272.6***	***287.8***

IMPLEMENTATION

2.139 The project was coordinated by a multidisciplinary Leading Group under the leadership of the Region's First Vice Chairman and the Vice Chairman responsible for agriculture and water resources. Similar groups were operational in each of the 5

prefectures and 22 counties comprising the project. The MWR's Water Resources Bureau was responsible for project design, implementation, procurement, river basin water management, and development of self-financing irrigation and drainage districts. The Tarim Management Bureau under the Commission was responsible for regional water resources planning and management and civil works on the Tarim River. The Regional Planning Commission was responsible for reviewing of the project work plans, project monitoring and supervision, and coordination, mobilization and allocation of counterpart funding. The Regional Project Management Office (PMO) and PMOs in each prefecture were responsible for overseeing project design and implementation. Within the PMOs the Finance Bureau was responsible for overall project management and financial management.

2.140 At the outset there were some serious problems and misunderstandings between the regional and prefecture PMOs about the objectives of the project, and poor coordination and cooperation. Misunderstanding stemmed from the common view that the project was to reduce water use in the upstream areas and transfer the saving to downstream. Thus many prefecture chiefs, particularly those in upstream areas, felt that the basin-level management gave insufficient weight to their opinions and the interests. More focused outreach and publicity efforts by the TMB started a year into the project and by 2001 a common vision of water conservation gained credibility among basin stakeholders at all levels.

2.141 Inadequate staffing, poor coordination and cooperation at senior levels plagued the first half of project and held up attempts to apply unified management and regulation to the basin. The incomplete complement of senior staff, allied with insufficient and uneven funding for management activities, contributed to a lack good communication among the TMB, the Regional Water Bureau and the Regional PMO on integrated water and land resources management. It was only in mid-2001 when the Regional Government's leaders – and the regional Finance Bureau (the local arm of the Ministry of Finance) – took a greater interest in the project that a full-time Standing Vice-Director was appointed to manage the project. This with other senior appointments, and transfer of highly motivated staff to key positions, greatly accelerated progress and the investment completion rate increased from 42 percent to 90 percent over the period 2002-03.

2.142 Despite managerial improvements counterpart funding was problematic, slowing implementation until mid-2002. Counterpart fund allocation, timing and amounts were not well harmonized with the project's requirements, particularly at county and prefecture levels. The multiplicity of funding sources - seven regional/local and one central agency[73] - exacerbated the issue and annual shortfalls. Central funding was not immune to shortfalls either - in 2000, for example, there was no financial support from MWR for the Regional Water Bureau whose activities ground to a halt as a result. The Bank-proposed "Water Resources Protection Fund" was in breach of central government rules and policies and this hindered financial support for Commission. In general the shortage of counterpart funding

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73. For example, in 1999 counterpart funds of Y272 million (US$34 million) were due from: Counties Y118 million (43%); Prefectures Y42 million (15%); Comprehensive Agricultural Development Fund Y34 million (13%); Regional Cotton Fund Y30 million (11%); Relief/Labor fund Y20 million (7%); Water Resources Bureau Y12.3 million (4.5%); and Regional Finance Y5.2 million (2%) and local farmers.

was a serious problem for progress on the capacity-building and institutional aspects of the project until 2002 – irrigation and drainage engineering was less badly affected as it was driven by local demand. Accordingly farmers' labor contribution was generally more than planned. Local funding ceased to be a problem after 2002 when the independent and centrally-funded Y10.6 billion (US$1.3 billion) Tarim Basin Water Resources Rehabilitation Program topped-up local contributions.

2.143 Procurement, despite being given detailed by the Bank attention during appraisal, exacerbated the counterpart funding problem causing delays in project works, technical assistance, Self-financing Irrigation Districts (SIDD) pilots and research and implementation of Management Information Systems (MIS). Major problems were unfamiliarity with internationally accepted norms, insufficient staff and financial support at provincial and county levels, poor coordination in the regional PMO, and failure to follow Bank norms and procedures for procurement. While proactive supervision and additional training provided corrective action in many cases this was not always sufficient. An ex-post field review of contracts in 2004, for example, found that almost 60 percent of contracts examined had procurement issues, the most common being inadequate attention to advertising bid packages, inconsistent bidding documents and prequalification. Even so, none were sufficient to invalidate disbursement.

2.144 Given the various delays the project closing was extended by one year after mid-term review (MTR, June 2002) and some of the project components were adjusted. Objectives remained unchanged. The main changes introduced at MTR following pressure form the Bank were a 55 percent reduction in land reclamation to about 41,000 ha driven and an increase in low-yield land improvement by 22 percent or 23,200 ha. These changes curtailed irrigation expansion and enabled water to be used more efficiently in line with basin development objectives.

Monitoring and Evaluation

2.145 **Design.** The project gave great importance to Monitoring and Evaluation (M&E) and the establishment of baselines, but provided only modest guidelines for reporting inputs, outputs, outcomes and impacts. The Planning Divisions of each level of PMO managed the M&E process focusing on inputs/outputs and environmental indicators. Each year there was independent M&E of key socio-economic performance indicators. Half the project counties (11) were covered by the Regional Agricultural Department's Rural Economic Stations, the balance by Xinjiang's Agricultural University School of Economics and Management. The impact of the project was captured by M&E of 1,100 households that includes about 6,000 people.[74] A survey selected 50 households from 3 townships and 3 villages stratified according to average income (high, medium, low) in each of the 22 counties. In addition, sample selection included one non-project town/village for each two within the project area. While the selected households are described as "random" this is not

74. The survey included 6,491 people in 1998 and by 2003 this had declined to 5,962. Thus the sample ratio was slightly over 1:1,000.

the case. The Chinese design team told IEG that at the village level the households were purposely selected by the local heads of administration.[75]

2.146 **Implementation.** The baseline was satisfactorily established in November-December 1998. Although annual longitudinal surveys had been planned this was only achieved for macroeconomic indicators gathered by state statistical agencies and the household surveys contacted to independent non-project agencies. Project agencies (with some exceptions) only started to take M&E responsibilities seriously with the 2002 change in management and local funding (paras 2.141). Procurement of essential MIS equipment was only completed in 2001 and installation at prefecture level in 2002. Thus comprehensive monitoring data for all indicators are only available for 2003 and 2004 – even then the M&E budget was reduced by a third in the last two years of the project.[76]

2.147 At the completion of the project funding for M&E ceased. While detailed monitoring of inputs and outputs is continued routinely at all levels, the cessation of the Tarim II M&E led to a lack of focus on evaluating date collected and loss of the independent assessment of outcomes and impacts. This is a major failing as the project benefit stream was still growing (e.g. orchards and the cumulative effects of better water management.) Given the modest cost of the exercise - US$37,000 a year for Xinjiang University's survey of 11 counties – and the US$1.3 billion allocated to the follow-on Tarim Basin Water Resources Program – this demonstrates little official concern for demonstrating, rather than asserting, impacts.

2.148 **Utilization.** Until 2002 many of the required performance management indicators were inadequately monitored. This adversely affected planning for implementation of water and environmental conservation measures and O&M, particularly at provincial level, and was heavily criticized during the Bank's first six supervision missions. Subsequently, attention to M&E improved and this enabled improvements to project design and implementation after mid-term review.

2.149 Monitored data were extensively reported by the project and provide a wealth of indicators and other information from which to infer project outcome and impact.[77] There were a number of shortcomings. First, a comprehensive evaluation of all the data was hindered by differing data protocols: Xinjaing University maintained a computerized data base; the Rural Economic Stations kept only manual records. Second, although there were without project controls, the quality of these was eroded by the expansion of the project area and spillover effects. Thus by the end of the project instead of one control for two project samples, there was only one control for 4.7 project sample town/villages.[78]

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75. The administrative heads selected specific households by income group following the guide 30% high, 40% medium, and 30% low income. The initial survey instrument contained 43 questions put by the Bank and the final questionnaire grew to 60 questions after local consultation and field testing.
76. Y300,000 a year was the amount allocated to Xinjian University for 11 counties; in 2003-04 this was reduced to Y200,000.
77. Monitoring and Evaluation Report of Years 2003-2004. Xinjiang Agricultural University School of Economics and Management. March 2005. 77 pp.
78. The ICR notes that it used data only from Aksu prefecture to determine project impact on farmers' incomes (ICR, page 23.)

Although IEG interviews of Xinjian University staff confirmed the existence of basin-wide none-project controls none of these data are presented in the official evaluation reports or were made available to IEG. Thus project impact was determined from a single difference "before and after" approach including all the sample households. This may give a slight downward bias to estimated project impact as it includes an unspecified number of "non-project" households. IEG was also informed that there was no formal attempt to triangulate household findings with other independent surveys.[79]

2.150 Overall rating of M&E is modest.

Safeguard Compliance

2.151 Five safeguard policies were invoked by this project.

2.152 Environmental assessment (OD 4.01) at appraisal categorized this project as "B." However, because the project included the new large dam at Xinir in a seismically active area and 75,350 ha of new irrigation on reclaimed land it should have been classified as a category "A" project.[80] The region justified its 'B" categorization on the basis that: the dam would provide water from ecological purposes; there was no involuntary resettlement; land restoration would reverse negative environmental impacts from earlier poor water management; that China's own environmental screening and mitigation plans were a satisfactory substitute for the Bank's policy; and that this was normal practice for Bank projects in China. The debate about the correct environmental classification of agricultural and water projects in China is not new as shown by the Inspection Panel findings on the Western China Project.[81] IEG's review of the Bank's water policy pointed out that the dilemma of safeguard policies is that unless they are mainstreamed by borrowers, they primarily serve to protect the Bank from risk and criticism.[82] As the mitigation of environmental impacts of this dam was screened by NEPA and Chinese experts, as well as an independent dam safety panel (OP 4.07) approved by the Bank, and there have been no reported problems, IEG rates the Bank as satisfactory on application of its environmental safeguards – this is reinforced by the due diligence to verify impacts.[83]

2.153 **Indigenous Peoples** (OD 4.20). While the project also significantly affected indigenous people who are the majority in the area, they are greatest beneficiaries and fully participated in all project activities. Within Aksu prefecture poverty and miniscule land holdings (1.3 mu or 0.9 ha per capita) lacking dependable water supplies induced almost 13,000 Uygur farmers to opt for voluntary relocation from the poorest areas of Keping county to the Laiqilang irrigation subproject. After screening to target viable immigrants, 10,000 farmers were each offered 4 mu of irrigated reclaimed land. IEG were informed that

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79. For example, the Agricultural Statistics Bureau's Rural Inventory Team results showed "higher net incomes than the project surveys but they followed the same trend."
80. The Xinir dam was 18 m high and 12.2 km long. The reservoir covered 16.8 km^2.
81. The Inspection Panel. 2000. The Qinghai Project - A Component of the China: Western Poverty Reduction Project (Credit No. 3255-CHA and Loan No. 4501-CHA). Report No. 20739. April 28, 2000.
82. IEG.2002. Bridging Troubled Waters – Assessing the World Bank Water Resources Strategy, p 22-23.
83. See project supervision reports and the ICR Annex 9, page 35.

while volunteers had been given a 3-year transition to establish themselves, most have retained their original holdings and had not yet moved their families to the area.

2.154 **Involuntary Resettlement** (OP 4.30). No involuntary resettlement was foreseen at appraisal. However, the PAD cautioned that it could occur as alignment of canals and drains was finalized - as insurance the Bank and the Regional Government agreed a Resettlement Policy Framework that fully complied with OD 4.30.

2.155 In June 2000 the Bank's supervision team found about 30 percent of sites inspected involved land acquisition of which one include involuntary resettlement. The Laodahe canal involved relocation in March 2000 of a primary school and 4 farmsteads, acquisition of 1,388 mu (92.5 ha) of land, and related assets of 273 farmers.[84] The supervision team found that compensation rates were generally lower and not in compliance with the resettlement policy framework.

2.156 A second resettlement mission met with those responsible in February 2001, mitigation was agreed and the June 2001 supervision mission reported full compliance. The average income of all 273 project-affected people was improved substantially as a result of the project. IEG visited 21 Brigade, Ayikule Town of Aksu, and met with those resettled who confirmed they had been fully compensated. The increased focus of resettlement predated the construction of the Xinir dam and ensured the region's attention to agreed compensation policies. [85]

2.157 **International waterways (OP7.50).** The headwaters of the tributaries of the Tarim River rise in the Kyrgyz Republic and Tajikistan. As there was no adverse effect on the quantity or quality of water flows to other riparians the Bank's regional vice president approved an exception in August, 1997.

2.158 **Integrated Pest Management (OP 4.09).** The value of crop losses to pests in the project area averaged US$86 million a year and control was primarily through application of chemicals pesticides. Elsewhere in China poor pest management on cotton had significantly reduced yields of this nationally important crop. Thus IPM was justified for economic and environmental reasons. The project, supported by AusAid technical assistance, successfully carried out training of trainers to build the capacity of the Regional Plant Protection Department and prefectures. The initial proposal to train farmers directly and empower them to make decisions about timing and application of IPM proved to be unworkable – too many farmers to train, official reluctance to delegate IPM decisions to

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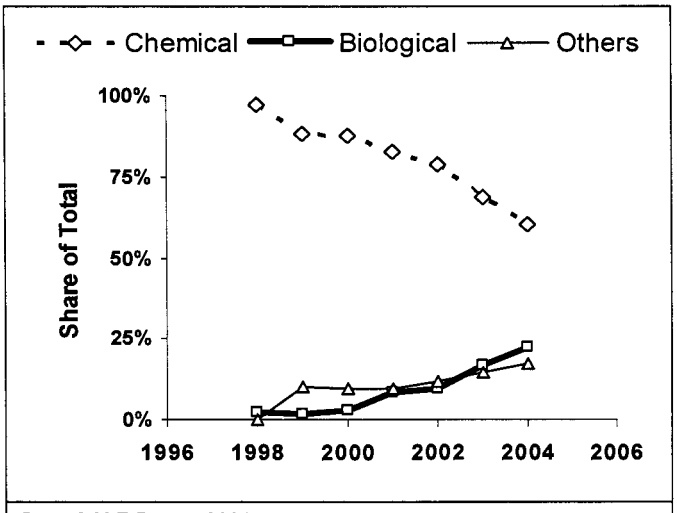
84. The Bank's Resettlement Thematic Supervision Mission (June 8-15, 2000) inspected 23 locations within16 water projects in 4 prefectures- Kizilsu, Kashgar, Bayingol and Aksu. Most involved less than one ha and were on state land. The mission report noted: the Regional Agricultural Division was aware of possible land acquisition in the field, but no reports....The Yes of No involuntary resettlement is checked by the Regional PMO from the 5 prefecture PMOs through telephones. There is no efficient and accurate reporting system to check whether there is any land expropriated or house demolished for construction of the civil works in the project area." Supervision Report. June 26, 2000.

85. The ICR reports (page 34) that average income per capita was Y 995 per year; by 2003 this had increased almost three-fold to Y 2,584 per year. People interviewed by IEG at 21 Brigade Village indicated that their incomes had "risen a lot because of the project " but this could not be verified.

farmers and the low priority for training when budgets were constrained.[86] At project closure 84 percent of farmers relied on unified management and instruction from Township Chiefs and extension technicians. Farmers provided free labor for IPM as almost two-thirds is applied manually.[87]

2.159 The impact of IPM on reducing overall pesticide application and the use of chemical pesticides is substantial (Figure 3). Total pesticide use declined by an average of 90 tons/year over the period 1998-04. Although the M&E data show a clear inverse relationship between pesticide application and economic losses, the economically optimal level of applications was not determined.[88] Pest infestations of cotton affected 3.7 percent of the area in 1998 and 4.1 percent in 2003 and less than 1 percent of corn in both years. Although the area affected by pests remains fairly constant the average value of economic damage approximately doubled between 1998 and 2003 suggesting that more pest management is required.

Figure 3: IPM was successful in reducing dependence on chemical control



Data: M&E Report 2004

Relevance

2.160 The objectives of the Tarim II Project were clearly highly relevant to the Bank's land and water strategies and CASs in terms of water conservation and environmental goals and poverty alleviation. The choice of a river basin whose institutions for management are unified within one province provided simplified conditions that enabled piloting of new approaches to management that were unfettered by inter-provincial differences in views, ownership or environmental conditions.

Efficacy

Objective 1. Irrigated agriculture development increased incomes for poor farmers.

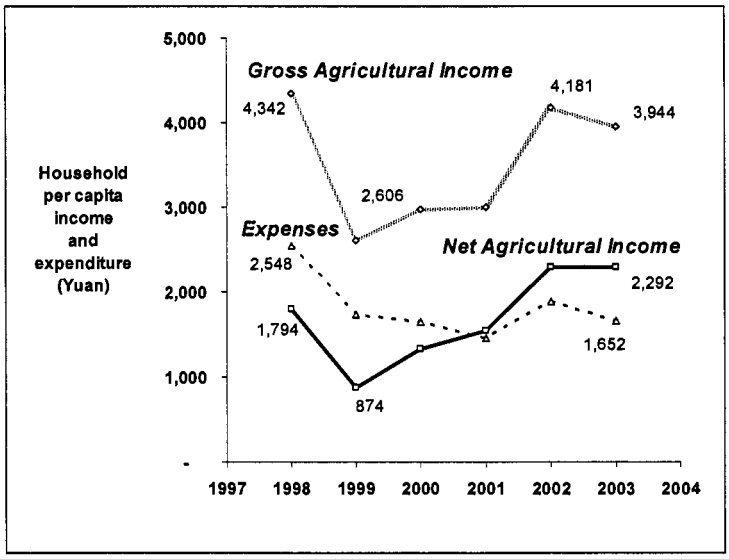
2.161 **Incomes.** Agriculture provides 87 percent of all income in the household longitudinal surveys conducted by the project's M&E team. While gross incomes from

86. Mangram, James. 1999. Memorandum on the evaluation of IPM, revised training plans and reform needs. August 28, 1999.
87. Farmers are expected to provide up to 50 days free labor for Township-directed work programs. Spraying pesticides from aircraft accounted for 14 percent of applications; large machinery 24 percent.
88. Linear regression shows: Economic loss (000 Yuan) = -0.4982 (Pesticide total in tons) + 1122.5; R^2 = 0.529.

agriculture declined by about 9 percent between 1998 and 2003, net incomes rose by 28 percent because of reduced production costs (Figure 4). At first sight this would appear to indicate that the impact of increased irrigation on production was marginal. If fact, the productivity response was substantial (see para 2.162) and the decline in total incomes was a result of major price declines in cotton and grains that accounted for 90 percent of sown area in 1998.[89] Much of the decline in farm-gate prices was the result of the East Asian financial crisis of the late 1990s and the adjustments to WTO accession.[90]

2.162 Partly offsetting the price sensitivity of strategic crops to international markets and stocks, the project facilitated the diversification of agriculture into higher-value crops thus reducing risks to farmers' incomes from exogenous factors (Table 10.). Agricultural income also benefited from increased forestry and growth of livestock that almost doubled in value 1998-2003. At project completion it accounted for 20 percent of gross income. Economic forestry doubled in area to 127,700 ha and increased supplies of feed (alfalfa), allied with improved grassland management, allowed livestock offtake to grow from 298,000 to 720,000 head.

Figure 4 : Farmers' net household incomes from agriculture increased



Source: M&E Report, op cit.

89. With one fourth of global output, one fourth of cotton stocks, and approximately 30% of world consumption, China plays a major role in cotton, affecting the movements in prices. From 1994 to 1998 Chinese cotton farmers produced 102.9 million bales of cotton while Chinese mills consumed 97.1 million bales, adding to their domestic cotton stock. During that same period the Chinese government, through various agencies that control cotton reserves, imported 12.5 million bales of cotton increasing their annual carryover stocks from 10.8 million in 1994 to 26 million bales in 1998, and China held 52% of the world's cotton stocks. This extraordinary turn of events created some of the strongest cotton prices seen in 30 years. Then, as the Asian financial crisis plunged virtually all internationally traded commodity prices to 40-year lows, the Chinese government began to dump cotton from their stocks and pushed world cotton prices even lower. **Source:** *National Cotton Council of America. February 11, 2005*

90. Chinese cotton export price fell from its historic peak of $8,912/ton in 1996 to a low of $1,009/ton in 1999, recovering to $5,122 in 2001 and again sliding to $591 in 2002. Maize export prices fell from $158 ton by almost 25 percent over the period 1998-2000 and remained fairly stable around $120/ton until 2004 when prices doubled. Wheat export prices increased steadily 1996-2000 to $$943/ton but dropped steeply reaching a low of $282/ton in 2003- but rising to $476/ton in 2004. ***Source***: faostat.fao.org. 30 April 2007.

Productivity Increased

2.163 Overall cotton yields were raised by almost two-thirds by 2001 but fell substantially thereafter possibly in response to reduced prices and cutback of inputs. Conversely wheat yields steadily increased by 31 percent over the period 1998-2002. Generally, existing farmland produced higher yields than either the improved low-yield fields or reclaimed marginal areas (Figure 5).

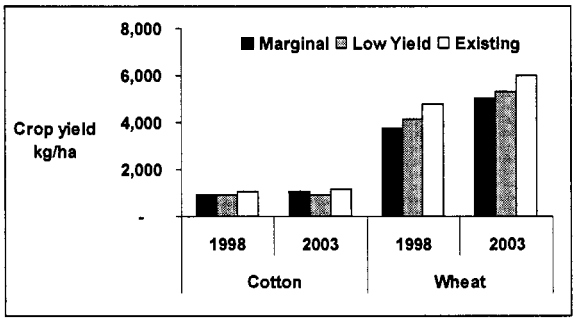
Table 10: Crop diversification occurred – are cultivated (000 ha)

	1998	2003	Change
Gross Cultivated	654.6	704.9	+8%
Grain	354.4	326.2	-8%
Cotton	234.1	196.3	-16%
Fruit trees	47.5	120.4	+153%
Vegetables	17.0	33.5	+97%
Melon/watermelon	5.6	20.1	+259%
Alfalfa	12.7	56.6	+346%

Source: ICR

2.164 **Production Costs.** The overall reduction in agricultural production costs is largely the reason for increased net incomes from agriculture over baseline values. The cost of growing cotton fell by 16 percent per ha driven by a 35 percent reduction in labor costs. Conversely, while labor costs for wheat and corn increased by almost a tenth per ha, material input costs declined by 20 percent primarily because of reduced costs of chemical fertilizers and manure and plastic film. There is insufficient agronomic and soil monitoring data to determine if the reduced fertilizer inputs are a reflection of better management and higher application efficiency, better crop rotations or the mining of soil fertility.[91] Other evidence suggests that agricultural extension was effective as 97 percent of farmers in 2003 responded that the service was either "very helpful" or "rather helpful."

Figure 5: Yields of major crops improved 1998-2004



Source: M&E Report op. cit

2.165 Increased production at lower cost greatly improved the input-output ratio. Thus the overall cotton output rose 48 percent to 18.6 kg/100yuan and wheat output rose by 41 percent to 119 kg/100yuan. Exceptionally, the output ratio of cotton on existing land fell by almost a tenth. Within the project area this caused a contraction of cotton planted area by 16 percent. But outputs for

Table 11: Changes in Net Household Incomes, Yuan

Sample year	Low	Medium	High
1998	4,500	14,000	23,000
2003	9,000	14,000	34,000
Incremental	4,500	0	11,000

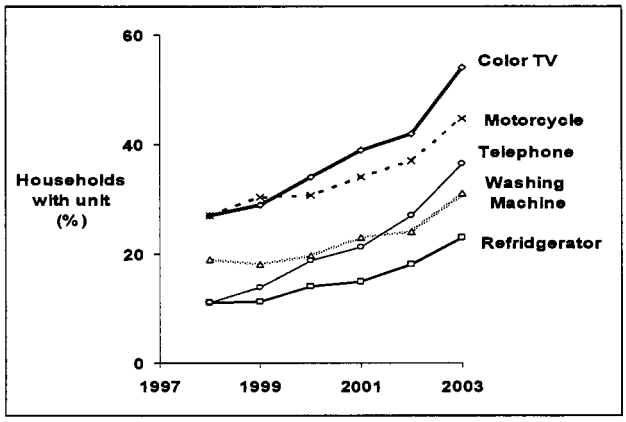
91. The Tarim II project included a large set of activities focused on improving agricultural support services. These included extension that improved and reduced chemical use. At the mid-term review the project included 50 yuan per mu for all land reclamation and low-yield land improvement areas for the incorporation of green manure (nitrogen fixing legumes) which greatly improved soils and fertility, increased yields and reduced needs for chemicals.

cotton on formerly low-yield land rose by 143 percent and on reclaimed marginal land by 90 percent demonstrating the efficacy of drainage improvements and new irrigation.

2.166 **Net income.** This increased for the high income and low income farmers but remained fairly constant for the medium income group according to the ICR (Table 11). The reasons for this are unclear and the M&E data made available to IEG provide no answer. Despite these improvements there still appears to be insufficient income for schooling for some of the poorest – over a fifth of surveyed households have children who have not attended school, and 80 percent of these households gave "lack of money" as the reason.[92] Even so, there is no evidence that living expenditures are being boosted by the sale of household assets. Quite to the contrary, asset accumulation has occurred.

2.167 First reduction in state taxes and items handed over to the state collective increased farmer's incentives to become more productive. Overall taxation was cut by more than half and it accounted for only 9 percent of net income in 2003.[93] Household expenditure on durable goods increased in all areas (Figure 6.) although Hetian prefecture, the poorest, showed only modest gains. Average household area was expanded by over 30 percent and there was a shift towards more durable quality construction – almost a tenth of homes replaced earth walls with either wood or brick or concrete.

Figure 6: Ownership of durable goods rose



Source: M&E Report op. cit.

2.168 In summary, the objective to increase farmers' incomes was fully achieved. How far this is attributable to the project is unclear due to the lack of without-project controls.

Objective 2: Systems to ensure sustainable use, development and management of water resources and land were established.

2.169 This objective was substantially achieved with few shortcomings. Major components included establishment of effective institutions to allocate and regulate water use to increase land productivity, development of a knowledge base to inform decision-making and infrastructure to enable efficient management of water.

Effective River Basin Management Institutions were Established

2.170 The Tarim Basin Water Resources Commission is China's only river basin organization wholly within one province that functions as a decision-making body which includes all the key administrative or management interests of the basin. Established only

92. M&E Report of Year 2003-2004, page 62.
93. M&E Report of year 2003-2004. Table 2-38.

six months before the project was approved, the Commission was guided by the "Regulations on the Management of the Water Resources of the Tarim Basin" approved by the Regional Peoples' Congress. The primary purpose was to ensure that water resources development and management would be under a system of unified administration and management, according to five principles:

- rational development, utilization, protection and management of the water resources of the Tarim Basin,
- exercise control over water disasters,
- fully derive the comprehensive social, economic and ecological/environmental benefits of water resources,
- ensure the sustainable development of the national economy in the basin, and
- improve the livelihood of the people and the environment" in the basin.

2.171 The Commission is composed of two parts: the Board of Commissioners (called a "Standing Committee" in PRC comprising 14 members that meet twice a year); and the Tarim Basin Management Bureau. The Regulations combined the two entities into one organizational framework, gave them enhanced responsibilities and accountability, and provided mechanisms to secure adequate funding. A small Executive Committee was appointed by the Board to act on its behalf between sessions.[94] Prior to the formation of the Commission the Management Bureau oversaw all activities and attempted to reconcile the differences among the prefectures in order to promote regulations for water licensing and use according the China Water Law. However, being confined to the mainstream of the Tarim River they lacked the authority and status to bring the prefectures together, and were independent of the Standing Committee. Similarly the Committee was unable to address the inter-jurisdictional issues adequately partly due to their structure and partly due to their composition. Thus, at the beginning of the project the institutional framework for water planning and management was weak and ineffective and integrated water resources management was absent.

2.172 Most of these weaknesses were resolved by effective Bank supervision that helped clarify the details and rationale of the reorganization and facilitated agreement among stakeholders in the first two years of the project. A five-year development plan for the basin was approved by the Standing Committee in August 1998. More importantly, in 1999 the Board agreed to give greater representation to the prefectures. With a 14 member board, the five prefectures felt they had little chance to represent their interests during the two annual meeting of the Standing Committee. And during the interim, the Executive Committee (that had no representation from the prefectures) could take action on matters delegated to it by the Standing Committee, which may not be in the interest of the prefectures. A rule change was agreed that would require concurrence of at least three of the five prefectures concurrence in the Standing Committee voting, and that one or more prefecture representatives would be members at large to the Executive Committee.

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94. The Executive Committee had the Vice-Chairman of the Regional government responsible for agriculture and water resources as its Director, and four Vice-Directors comprising the Secretary General of the Regional Government and the Directors of the Planning, Finance and Water Conservancy Department of the Regional Water Resources Bureau.

2.173 Despite these rearrangements of the Commission it still proved to be very difficult to reach agreement on allocation and regulation of water use in the basin – even though the first quotas had been introduced in 1988 under the Regional Water Resources Department.[95] The primary reason given to IEG was that the goal of the Commission was to rejuvenate the flow of the lower Tarim River was at odds with increased use of water that was needed to meet the goals of the 10th Five-Year Plan. Specifically key goals of prefectures (*inter alia,* to double farmers' incomes and the prefectural contribution to regional GDP) would be jeopardized with reduced water availability. Although there was a two-thirds majority initially in support of water quotas in 1999 this broke down and eventually (2002) the Commission worked with the regional government to impose quotas to bring closure to the debate.

2.174 These quotas are imposed on the prefectures and fines are levied if the quotas are exceeded.[96] Traditionally most prefectures have taken more then their quota while at the same time continuing to extend irrigation infrastructure.[97] Fortunately, an effective dispute resolution system forms part of the Commission and this was satisfactorily resolved. Thus while most prefectures agree to reduced water quotas, the date for reaching target values have recently been delayed from 5 to 15 years. Indications are that average usage in excess of quotas is about 20 percent and that most prefectures have agreed to reduce consumption by about 10 percent per year.[98]

2.175 **Local institutions for water management significantly improved – but not as planned.** Prefecture Water Resource Bureaus effectively manage water allocation to next level down, the counties, using the nationally-approved water withdrawal permit system. At this level six Water Supply Corporations (WSCs) were supposed to receive the bulk water supply and retail it via contracts to newly-created and self-managed Water User Association that, in turn, allocates it to the farmers. In practice it was found that the WSCs duplicated many of the functions of the exiting prefecture and county water bureaus and only one in Aksu prefecture (serving 19 WUAs) was still active at project completion. Also it was found that WSCs became an extension of the township water bureaus and adopted a paternalistic approach to management that precluded WUAs taking full responsibility for their own affairs.

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95. The quotas were developed by the Regional Water Resource Bureau ("top down") on the basis of regional water balances, actual and proposed infrastructure and cropping system, and other water demands. Subsequently this was supplemented and adjustments made on the basis of detailed water balances conducted through the project at country level ("bottom up"). Both could be conducted independently but as the knowledge base is built there will be a convergence towards a commonly agreed quota value. Thus a county could aim to save water through engineering and management improvements and put part of this saving towards reducing its use to meet the Bureaus quota and part towards serving new irrigation or other water demands such as industry.

96. In 2003 Aksu Prefecture was fined 10,000 RMB for exceeding its quota because subdivisions 1 and 2 exceeded their sub-quota. They, in turn, were fined 6,000 RMB.

97. In 2001, for example, the Kizilsu prefecture argued that although its historical usage was 0.107 billion m^3, new irrigation construction over 130,000 mu (8,700 ha) would push their requirement to 0.196 billion m^3. The quota proposed by the Bureau was 0.135 billion m^3.

98. This information from IEG interviews with Bureau officials in Urumqi partially contradicts the mostly "full compliance" noted by the 11th Supervision Mission (para 11) in 2003.

2.176 Upgraded or new irrigation and drainage infrastructure met all the project's physical targets and this provided timely and reliable water supplies that increased agricultural productivity.[99] This fully functioning system provided the basis for the establishment of viable WUAs whose number greatly exceeded appraisal expectations: 15 against the 8 planned. In addition another 208 were established before project closure and by the time if the IEG mission this had reportedly increased to over 1,500 including those outside the project area because of the Regional government's "Delivering water to Households" program that aimed to engage farmers in a more participatory approach.[100] On the whole IEG found from a series of field interviews that most WUAs are effective in managing and conserving water at the local level, but not without problems (Box).

2.177 Some WUAs are in name only – farmers do not actively participate in their management. The share of "paper" WUAs is not known. In many of the poorer areas that IEG visited, farmer's literacy is low (reportedly about 20 percent) and the country officials take the initiative to organize the WUA and then run it as an extension of the township, water bureau or state enterprise. For example, at the tail end of the Dongfeng main canal in Aksu prefecture the Tien Feng Seed Company (a state enterprise) manages one of the project's pilot WUAs that is part of a SIDD that includes 8 villages created on 11,000 mu (733 ha) of reclaimed saline soils. Comprising 3 villages the farmers in the WUA neither manage budget nor water – everything is done by the state enterprise staff – but they do undertake O&M within the command area. Water tariffs are calculated from the cultivated area, not volumetrically. Despite being a "paper" WUA water management followed the conservation principles in the project design and the state enterprise staff were assiduous in collecting water fees and ensuring O&M was undertaken by beneficiary farmers. This confirms the findings of research in Ningxia and Henan provinces that, when implemented, water management reform leads to water savings and meets the primary goal of water sector officials.[101] This study also noted increases in farmer's incomes appeared to more closely allied with manager's incentives than water reform *per se* – although reform may lower farmer's overhead costs (Box 2) and reduce water bills.

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99. 123,373 ha of land were improved and 41,462 ha of land were reclaimed. This included 1,009 km of main canals; 1092 km of main drains; 98 reservoirs and live storage; 29 water resource measuring stations; 2,340 km of lateral canals; 3,108 km of field canals and 20,846 water control structures.

100. This program aims at improving water delivery efficiency to farm households through more accurate water measurement and accounting and application of volumetric charging.

101. Wang, Jinxiz, Zhigang Xu, Jikun Huang and Scott Rozelle. 2003. Incentives to mangers and participation of farmers: which one matters for water management reform in China? CCAP Working paper 03-E17.

Irrigation and Drainage Districts are not self-financing

2.178 The concept of SIDDS has taken a firm root in the basin and IEG found compelling evidence that accounting and billing procedures for water has been mainstreamed within the project area. Billings actually collected were generally better than 90 percent. But none of the SIDDs visited was fully self-financing. The primary reasons are that water tariffs are too low and do not cover costs, and that the prefectural authorities prefer to reduce taxes and fees on poor farmers and subsidize water management activities. In the Qinbuluguqi WUA of Aksu prefecture, officials indicated that the present water fee of 0.0594 RMB/m^3 would have to increase by about 30 percent to cover the SIDD's costs. Table 12 shows how water fees are collected and allocated in this area.

Objective 3: The natural riverine forests along the lower reaches of the Tarim River were partially restored and preserved.

2.179 Despite increased irrigated area and water use, the ICR and Chinese officials argue that better and improved institutions, infrastructure and management, and shifts in cropping patterns, resulted in water savings that were more than the additional demand. Thus this objective was achieved as a the result of the synergy generated by the reduction of water losses in canal systems, land leveling, improved water application efficiency to crops, more effective use of basin storage – both reservoirs and groundwater - and better water scheduling at all levels.[102]

Table 12: How water revenues are spent – Qinbuluguqi WUA, Aksu Prefecture

Sources	Allocation	Revenue used for:
Revenue generated from water fees collected by WUA and given to water resource bureau	10%	Administration and O&M of canals and drains supplying WUA
	35%	Township administration
	25%	O&M of water source, canals and drains
	15%	Flood control
	25%	Staff salaries of water resource bureau
WUAs own fee levied on farmers	100%	Administration and O&M – most frequently paid in free labor

Source: IEG interviews of WUA and SIDD official and beneficiaries. November 7, 2006.

102. The Tarim river sub-component financed activities on the middle reaches of the river to enhance conveyance of water downstream This including 325 km of river training works, flood control levees and 27 ecological and water control structures in the levee system to rationalize diversion of water from the mainstream.

Box 2: Growing WUAs – the experience of Mousonma Irrigation District, Kashgar prefecture

The project started a pilot self-financing irrigation and drainage district (SIDD) from an initial WUA that included 5 villages served by a 14.3 km lateral, mostly unlined, canal covering 4,500 mu (300 ha). 150 local officials were trained in WUA management and improving water use efficiency and this was extended to 200 farmers from 17 townships and 22 villages. Overseas study tours were paid for by the prefecture. Over the period 1998-2000 about 13 km (81%) of the branch canal feeding the lateral canal were lined and 63 water control structures installed (including 57 water measuring points and 4 water level controls). By 2003 the county included 21 WUAs covering 209 villages and 66,915 households over an area of 589,570 mu (39,304 ha). The water supply to the WUAs is managed by the Water Bureau on the basis of cropping patterns, water demands and schedules compiled by the individual WUAs. The WUAs main functions are to:

* raise awareness of water conservation techniques and apply them;
* plan and manage distribution of water with the command area and provide O&M;
* arbitrate disputes, audit supplies and collect water tariffs.

Main problems:

*The portion of the water tariff retained by the WUAs covers only half the required O&M, in consequence there have been canal breaches and wastage of water;

* The project neglected to upgrade on-farm irrigation distribution facilities;
* Water tariffs are too low. The prefecture sets the base rate and this is implemented by the county with upward adjustments for local circumstances. Even though the county has the final authority over the actual rate, prefectural concerns to reduce the burden on poorer farmers normally means that the county has no say in the tariff actually charged to farmers;
* About a third of the tariff revenue raised from the WUAs is used by the county for flood fighting and relief works; and
* The pilot WUA's 3 technical staff are free in that they are paid for by the water resources bureau and the village committees from other income.

Advantages (as reported by a Group Head who farms 11 mu and manages supplies for 41 households):

* Before the project it took 40 hours to distribute the water, it now takes 3 hours;
* Earlier every household had to send people to ensure their fair share; now we trust the WUA
* Earlier we had many quarrels over water, now almost none;
* Earlier we paid 50 RMB per household for water, now we pay 30 RMB mainly because rules are obeyed, water losses are reduced and management is improved;
* We undertake O&M and the WUA members agree to pay extra for this – normally in kind;
* We have diversified cropping to vegetables and fruits in greenhouses using grants from county
* Household income was 3,500 RMB, now it is 6,000 RMB.

Source: IEG interviews, November 6, 2006, Kashgar and in the field

2.180 A notable accomplishment was the introduction of the conjunctive use of surface and groundwater to minimize evaporative losses of water.[103] Among the many water conservation measures successfully promoted by the project were use of plastic tube and greenhouse cultivation, mulching and high technology drip and spray irrigation.

2.181 An alternative explanation – or contributory one – is that perhaps the supply of precipitation to the basin in the form of rain and snow has slightly increased. Conversely, if precipitation was less this would augment the project's achievements. This was not

103. Lowering the groundwater table through improved drainage reduces the rise of water to the surface through capillary action and thus evaporative losses and salt accumulation at the surface. Flood flows from the mountainous rim of the basin percolate into the piedmont slopes and were captured through the installation of well fields and supplemented surface water supplies downstream. Reducing the area of water stored in shallow surface reservoirs during the hot dry summers by either not constructing them at low elevations (e.g. at Louhuluke) or replacing them with high elevation supplies all greatly reduced non-beneficial evaporation.

investigated during the project and as far as IEG can determine was not even considered in the results chain of cause and effect. ***This is a notable omission that should be investigated before it can be firmly concluded that man-made improvements are solely responsible for the improved environmental situation.***

2.182 Whatever the cause, water savings have allowed six separate water deliveries totaling 1.7 billion m^3 to be made to the lower river "green corridor" since 2000. This has allowed expansion of the area of terminal lake systems at Taitema from zero to 200 km^2. The increased river flows and the reinstatement of the lake system have resulted in the water table rising between 3.2 m and 12.6 m in the lower river reach and a halving of the mineral content of groundwater from 4-5 g/l to 2-3 g/l.

2.183 The increased supply of better quality water has rejuvenated trees, shrubs and grasslands on both sides of the river providing food, shelter and water for wildlife and people. Twenty-five species of native birds, amphibians, reptiles, 11 species of fish and other wildlife, such as red deer, have also returned. Tree ring analysis of *Populus Divesifolia* (called *huyang* in Chinese) showed a dramatic increase in growth rates after 2000 and the area under *huyang* in the basin increased over the period 1998-2003 from 158,941 ha to 175,016 ha. This notable environmental achievement received national and international press coverage.[104]

Efficiency

2.184 **Overall efficiency is rated as substantial.** The economic rate of return (ERR) for the overall project was recalculated in the ICR at completion based on benefits generated from land reclamation component and from diversification to higher-value crops. The recalculated ERR is 19 percent compared to 14 percent estimated at appraisal. The Net Present Value (NPV) achieved was Y675 million at completion compared to the appraisal estimate of Y411 million. The major difference between the economic analyses carried out at appraisal and that done at completion is that the appraisal under-estimated the scale of diversification into higher-value agricultural production and also the assessment of increases in major crop productivity. These higher benefits were offset to a degree by lower economic costs at ICR compared to appraisal because of China's entry into the WTO.

2.185 In spite of a significant downturn in cotton, wheat and other prices had a major impact on the project in the first and second years, with a corresponding reduction in house-hold incomes, the Financial Rate of Return (FRR) for the overall project at completion was 16 percent. The appraisal estimate of 17 percent was made based on market prices prior to China entering the WTO and included allowances for the distortions in the market at the time and higher financial prices. A more recent and independent estimate of the costs and benefits of growing fruit in Aksu prefecture gives very favorable FRRs for apples and pears under present agronomic practices. It notes, however, that profits would be even higher if trees were better pruned and mechanization were introduced

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104. China Daily. 2004. Quenching thirst in Tarim Basin. April 13, 2204.

as labor accounts for almost a third of total costs.[105] Thus it is likely future benefits could be much higher than anticipated at completion.

2.186 This assessment believes the actual ex-post economic rates of return using the same economic and financial models could be lower. This is because the cost stream in these calculations only captures costs directly attributable to the project and fully attributed all benefits to these inputs alone. Yet we know that other international sources of funding supported development inputs which directly or indirectly benefited the project, as did China's own regional investments. In addition, there were many regional, prefectural and country inputs – such as China's own comprehensive agricultural development program. Also much of the O&M expenditure is given in free labor and not included. Balancing these downside factors, none of upside environmental or social benefits from the project is included either. It may well be that these factors cancel out if costs and benefits can be quantified.

OUTCOME

2.187 The outcome of the project is rated as satisfactory. The justifications for this rating are summarized in Table 13 and elaborated below.

Table 13: Evaluation of factors contributing to outcome

Objectives	Relevance	Efficacy	Efficiency	Outcome
1. Increase incomes of poor farmers through irrigated agriculture development	High	Substantial		
2. Establish systems to ensure sustainable use, development and management of water resources and land	High	Substantial		
3. Partially restore and preserve the natural riverine forests along the lower reaches of the Tarim River	High	Substantial?		
Overall	***High***	***Substantial***	***Substantial***	***Satisfactory***

2.188 While it is clear that the project had a major development impact, IEG cannot be certain that the benefits generated in the project area and captured by the M&E system are solely attributable to the Bank's financing and support. Despite being a second phase project no evidence of a counterfactual was presented. In addition to direct and very substantial Chinese development financing for water development within the basin, six other external agencies provided developmental support. The ADB assisted development of local highways that facilitated development of local markets and commerce. The UK's DFID supported water sector reform projects in two prefectures and Germany sponsored a water-saving projects: both would have had spillover effects. In addition the Japan International Cooperation Bank assisted with Y1.97 billion (US$240 million) for water

105. Machesini, Sergio, Huliyeti Hsimu and Maurzion Canavari. 2005. *Production costs of pears and apples in Xingjian (China)*. DEIAgra Working paper 05-003. University of Bologna.

development in 15 prefectures. Kuwait and Saudi Arabia were also supportive. For these reasons the ICR rating of highly satisfactory was downgraded to satisfactory.

RISK TO DEVELOPMENT OUTCOME

2.189 **Overall risk to development outcome is rated as moderate.** The main risk factors contributing to this rating are economic, technical, governmental, financial and exposure to natural disasters. Local stakeholder, social, financial and environmental risks are low.

2.190 Economic and technical risks relate mainly to agriculture - cotton and grains in particular – and are moderate to high. The volatility of international trade in cotton and grains at the start of the project clearly demonstrated the major role these play sustaining in farmer's incomes, and the risk factors are still moderate to high (footnote 84.)[106] This risk is compounded by technical ones caused by the widespread adoption of genetically engineered cotton known as biotechnology or Bt-cotton. The first risk is continued inadequate institutional support and extension guidance for Bt-cotton that causes over-application, misuse or mishandling of pesticides essential for the continued health of Bt-cotton and that have potentially adverse health and financial impacts on farmers.[107] The second is the risk of secondary pest infestation (stink bug) and the continued high cost of purchasing Bt-cotton seeds.[108] Risks to grains are primarily changing government policy in China and the effect of international prices on local producers.[109]

2.191 Continued government subsidies to SIDDs, if significantly reduced or curtailed, pose a low to moderate risk to the physical maintenance of infrastructure constructed under the project. And if the effectiveness of this infrastructure is put at risk, water conservation may be jeopardized and with it the "green river." There is also a risk that continued subsidies for water costs may undermine the rational for water conservation, given the prevalence of low water tariffs throughout the basin, and the uncertain or marginal financial viability of WUAs.

2.192 The eastern part of the Tarim basin experienced a major earthquake in 2001 that damaged infrastructure and slowed project implementation in that area. Given the proximity to active plate boundaries the likelihood of this risk remains moderate but local impacts could be large.

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106. MacDonald, Stephen. 2007. *Progress and problems estimating China's cotton supply and demand.* USDA Outlook Forum. 2007.
107. Pemsl, D, H. Waibel and A.P. Gutierrez. 2005. *Institutional constraints for the success of agricultural technology in developing countries: the case of Bt-cotton in Shandong Province, China.* Proceedings of the German Development Economics Conference, Kiel.
108. Grain. 2007. Bt-Cotton, the facts behind the Hype. Seedling. January 2007. http://www.grain.org/seedling_files/seed-07-01-4-en.pdf
109. Zhou, Zhang-Yue and Tian Wie Ming. 2006. *Evolving trends in grain production in China.* Australian Agribusiness Review. 14. 2006.

BANK PERFORMANCE

2.193 **Overall Bank performance was highly satisfactory.** Design and appraisal is rated as highly satisfactory. Innovative project design reflected both the Bank's Water Resources Management strategies and those of the China' central government and the region. The Bank's extensive global learning and experience was applied to the project and partnership with AusAid leveraged world renowned technical expertise to assist the nascent river basin commission to solve its complex water and environmental problems.

2.194 Supervision is rated as highly satisfactory. Attention to fiduciary and safeguard issues and physical progress was highly satisfactory. Missions were intense and reporting was excellent. Aide memoirs clearly identified the main implementation and development issues and advice to the regional government and implementing agencies was clear, direct and relevant while being flexible and pragmatic.. Progress towards physical development objectives and emerging risks were clearly tracked and ratings accurately reflected reality in the field. The supervision strategy employed an efficient combination of the TTL/Co-TTL (based in Washington and Beijing, respectively) with clear roles and responsibilities and the ability to interact with and be responsive to the daily needs of the client. The only downside is that insufficient attention was given to utilization of the M&E, particularly the omission of the climatic variables needed to conclusively demonstrate project impacts on the regional water balance.

BORROWER PERFORMANCE

2.195 **Overall Borrower performance was satisfactory**. The technical aspects of project preparation were highly competent, responsive to the innovative ideas imported by the Bank and the views of local stakeholders in the basin. As a result this technically complex project was prepared, appraised and negotiated in just 17 months. Borrower preparation, however, overlooked the lack of managerial capacity on procurement and M&E below the main national and regional agencies and this later caused implementation delays. Even so, the regional government recognized the problem and was assertive in getting the project back on track and ensuring good leadership.

2.196 The performance of the implementation agency was mixed. Very poor initial performance caused by an inadequate complement of key staff, ineffective leadership and deficient counterpart financing was countered by outstanding performance in the second half once these problems were remedied. Subsequently there was effective coordination across agency, technical, administrative and political boundaries. An earthquake impeded progress over the period 200-2001. As a result, implementation of this technically complex and geographically wide-spread project was completed with a one-year delay.

2.197 Finally, the provincial government's ambivalent approach to raising water charges indicates they still do not see the link between price signals on scarce resources (e.g. water) and their stated conservation efforts. As this poses a substantial risk to the sustainability of irrigation improvements and the adequacy of water to feed the "green corridor" this assessment rates overall Borrower performance as satisfactory.

SUMMARY OF KEY FINDINGS FROM THE TARIM BASIN PROJECT

2.198 There are six:

- This project conclusively demonstrated that higher crop yields and incomes are possible using less water.
- Provincial officials are reluctant to raise irrigation water tariffs to levels approved by the central government and agreed with the Bank.
- The link between water resource conservation and its economic pricing does not appear to have taken root in Western China. Despite the ideas introduced by the Bank the Chinese continue to rely on the administration, not the market, to allocate water.
- While many WUAs and SIDDs were formed and the idea of self-reliance and self-financing is strongly emphasized by Chinese officials, in practice many WUAs and SIDDs are just extensions ("paper WUAs") of the top-down state administration designed to meet imposed targets.
- Operation and maintenance of irrigation infrastructure will mostly rely on state subsidies because of an unwillingness to charge for water. Consequently SIDDs do not appear to be viable.
- As with the other projects, greater care is needed to the design, implementation and application of M&E. Local capacity-building is needed. The results chain for achievement of project objectives needs to be carefully thought through. If this had been done it is unlikely that the climatic element would have been overlooked.

3. OVERALL FINDINGS AND CHALLENGES LOOKING FORWARD

FINDINGS

3.1 **Overview.** The three projects provide a great range of experience covering more than ten years of water planning and development in China. The objectives of these prominent projects were key to the sustainable development of China's land and water resources and have provided insight into what works well and the remaining challenges. The overall impression is that China is superlatively good at constructing high quality infrastructure on time and generally within budget but is less good at reforming its way of doing business or developing new institutions.

3.2 **Strong in-country presence matters.** The mutual trust and shared responsibility in the implementation and supervision of the projects was possible through the maintenance of a consistent Bank task teams throughout implementation. The fact that the projects were task-managed from the field office facilitated Bank-Borrower cooperation and partnership.

3.3 Key elements of success require active Bank engagement over the long term and consistent promotion of sustainable land policy and management practices. However, when projects are replicated in different areas care has to be taken that institutional assessment is not based on unfounded prior assumptions or higher level agreements. It is notable below the central and provincial level in China that local level institutional capacity and knowledge of current best practice and is very uneven.

3.4 **China benefited substantially from the Bank's insistence on application of its procurement and safeguard policies and contracting procedures.** Staff of the central government, its agencies and provincial governments were unanimous in the view that this greatly improved Chinese institutions, building significant human capital and making them internationally more competitive. In the Tarim Basin and at Xiaolangdi projects, in particular, improved procurement significantly lowered costs, as did introduction of standard dispute resolution systems.

3.5 **China's resource mobilization was problematic.** At the provincial level resource mobilization was problematic, widespread and created delays in orderly implementation. While the principle of devolving financial responsibility to the lowest levels of government are laudable they pose particularly difficult coordination problems for projects that cover several jurisdictions.

3.6 Adjustment **to the market-economy is slow – particularly for large infrastructure.** There remains a willingness to subsidize development even when this has strong private goods characteristics. The Bank expected beneficiaries to pay economic prices or at least the cost for the private goods generated by public investment in all four projects and this was part of the project design. Despite this, central and provincial authorities were unwilling to raise water and power tariffs to agreed levels for major infrastructure. Conversely much smaller development was frustrated by the lack of resolve

and/or ability to discriminate between public and private goods. Sometimes this created bottlenecks - for example in the Loess Plateau many small dams that had significant down stream public benefits were cancelled because governorates only viewed the structure as providing local private benefits (in this case newly created warping land and water storage.)

3.7 **Integrated river basin planning has been piloted successfully but more needs to be done.** The Tarim Basin project was the first successful attempt in China at implementing integrated river basin development and management. It is notable for the inclusion of environmental improvement within its primary objectives. And unlike other river basin organizations in China it is the first to promote and nurture strong links between the river basin management agency, local political stakeholders at prefectural and county level and farmer beneficiaries. As in several other Bank-supported projects in China it has emphasized creation of financially self-sufficient water user associations. But as with those projects, the government sends mixed signals on cost-recovery and at the prefectural and county levels welfare consideration continue to outweigh financial prudence.

3.8 **There is a lack of political resolve to reduce water consumption through new institutions.** The absence of strict enforcement of the water quota system or realistic water pricing is a major issue that could, in the medium to long-term, jeopardize project achievements. Undervalued water resources are may be misallocated. The larger issue of maximizing the value-added from water development has not been addressed. The current quota system by administrative allocation takes no account of the economic value of water or its opportunity cost in current uses. New mechanisms need to be agreed to develop criteria to allocate water efficiently.

3.9 **Monitoring and Evaluation requires capacity building and reorientation to measure outcomes and impacts**. M& E was problematic for all four projects even when it appeared to be carefully planned at appraisal. While all projects excelled in measuring process and physical indicators, most had difficult is establishing robust systems to measure socio-economic impacts and interpret the findings. The major difficulty was that most of the implementing agencies were engineering-focused and delegated non-engineering M&E to external agencies of varying capability and experience.

CHALLENGES LOOKING FORWARD

3.10 The overall conclusion from this project performance assessment is that while the Government of China has promoted water use efficiency through individual projects there is very little political will in the provinces and below to make the hard institutional choices this would involve. Responding to these constraints the government has continued to facilitate high level thinking and policy debate on national water policy and modify the governance framework from time-to-time.

3.11 To provide a firm base for comprehensive management of China's land and water resources the government initiated a long series of laws, rules and regulations starting in the 1980s. Initially these laws were reactive and aimed at addressing specific problems in water pollution, soil conservation, flood control, water management, environmental protection and land administration. Later laws and regulations have tended to strengthen

the increasingly holistic approach to water management although the path has been difficult to navigate. The major difficulty has been modifying China's supply-driven water system, a legacy of the earlier planned economy, and harnessing the more recent demand-driven exploitation to create a law-based, economically efficient, and ecologically-sound water management regime.[110]

Enabling environmental management through laws and regulations

3.12 Institutions to guide water planning, allocation, licensing, withdrawal permits, compensation, and construction, and consultation procedures for water disputes, were created by the 1988 Water Law. This Law provided the first comprehensive set of principles to manage water in China and is the fundamental "umbrella" law for water management. Water use for domestic consumers was given priority as was balancing utilization against potentially harmful externalities. Water and flood management were unified under the Ministry of Water Resources and multipurpose water for use was highlighted.[111]

3.13 Subsequently MWR's responsibility for watershed and land management was formalized through the 1991 Water and Soil Conservation Law. This focused on protection of soil and water loss as the first priority of conservation work, giving emphasis to aforestation and ecologicall-sound forest management, prohibition of cultivation on steep slopes, and restoration of vegetative cover after completion of infrastructure projects. Specific policies to cope with soil and water loss in mountainous and hilly areas include integrated regulation and management, establishment of a contract system for regulation and management of small catchments in soil eroded areas, and establishment of market-oriented mechanisms for soil and water conservation. Although this led to the development of plans and local level regulations for fee collection to cover the cost of erosion control facilities, lack of funds at the local level seriously constrained its implementation and enforcement. The Bank's Loess Plateau and earlier Red Soils projects alleviated these constraints locally.

3.14 Further emphasis on a river basin approach in the preparation of flood control plans and coordination with land-use plans developed by provinces and municipalities was authorized through the 1997 Law of Flood Control. Although local interests were supposed to take a subordinate role in the planning, the responsibility for flood fighting and relief was placed with them following policies and management rules developed in coordination with the river basin authority. Conflict resolution was to be through negotiation, with higher-level government – the MWR having final authority. Overall environmental safeguards were formalized through the 1989 Environmental Protection Law that gave the State Environment Protection Administration (SEPA) the authority to coordinate and manage environmental protection. While SEPA had the overall responsibility for water

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110. Boxer, Baruch. 2001. Contradictions and Challenges in China's Water Policy. Development Water International. Volume 26, Number 3, Pages 335–341, September 2001.

111. The 1988 Water Law built on the 1984 Water Pollution Control Law (the first law for water and pollution management in China) and covered the integrated use of surface and groundwater, provision of water for environmental management and water conservation.

quality and pollution issues, the MWR retained the authority to supervise and manage protection of water resources, thus creating overlap of jurisdiction in some areas.

3.15 In practice these laws proved difficult to apply for a number of reasons. First, water resources and pollution management are primarily the responsibility of provincial authorities. Second is that, while the central water and environmental agencies retained technical control over river basins, there was no single administrative authority looking after the spatial accountability from one province to the next within a single river basin – the Tarim Basin being the single exception. Third, as already noted, some provinces withdrew more then their allocation. On the Yellow River the periods of no flow in the lower reaches reached crisis proportions in the late 1990s and only then did government react.

3.16 The drying-up attracted national and international attention that led to an appeal signed by 138 academicians of China Academy of Science and China Academy of Engineering to plead for *"Acting Together and Saving the Yellow River."* This group subsequently undertook its own investigation that covered much of the river basin. At the same time the China Central Television and Economic News Daily co-organized a media campaign named *"Long March Exploration to the Cause of Yellow River Dry Up"* that heightened public awareness. As a result, following approval of the State Council, the State Development and Planning Committee and MWR jointly issued the Yellow River Water Regulation Management Regulation Stipulation in December of 1998.[112] The beneficial effects of this on operations at Xiaolangdi have been discussed earlier, as was the way provincial politicians were able to bypass the regulation when it did not serve their purposes.

Overlap and Conflicting Responsibilities for Water Frustrate Reform Progress

3.17 The single biggest problem is that a large number of organizations and authorities have administrative, technical or *de facto* responsibility for parts or facets of a unitary resource - water. In many instances the ultimate authority is unclear because of overlapping jurisdictions or lack of clarity in the enabling laws and regulations. Often key stakeholders are not represented or informed. Even when jurisdictional authority is clear at the provincial level and below, the ability to effectively manage is frustrated by inadequate information or the unwillingness of local governments to cooperate on "common good" issues because they may hinder local economic development.

3.18 Ten central ministries and agencies have overlapping responsibility for various aspects of water resources and service management and administration. The MWR is the lead agency that delegates water resources management and planning to the nine River Basin Commissions that, in principle, help resolve conflicts between jurisdictions and sectors and ensure that multiple uses are in accord with established priorities. They have two important constraints. First, the Commission's authority applies only to inter-provincial waters. Second – with the sole exception of the Tarim Basin – they are not

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112. Fu, Guobin, and Shulin Chen. 2006. Water Crisis in the Yellow River: Facts, Reasons, Impacts, and Countermeasures. Water Practice & Technology Vol 1 No 2. IWA Publishing 2006.

accountable to, nor have any representatives from, the provincial governments or lower levels of administration. Centrally-funded projects are supervised by the MWR's Provincial Water Bureaux implement and supervise below this level, their Water Affairs Bureaux manage local level water resources strategy, including water quantity and quality, provide integrated management for city and country water services and pollution management. The arrangements for continuity of water and land policy from the centre to the local level are admirable but it has a serious flaw that creates local conflicts of interest. The Bureaux report and depend upon funding from provincial governments whose jurisdictions are unrelated to hydrological boundaries. More critically, staff of these agencies are employees of the provincial or country government, not the MWR.

3.19 Control of the water resource base and degradation of it by pollution is critical to maintain utilizable supplies. Yet overlapping responsibility frequently frustrates this objective. Pollution reduction targets are based on a basin pollution plan prepared by SEPA who implement them through their Provincial Environmental Protection Bureaux (EPBs) at their various Environmental Monitoring Stations. However, their responsibilities for quality issues and planning overlap the mandate given to MWA's Water Affairs Bureaux particularly for urban areas. As with water quantity, management of water pollution also has conflicts of interest – EPBs are subsidized with income from wastewater pollution charges and fees –as local governments may put a higher priority on unrestricted industrial and urban development following implementation of the regional and governor's responsibility system. Thus local enforcement is weak.

3.20 Overall coordination at the apex is also weak. While the governing laws intended close cooperation between MWR and SEPA both ministries tend to work separately and submit separate and often conflicting water management plans to the State Council. In part this is because their basic water planning criteria, data and assessment areas are neither harmonized nor compatible.[113] The Central Committee did institute a national leading group for Water Resources and Soil Conservation in 1988 to improve inter-ministerial and departmental coordination and similar leading groups at lower government levels. However, this lost high level support in the 1990s and disappeared in the 1998 reform of government's organizations. The only residual is the State Flood and Drought Control Relief Headquarters. Currently, provinces feel squeezed between MWR and SEPA and would prefer to align themselves with a unified basin organization to ensure consistent and equitable treatment and better integration of water quality and quantity management.[114]

Government response to coordination and management issues is slow

3.21 Responding to these problems, the Water Law was revised in 2002 to provide a more comprehensive planning and management framework for China's river basins. It endorsed the twin principles of total quantity control and quota management; reinforced the concepts of permits for water users and fees for supply, and reemphasized the importance of improvements in water use efficiency. The legislation also set down the principles of

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113. World Bank. 2006. China Water Quality Management – Policy and Institutional Issues.
114. McMahon, George F. 2005. The Yellow River Law: A Framework for Integrated River Basin Management. Proceedings of the Georgia Water Resources Conference April 25-27, 2005. USA.

water pricing reform, including the concept of reasonable return, equitable sharing of costs and the principles of compensation and price related to water quality. For the first time water markets were included among economic instruments as was the principle that the "polluters pays."

3.22 However, the revised law makes no provision in the River Basin Commissions for the representatives of local stakeholders at the provincial and municipal levels and takes no account on inter-provincial river basin agreements with concerned governments.[115] No attempt was made to mainstream the Bank-assisted experiments on broader participation in the Tarim River Basin because it was too early to do so. Indeed, in hindsight it appears that the new resolve imparted by the 2002 law may have been the reason that the government of Xinjiang Province revitalized implementation of institutional reform which had been problematic until then. But four years later the unclear relationship between river basin commissions and local governments still hinders dispute resolution.[116] More importantly, the revised law did not clarify or redefine the roles of the national level water and environmental organizations that had overlapping responsibility for managing this increasingly scarce resource.

3.23 The devastating floods on the River Yangtze in 2002 refocused the government on the consequences of poor coordination among the multitude of organizations that had made environmentally sound river basin management elusive. In response the government set up a Task Force on Integrated River Basin Management (IRBM) in 2003 to help it redress these problems.[117] The objectives of the IRBM Task Force were to (1) assess existing laws and regulations and make recommendations to state legislation authorities; (2) review existing river basin management practices, assess the coordination of existing river basin management, and make recommendations to the State Government and river basin commissions at the national level, on the Yangtze River Basin in particular; (3) promote relevant economic tools such as water rights, water pricing, subsidies, compensation, tradable permits, and green taxation for integrated water resources management at the national level and in the Yangtze River; (4) promote stakeholder participation and community involvement; (4) provide a platform for information sharing; and (5) establish and promote communication tools including workshops and publications.

3.24 The 2004 report of the Task Force provided four far-reaching policy recommendations to China's State Council. It recommended establishment of a national-

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115. Wang, Yuhua. 2003. Water Dispute in the Yellow River Basin: Challenges to a Centralized System. Commentary. Woodrow Wilson Center. Washington. D.C. August 2003.
116. Ganyan Zhou. 2006. Institutional Arrangements for River Basin Management: A Case Study Comparison of the United States and China. The World Bank China Water AAA. Study Summary Note Series. Washington. D.C.
117. The Task Force was established by the China Council for International Cooperation on Environment and Development on March 28, 2003. CCICED is an advisory group supported by CIDA and the Chinese Government and is chaired by a leader of the State Council of China. The Chinese Council Members are ministers, vice ministers, and famous scholars in environment and development; the international Council Members are of comparable stature. The Task Force comprised 12 prominent experts; six from China and six others drawn from Japan, Netherlands, UK, USA, the Ramsar Convention Bureau and WWF International. Source: http://www.ramsar.org/wn/w.n.china_yangtze_taskforce.htm.

level IBRM commission involving the National Development Reform Commission, MWR and SEPA that would coordinate policy and planning, establish standards and targets and resolve conflicts. [118] Practically it proposed that IRBM principles should be piloted in two priority tributaries of the Yangtze River Basin to rationalize existing laws to reduce contradictions that hinder institutional reform, and that subsequently Master Plans for each major river basin should be undertaken. The Task Force reaffirmed the importance of the new direction of the 2002 Water Law emphasizing mechanisms to enable open and free access to development planning proposals, economic and incentive measures that include social and economic costs, and including the value of ecosystem services including 'environmental pricing. Importantly, it called for examination of water pricing as a perverse subsidy using case studies.

3.25 In 2003 the NDRC and MWR jointly issued regulations to increase water prices for industry and water supplies and, to a lesser extent, those for agriculture. The "Outline of the National Water Saving Plan" was endorsed by the Ministry of Construction that stated that all new and reconstructed building would be required to install water-saving devices by 2010 and that excessive consumers of water would be subject to higher water tariffs.[119] The longer-term objective by 2010 is to supply through water saving half the incremental industrial demand and most of the incremental demand in irrigation. The water-saving plan was officially released in February 2007.[120] How far this plan took account of the CCICED recommendations is unclear but it clearly resonates with them and is in harmony on many issues.

China Moves toward a Water-Saving Society, Slowly

3.26 As indicated, China has increasingly emphasized the imperative to move towards greater and more efficient water use. To this end the MWR started implementing water saving pilots over the period 2001 to 2010 to determine best practice. The first phase focused on areas with serious water shortage and water pollution problems suitable for the demonstrative purpose. The second phase will establish water conservation demonstrative areas in selected provinces and river basins. According to MWR between 1998 and 2004 US$2 billion was allocated by central government for physical modernization and rehabilitation of large-scale irrigation systems and since then annual investment has risen to about US$1.5 billion.[121]

3.27 Using pricing to induce conservation has been only modestly effective. As this assessment shows this is mainly due to lack of enforcement at provincial level. Even though the MWR and Ministry of Finance issued guidelines in 1988 that required water institutions to become financially autonomous by raising water fees over the next 5-10 years to recover all costs, they never approached full cost recovery.[122] The Xiaolangdi experience is a prime example. Nationally average tariffs for water supply increased from

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118. CCICED Task Force and WWF. *Promoting Integrated River Basin Management and Restoring China's Living Rivers*. Beijing. October 2004. http://www.harbour.sfu.ca/dlam/04riverbasin%20rpt.htm
119. Xinhua News Agency. 2003. China to Speed up Urban Water Price Reform. August 19.
120. WorldWatch Institute. 2007. China Sets water-Saving Goal to Tackle Looming Water Crisis. Feb 27.
121. Li, Yuanhua. 2006. Water Saving Irrigation in China. Irrigation and Drainage. 55: 327-336.
122. World Bank. 1993. China – yellow River Investment Planning Study. 2 vols. Report No. 11146-CHA.

0.028 Yuan per cubic meter in 2000 to 0.06 Yuan per cubic meter in 2005. A major constraint in the agricultural sector is that water charges are frequently included within local land and agricultural taxes and there is no direct connection between water fees, quality of service and water use. Thus there are few incentives for farmers to conserve water.[123, 124] Among the more positive signs that things are changing there are now over 20,000 water user associations that are co-managing irrigation water at the local level. However, as this evaluation and other assessments have shown, the role and effectiveness of WUAs is very uneven [125]

3.28 Even so, the research by Wang and others showed that the mere fact of shifting management from the collective to either a WUA system or contracting did not lead to water savings unless managers were given positive incentives. When there were incentives water use per hectare was reduced by about 40 percent.[126] The incentives apparently also improved the efficiency of the irrigation systems: there was no change in the output of major crops, such as rice and maize, and rural incomes and poverty remained statistically unchanged. Conversely, water reform led to a decline in wheat production because it depended mainly on irrigation. On a larger scale this would significantly challenge China's foodgrain self-sufficiency policy – a constraint that could be relieved by importing wheat.[127]

An Increased Focus on Water Savings

3.29 Until the mid-1990s the primary objective was to improve the irrigation efficiency of major physical infrastructure using well-tried methods including canal lining and better water control and scheduling that now cover a third of all irrigation. Water saved was typically used to extend the area or intensity of irrigation. Subsequently, much more attention is now paid to water saving technology. Nationally 10 percent is equipped with low pressure pipes and 6 percent with sprinkler, drip or other micro-irrigation.[128]

3.30 Improved agronomic and land management practices have also led to water saving on over 3.5 million ha of rice fields.[129] Aerobic rice, for example, is now grown on 140,000

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123. IPIM. 2002. Sixth International Forum of Participatory Irrigation Management, Held by the Ministry of Water Resources and the World Bank, Beijing, April 21-26, 2002. Several papers at this conference review the Chinese reform experience: China Irrigation District Association. "Participatory Irrigation Management: Management Pattern Reform of State-owned Irrigation District; " Management Authority of Shaoshan Irrigation District. "Positively Promoting Reform Based on Practices of Irrigation District, Obtaining Achievement of Both Management and Efficiency."

124. Ma, Z. "Deepening Reform of Farmer Managed Irrigation System, Promoting Sustainable Development of Irrigation District." *Participatory Irrigation Management: Innovation and Development of Irrigation System.* L. Nian eds. Beijing, China: China Water Resources and Hydropower Publishing House, 2001.

125. Wang, Jinxia, Zhigang Xu, Jikun Huang And Scott Rozelle. 2005 op cit.

126. Typically the incentive structure allowed the system manager to keep the difference in price between the standard quantity of water allocated and the quantity of water actually used.

127. http://www.fao.org/AG/aGL/aglw/cropwater/wheat.stm#methods. The figure given assumes that the overall irrigation efficiency is about 50%.

128. MWR. 2006. 2005 Statistics Bulletin on Water Activities.

129. Regassa E. Namara, Intizar Hussain, Deborah Bossio and Shilp Verma. 2007. Innovative land and water management approaches in Asia: productivity impacts, adoption prospects and poverty outreach. Irrigation and Drainage Volume 56, Issue 2-3 , Pages 335 – 348.

ha in northern China facilitated by the availability of efficient herbicides, seed-coating technologies and mechanization[130]. Water use was about 60 percent less than that of traditional lowland rice grown in standing water, total water productivity 1.6 to 1.9 times higher, and net returns to water use 2 times higher.[131] Use of plastic tunnels, dry-tillage, and greenhouses has grown five-fold since 1995 to over 2.5 million ha in 2004.[132, 133]

3.31 The recently completed Bank-assisted Water Conservation Project in north-eastern China was highly successful in demonstrating that water consumption can be reduced while farmer's income increased.[134] It also showed that workable institutional arrangements can be implemented to reduce the long term depletion of groundwater resources. It successfully and explicitly mainstreamed the concept of increasing value-added per unit of evapotranspiration. This shifted an earlier Bank focus away from promoting only crop diversification to promoting improved cropping, agronomy and the volumetric measurement of water use. Generally, higher incremental incomes were achieved with the more advanced irrigation application technologies.

3.32 The lessons on how to conserve water utilized for agricultural production are being scaled-up in central government programs: the National Water Conservation Program financed by the Ministry of Finance's State Office for Comprehensive Agriculture Development and the National Irrigated Agriculture Water Saving Program by the Ministry of Water Resources. Local government programs for water conservation have been also initiated following the precedent set by the project. For example, the preparation of county-level groundwater management plans, piloted in four counties under the project, has been taken up by a further 21 counties across Northern China. Prosperous urban areas (e.g. Beijing and Qingdao) are also planning to invest both in water saving, with a view to urban water supply, and in the "harmonious society" approach to balancing rural and urban development and incomes.

3.33 The more liberal Chinese approach has allowed provinces and townships to experiment with innovative ways of managing water particularly in those provinces where internal demand exceeds the quota. Successful innovations are endorsed by the MWR (Box 1) but they are not mainstreamed nationally in new policy initiatives.

3.34 The most notable success at water conservation has involved five water rights transfer in Ningxia and Inner Mongolia and was the first time the principles of a water right

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130. Also known as AWDI – alternate wetting and drying or intermittent irrigation.
131. Wang Huaqi, B.A.M. Bouman, Dule Zhao, Wang Changgui, and P.F. Moya. 2002. Aerobic rice in northern China: opportunities and challenges. Proceedings of a Thematic Workshop on Water-Wise Rice Production, 8-11 April 2002 at IRRI headquarters in Los Baños, Philippines.
132. Zhou Xingxiang, Renjie Dong*, Shujun Li, Gaojun Peng, Lanfang Zhang Jicong Hou, Junhua Xiao, And Benhai Zhu. 2003. "Agricultural Engineering in China". Agricultural Engineering International: the CIGR Journal of Scientific Research and Development. August 2003.
133. Zhang, Z.B. 2005. Shading Net Application in Protected Vegetable Production in China. Acta Horticulturae 719.
134. China Water Conservation Project (IBRD-4589.) 2000-06. Report No. ICR0000191. March 27, 2007.

transfer were officially approved in China.[135] More importantly they recognized that these rights had a value and set up official procedures for approval and the determination of the price of water rights transfer.[136] Preceding the rights transfer in the Yellow River Basin, the first water trade took place in Zhenjiang Province in the southern part of the Yangtze River delta.[137] These trades also highlight the fact that the high water usage of these industrial facilities– a result of outdated technologies – offers a second opportunity to reduce water consumption once new standards are established and regulated. This is true of other sectors too (Table 14).

Box 3: Inner Mongolia Autonomous Region's 2000 Water Trade

A new coal power plant could not obtain sufficient cooling water because of its own high demand exceeded the province's quota of the Yellow River runoff. To resolve this issue the plant, with the help of the province and local government, invested about US$11 million to increase water use efficiency in adjacent irrigation districts. In return for its investment, the government granted the plant an annual withdrawal right of 50 million cubic meters of water from the Yellow River – the amount of water saved. The plant found the trade considerably cheaper than adopting the alternative of using air-cooling technology to reduce demand. Since then the two Autonomous Regions of Inner Mongolia and Ningxia have sponsored four similar water trades. These water trades were endorsed by the MWR in 2005.
Source: Wang, Yahua. 2000.

Table 14: Water Use in China is Not Efficient

Indicator	*Unit*	*Developed Country*	*China*
Agricultural water share of total water use	%	9 - 64	69
Agricultural water use efficiency	"	70 - 80	45
Proportion of industrial water recycled	"	80	45
Water use for steel products (m3/ton)	"	6	23-56
Unaccounted for water – Urban supplies	"	12 - 25	>20
Share of urban wastewater treated	"	80 - 90	30
Productivity of water as share of GDP			
Total Economy	**GDP$ per m3**	14-48	2
Agriculture Sector	"	1.4 – 5.8	0.5
Industrial sector	"	8-100	4.2
Service Sector	"	27-175	12.6

Source: Wang, Y. 2005.

Improved land management has been successful – but sustainable?

3.35 Since the 1970s the objective of land management has changed from a primarily productive focus to one in which it is recognized that they also provide environmental services – particularly for water management and reduction of desertification. According to MWR, by the end of 2005 almost one million ha of erosion mitigation had been implemented including 0.4 million ha of watershed improvement and 0.6 million ha of

135. In 2004 MWR made the following rules: "The Directive of Water Right Transfer Pilot Project in Mainstream of the Yellow River in Ningxia and Inner Mongolia" and "Regulation on Yellow River Water Right Transfer (Tentative)." The five pilot projects included 3 irrigation schemes.
136. Su Qin. 2006. System & Practice of Yellow River Water Rights Transfer. http://www.mwr.gov.cn/english1/20060110/20060110104434EVNCBZ.pdf
137. Wang, Yahua. 2005. *op cit.*,

ecological restoration.138 But MWR is now a small player because of the large areas of steeply sloping land afforested under Sloping Land Conversion Program that is designed to convert 14.67 million hectares of cropland (including a target of afforesting 4.4 million ha of land with gradients of more than 25 degrees) in 23 provinces to forest by 2010 and has an overall budget of more than US$40 billion. In addition, it had a soft goal of afforesting an equivalent area of wasteland. By 2004 SLCP had converted 7.2 million ha of cropland and afforested 4.9 million ha of wasteland.[139] If successful these programs are likely to have a very positive impact on China's landscape, natural environment and water resources.

3.36 Independent reviews of the implementation experience, however, have raised a number of issues affecting the sustainability of SLCP. There is also a need to fine-tune the environmental objectives to the differing regional climates – planting trees rather then grass in Loess Plateau region may be efficient for carbon sequestration but may not be the best option considering water resource shortages.[140] Coordination between the State Forest Administration and MWR on watershed management is problematic. Although the subsidy is directly financed by the central government, not all village, township and county governments are in a position to finance local costs (i.e. mediation between central agencies and farmers, inspections) particularly as production benefits on converted land are free of all taxes – this could be an issue given that the overall survival rate of trees is about 75 percent, and perhaps only 70 percent in the Yellow River Basin. Field evidence indicates it may be lower.[141]

3.37 There are also concerns that short-term subsidies may not cover lost income in some areas while converted lands mature and yield returns. And about a third of farmers have indicated that should the subsidies cease they will take back the land into cultivation.[142] One way of mitigating this risk would be to increase off-farm rural employment as it would reduce the pressure on fragile land resources. Additionally, there have been reports that local governments are taking their costs from the subsidy, thus reducing incentives for farmers to participate. Farmers are reportedly also showing an increasing reluctance to "voluntarily" convert adjacent barren lands (that are sometimes the worst eroded) because of the high labor requirement. Even so, independent field surveys found that highly sloping and low-quality land was being predominantly targeted. Conversely, there is a concern that disbursement pressures have led to the inclusion of land that should not be targeted, thus lowering program efficiency and increasing costs.

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138. MWR. 2006. op cit.,.
139. Bennett, M.T. and J. Xu. 2005. China's Sloping lands Conversion program: Institutional Innovation or Business as Usual? Workshop on "Payment for Environmental Services – Methods and Design in Developing Countries. Beijing.
140. Sherr, S.J., M. T. Bennett, M. Loughney and K. Canby. 2006. Developing Future Ecosystem Service Payments in China: Lessons Learned from International Experience. A report prepared for the China Council for the International Cooperation on Environment and Development Taskforce on Ecocompensation.
141. Xu, Z, R. Tao, Z. XU and M. Bennett. 2005. China's Sloping Land Conversion: Does Expansion Equal Success? CCAP Working Paper.
142. Uchida, E., Z. Xu and J. Xu. 2005. Grain for Green: Cost effectiveness and Sustainability of China's Conservation Set-aside Program. *Land Economics* • May 2005. 81 (2): 247–264

3.38 Finally, there is negligible monitoring and evaluation to measure and link the environmental benefits of the program to erosion control, sedimentation and water resources. This is perhaps a casualty of the absence of the MWR from the SLCP program and the multiple development objectives. While China's State Forestry Administration see the program primarily in ecological terms, most of the provincial and county-level officials – and project beneficiaries – see it as a centrally subsidized poverty alleviation program.

Progress on essential reforms is being outpaced by growing water demand

3.39 As a result of the rapid pace of urbanization in China, urban and industrial water demand has steadily grown at 5 percent since the 1980s and is projected to accelerate.[143] The driving force will be the more than doubling of urban populations from 118 million to about 260 million between 2002 and 2020. Income growth in both rural and urban areas increased per capita water consumption by more than a third over the period 1989-1997 and this is likely to continue. Overall water demand in the most water short areas of North China in the area covered by the Yellow (Huang), Hai and Huai river basins – the 3-H basins – will depend much upon the growth of GDP. As the recent GDP growth rates have exceeded the "high" scenario of 8.5 percent envisaged by the investment planning studies and their 2002 updates (para 1.33), it is projected that total water demand will increase from an average of 150 billion cubic meters a year (bcm/year) in 2000 to about 173 bcm/year in 2020. In very dry years this could exceed 210 bcm/year. Against these demands the total water supply will be 144 bcm/year, of which 73 percent will come from surface water.

3.40 The huge shortfall in supply is very significant as it will affect economic activity and the lives of 324 million people in 100 major cities within twelve Northern provinces.[144] Given that urban, industrial and domestic water supply are accorded a higher priority for water in the national policy the agricultural sector will contract unless it can use water far more efficiently than at present. This will be difficult. Accordingly, it is projected that because as much as 6 bcm/year of water could be shifted out of agriculture, the area of cropped land could contract by about 4.2 million ha. The overall impact of water shortages in all sectors is projected by 2020 to have an annual economic cost of between Y 44 billion (US$ 5.4 billion) and Y 70 billion (US$ 8.5 billion.) These potential losses can be partially alleviated by increasing water use efficiency, reuse of and importing water. In addition to engineering measures, water pricing would catalyze moves towards greater water use efficiency and reuse.

3.41 China has clearly chosen supply augmentation via the inter-basin South-North Water Transfer Scheme as the most obvious solution. In part this is because it provides a guaranteed supply and the engineering required, though expensive, is well known, feasible and practical given the high quality of China's organizational and engineering skills demonstrated in the assessed projects. In tests of the various policy options it was found

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143. Gunaratnam, D. 2004. China water Resources Issues and Strategy. Issues paper prepared for the World Bank's Asia and Pacific Region.

144. Hebai, Henan, Shandong, Anhui, Jiansu, Shanxi, Shaanxi, Inner Monglia, Gansu and a small part of Sichuan and the municipalities of Beijing and Tianin.

that an overall increase in water use efficiency of 10 percent would reduce economic losses in 2020 by about US$ 1 billion a year. Including reuse and the full impact of water price increase would lead to overall reductions of about US$3.5 billion a year. The reduction of economic losses caused by the South- North transfer alone would be less, about US$3.1 billion a year. Obviously the water use option would not be cost free but it would be highly disaggregated and easy to implement as the intra-provincial water rights transfer demonstrated. The only problem with the institutional solutions is the lack or resolve and uncertainty about how quickly it could make a difference.

CONCLUSIONS AND LESSONS

3.42 During the Xiaolangdi and Tarim Basin Projects the Bank was able to work with national-level organizations of water policy issues given the cross-cutting nature of these enterprises. For the first and only time the Bank was in the privileged position of assisting MWR with the integrated planning of the Yellow River and Tarim River Basins. This was important because the incremental impact of the projects the Bank supported on water resources management could be modeled at the river basin scale and fully integrated with China's large portfolio of potential projects. In both cases, this approach indicated that the Bank- assisted projects were better than project alternatives that were thus rejected. And in both cases the Bank-assisted projects put a large emphasis on saving water in a river basin context.

3.43 Reviewing the post-1990 portfolio of agricultural water projects supported by the Bank in North and West China there has been a clear trend from building new irrigation that increases basin-wide water demand, to projects that seek to improve water use efficiency and conservation efforts. However, there have been some strategic mistakes that should have been avoided – the Guanghong Irrigation Project approved in 1999 effectively doubled water use for irrigation in the mid-reaches of the Yellow River near Xian. At the same time the downstream Water Conservation Project approved in 2001 was extremely effective in reducing overall water consumption and is a prime example of what the Bank should support.

There are three lessons:

- **The Bank needs to elevate its engagement in China's water resources policy discussions above the provincial level to emphasize the perverse incentives that are created by extensive agricultural water subsidies.** Subsidies for irrigation and land management jeopardize water conservation effort, longer term sustainability of irrigation and land reclamation projects and water availability for towns, cities, industry and environmental management. Despite more than two decades of Bank partnership and several state-of-the art projects piloting new approaches these tend to be enclave projects. While Chinese senior planners and politicians at the center acknowledge that pricing should play a role in ensuring more efficient and rational allocation and use of water this is still as at an early stage of application and far from politically acceptable in the provinces. Without such a change in the near future water shortages and environmental consequences of resource mismanagement will continue to grow to crisis proportions;

- **Monitoring and Evaluation requires capacity building and reorientation to measure outcomes and impacts.** There is little virtue in implementing development models for reclaiming degraded lands or for river basin management if impacts on welfare, incomes and the economy cannot be accurately measured. While this is less of a problem for physical achievements it is a major problem for measurement of socio-economic outcomes and impacts. Much more attention has to be given to understanding the appropriate counterfactual and ensuring unbiased sampling. There is also an issue around selection of the most effective M&E model considering the outcomes expected and the cost of the projects. Appropriate training to redress the problems found in M&E is clearly indicated. In addition, more attention should be given to fully utilizing existing Chinese resources. The Ministry of Finance has indicated that it has a national network of monitoring that include socio-economic indicators and that consideration should be given to working with them to triangulate evaluative findings; and

- **Much greater care is required in dealing with issues of attribution when estimating ex-post economic rates of return.** Specifically this means clearer definition of the project counterfactual and a systematic accounting of the effects of exogenous actors and investment on project impact. Without such attention to these exogenous factors there is a danger that estimated ERRs give a false impression of project impacts. This, in turn, may lead to incorrect lessons on development effectiveness and the efficacy of policy, institutional and engineering measures utilized to achieve development objectives.

Annex A. Basic Data Sheet

LOESS PLATEAU WATERSHED REHABILITATION PROJECT (LOAN 4477, CREDIT 3222)

Key Project Data *(amounts in US$ million)*

	Appraisal estimate	*Actual or current estimate*	*Actual as % of appraisal estimate*
Total project costs	252		
Loan amount	150		
Cofinancing	7.41	-	-
Cancellation	-	-	-

Cumulative Estimated and Actual Disbursements

	FY00	*FY01*	*FY02*	*FY03*	*FY04*	*FY05*	*FY06*	*FY07*	*FY08*	*FY09*
Appraisal estimate (US$M)	37.5	75.0	112.5	142.0	150.0	150.0	150.0	150.0	150.0	150.0
Actual (US$M)	7.7	33.8	53.9	95.7	130.4	146.7	146.7	146.7	146.7	146.7
Actual as % of appraisal	20	45	48	67	87	98	98	98	98	98

Date of final disbursement: 12/1/05 (DFID fund not completely disbursed)

Project Dates

	Original	*Actual*
PCD	-	9/10/1998
Appraisal	-	1/8/1999
Board approval	-	5/25/1999
Effectiveness	9/17/1999	9/17/1999
MTR	9/20/2002	9/20/2002
Closing date	12/31/2004	6/30/2005

Staff Inputs

Stage of project cycle	Actual/Latest Estimate	
	No. of staff weeks	US$ ('000)
Identification/preappraisal	-	55,008
Appraisal/negotiation	-	115,534
Supervision	-	363,214
ICR	-	13,516
Total	-	457,273

Mission Data

Date (month/year)	No. of persons	Specializations represented	Implemen. progress	Develop. objective
Identification/Preparation				
09/1997	7	A, 2AG, 2ES, WRS, F		
10/1998	6	AG, E, M, WRS, H, F		
Appraisal/Negotiation				
01/1999	6	AG, E, M, WRS, H, F		
Supervision				
11/1999	6	ES, OP, M, WRS, FM, AG	S	S
09/2000	9	AG, 2E, 2M, ESD, FM, 2F	S	S
09/2001	4	AG, E, WRS, F, PA	S	S
09/2002	4	AG, E, WRS, F, PA	S	S
09/2003	4	AG, E, F, OA	S	S
08/2004	4	AG, E, F, OA	S	S
ICR				
09/2005	3	E, OA, S	HS	HS

Note: A = Agronomist; AG = Agriculturist, E = Economist; ES = Environmental Specialist, ESD = Engineer for the Safety of Dams, F = Forestry Specialist, FM = Financial Management Specialist; H = Horticultural Specialist; M = Monitoring Specialist, OA= Operations Analyst, OP = Operation Officer, PA = Program Assistant, P = Procurement Specialist, S = Social Specialist, WRS = Water Resources Specialist

Other Project Data

Borrower/Executing Agency:

FOLLOW-ON OPERATIONS

Operation	Credit no.	Amount (US$ million)	Board date
NONE			

XIAOLANGDI MULTIPURPOSE PROJECT I (LOAN 3727-CHA)

Key Project Data *(amounts in US$ million)*

	Appraisal estimate	*Actual or current estimate*	*Actual as % of appraisal estimate*
Total project costs	2294.0		
Loan amount	460.0	459.8	99
Cofinancing	-	-	-
Cancellation	-	0.2	-

Cumulative Estimated and Actual Disbursements

	FY95	*FY96*	*FY97*	*FY98*	*FY99*	*FY00*	*FY01*	*FY02*
Appraisal estimate (US$M)	115.0	265.0	400.0	457.0	460.0	460.0	460.0	460.0
Actual (US$M)	124.4	221.8	360.7	458.9	459.6	459.7	459.7	459.7
Actual as % of appraisal	108	83	90	100	99	99	99	99

Date of final disbursement: 10/18/2001

Project Dates

	Original	*Actual*
PCD	-	7/21/988
Appraisal	-	4/8/1993
Board approval	-	4/14/1994
Effectiveness	9/22/1994	9/22/1994
MTR	6/30/1996	6/30/1996
Closing date	12/31/2000	12/31/2000

Staff Inputs (staff weeks)

Stage of project cycle	*Actual/Latest Estimate*	
	No. of staff weeks	*US$ ('000)*
Identification/preappraisal	130	650
Appraisal/negotiation	50	200
Supervision	64	460
ICR	8	25
Total	252	1305

Mission Data

Date (month/year)	No. of persons	Specializations represented	Implement. progress	Develop. objective
Identification/ Preparation				
Mission 1	*16*	3 Economists, 2 FMS, 1 Water Resources Eng, 2 Environmental, 2 Social Scientists, 2 GW and SW Specialists, 1 Procurement Spl, 1 Hydropower Eng, 2 Inst Specialist		
Mission 2	*15*	2 Economists, 1 FMS, 2 Water Resources Eng, 2 Environmental, 2 Social Scientists, 2 GW and SW Specialists, 1 Procurement Spl, 1 Hydropower Eng, 2 Inst Specialist		
Mission 3	*13*	1 Economist, 1 Cost Estimator, 2 Water Resources, 2 Environmental, 2 Social Scientists, 2 GW and SW Specialists, 1 Procurement Spl, 1 Hydropower Eng, 2 Inst Specialist		
Appraisal/Negotiation				
Appraisal	*16*	2 Economists, 2 FMS, 1 Water Resources Eng, 2 Environmental, 2 Social Scientists, 2 GW and SW Specialists, 1 Procurement Spl, 1 Hydropower Eng, 2 Inst Specialist, 1 Legal		
Negotiations	*3*	1 Water Resources/Dam, 1 Legal, 1 Disbursements		
Supervision				
1	*2*	1 water resources/dam, 1 geotechnical	HS	HS
2	*3*	1 water resources/dam, 1 geotechnical, training specialist	HS	HS
3	*3*	2 water resources/dam, 1 dam	HS	S
4	*4*	1 water resources, 1 dam specialist, 1 geotechnical, 1 procurement/cost specialist	HS	S
5	*3*	1 water resources, 1 dam, 1 geotechnical	HS	S
6	*1*	1 water resources/ procurement	HS	S
7	*5*	1 water resources, 1 dam, 1 geotechnical, 1FMS, 1 claims specialist	HS	S
8	*6*	1 water resources, 1 dam/construction, 1 dam, 1 geotechnical, 1 FMS, 1 Environment	HS	S
9	*6*	1 water resources, 1 dam/construction, 1 dam, 1 geotechnical, 1 Financial Specialist/Auditor, 1 Environment	HS	S
10	*2*	Water Resources/economist, 1 dam/construction specialist	HS	S
11	*10*	1 water resources/economist, 1 underground works, 1 geotechnical, 1 dam, 1 dam safety, 1 FMS, 1 Principal Financial Spl.,2 Environmental , 1 Claims Spl.	HS	S
ICR				
ICR	*5*	1 Water Resources/Economist, 1 Finance/Economist, 1 Economist, 1 Environmental, 1 irrigation/water resources modeler	HS	S

GW = Groundwater; SW = Surface water.

Other Project Data

Borrower/Executing Agency:

FOLLOW-ON OPERATIONS

Operation	*Credit no.*	*Amount (US$ million)*	*Board date*
Xiaolangdi II	L4200	430	6/24/1997

XIAOLANGDI MULTIPURPOSE PROJECT II (LOAN 4200)

Key Project Data *(amounts in US$ million)*

	Appraisal estimate	*Actual or current estimate*	*Actual as % of appraisal estimate*
Total project costs	2855.8		
Loan amount	430.0	309.5	72
Cofinancing	-	-	-
Cancellation	-	80.5	-

Cumulative Estimated and Actual Disbursements

	FY98	*FY99*	*FY00*	*FY01*	*FY02*	*FY03*	*FY04*
Appraisal estimate (US$M)	80.0	210.0	340.0	410.0	430.0	430.0	430.0
Actual (US$M)	7.2	110.0	195.4	234.9	306.5	349.4	351.5
Actual as % of appraisal	9	52	57	57	71	72	72

Date of final disbursement: 4/30/2004

Project Dates

	Original	Actual
PCD	-	2/28/1997
Appraisal	-	2/28/1997
Board approval	-	6/24/1997
Effectiveness	10/31/1997	1/12/1998
MTR	07/31/1999	6/11/2002
Closing date	12/31/2003	12/31/2003

Staff Inputs (staff weeks)

Stage of project cycle	Actual/Latest Estimate	
	No. of staff weeks	US$ ('000)
Indentification/preappraisal	130	650
Appraisal/negotiation	50	200
Supervision	64	460
ICR	8	25
Total	252	1305

Mission Data

Date (month/year)	No. of persons	Specializations represented	Implemen. progress	Develop. objective
Identification/Preparation				
3/10/97				
Appraisal/Negotiation				
03/11/1997		Mission Leader/Water Resources (1), Economist (5), Dam Specialist (3), Resettlement Specialist (1), Environmental Specialist (3), Financial Specialist (2), Flood Forecasting Specialist (1), Sediment Specialist (1), Reservior Operations (1)		
Supervision				
06/03/1998	8	Mission Leader (1); Dam Engineer (1); Financial Analyst (1); Dam/Tunnel Specialist (1); Geotech. Specialist (1); Environment Specialist (1); Hydraulics Specialist (1); Flood Forecast Spl. (1)	S	HS
11/02/1998	6	Water Resources Eng (1); Water Resources Spec. (1); Dam/Tunnel Specialist (1); Geotech. Specialist (1); Environment Specialist (1); Financial Analyst (1)	S	HS
03/30/2000	10	Water Resources Spl (3); Claims Specialist (1); Financial Analyst (2); Dam/Tunnel Specialist (1); Geotechnical Spl (1); Environmental Spl (2)	S	HS
09/06/2001	5	Task Team Leader (1); Water	S	HS

	Date (month/year)	No. of persons	Specializations represented	Implemen. progress	Develop. objective
			Resources Spcl. (1); Environmental Spcl. (1); Financial Specialist (1); Dam Specialist (1)		
	11/03/2002	6	TTL, Water Resources (1); Dam Specilaist (1); Water Engineering (1); Geotechnical Engineer (1); Environment Management (1); Economic Analysis (1)	S	HS
ICR	10/03/2003	6	Task Team Leader (1); Water Resources Spcl/Economist. (1); Environmental Spcl. (1); Financial Specialist (1); Dam Specialist/Modeller (1) And Irrigation Specialist(1)	S	HS

Other Project Data

Borrower/Executing Agency:

FOLLOW-ON OPERATIONS

Operation	Credit no.	Amount (US$ million)	Board date

NONE

TARIM BASIN II PROJECT (LOAN 4341 AND CREDIT 3093)

Key Project Data *(amounts in US$ million)*

	Appraisal estimate	*Actual or current estimate*	*Actual as % of appraisal estimate*
Total project costs	272.6		
Loan/credit amount	150.0	146.7	97
Cofinancing	-	-	-
Cancellation	-	2.6	-

Cumulative Estimated and Actual Disbursements

	FY99	*FY00*	*FY01*	*FY02*	*FY03*	*FY04*
Appraisal estimate (US$M)	20.1	57.3	98.8	127.5	143.8	150.0
Actual (US$M)	12.9	23.9	49.5	74.1	105.9	139.5
Actual as % of appraisal	64	42	50	58	74	93
Date of final disbursement:	10/19/2003					

Project Dates

	Original	*Actual*
PCD	-	3/19/1997
Appraisal	-	2/9/1998
Board approval	-	6/9/1998
Effectiveness	10/31/1998	12/18/1998
MTR	-	11/30/2001
Closing date	12/05/2004	12/31/2005

Staff Inputs (staff weeks)

Stage of project cycle	*Actual/Latest Estimate*	
	No. of staff weeks	*US$ ('000)*
Identification/preappraisal	-	495.38
Appraisal/negotiation	-	-
Supervision	-	696.53
ICR	-	-
Total	-	1191.91

Mission Data

Date (month/year)	No. of persons	Specializations represented	Implemen. progress	Develop. objective
Identification/Preparation				
09/15/1996	3	Irrigation Economist(1) Water Resources Engin (2)		
11/25/1996	4	Irrigation Economist(1); Water Resources Engin(1); Drainage Engineer (1); Anthropoligist (1)		
03/25/1997	2	Irrigation Economist(1); Water Resources Engin (1)		
05/18/1997	11	Water Resour. Engin. (2); Irrigation Economist(1); Environmental Spec. (1); Economist (1); Institutional/Financial Spec. (1); Anthropologist; (1) Revier Basiin Mgt. Engineer (1) Water Administration /Sidd Spec. (1); Farmer Org. Spec (1); Drainage Engin (1)		
Appraisal/Negotiation				
02/15/1998	8	Water Resour. Engineer (2); Water Resour. Management Spec. (1) Irrigation Engin. (1); Environ.Spec. (1); Operations Officer (1); Drainage Engineer (1); Financial Managment Spec. (1)		
Supervision				
11/14/1998	7	Wat. Rs. Eng. (Co-Ttl) (2); Fin. Mgt. Spec. (1); Procurement Spec. (2); Disbursement Spec. (1); Ipm Spec. (1)	S	S
05/07/1999	6	Co-TTL Wat. Res. Eng. (2); Agri./Enviromentalist (1); Institutional Spec. (1); Wat. Res. Man. Spec. (1); Agri./Ipm Spec. (1)	S	S
05/07/1999	4	Co-TTL Wat. Res. Eng. (2); Economist (1); Institutional Spec. (1)	S	S
05/07/1999	4	Co-TTL Wat.Res.Eng. (2); Economist (1); Institutional Spec. (1)	S	S
05/07/1999	3	Co-TTL (2); Procurement (1)	S	S
10/27/2000	3	Co-TTL - Wat. Res. Eng (2); Procurement Specialist (1)	U	S
06/08/2001	8	TTL (1); Economist (2); Irrigation Spec. (1); Water Resources Spec. (1); Social Spec. (1); Consultant (1); Interpreter (1)	S	S
11/30/2001	6	TTL (1); Water Resources Spec. (1); Economist (2); Irrigation Spec (1); Social Spec (1)	S	S
06/22/2002	9	TTL - Wat. Res. Eng. (1); Wat. Res. Eng. (1); Economist (1); Fin. Man. Spec. (1); Procurement Spec. (1); Institutional Spec. (1); Irrigation Engineer (1); Remote Sensing Spec. (2)	S	S
11/30/2002	5	Team Leader (1); Water Resources Engine (1); Irrigation Engineer (1); Agricultural Specialis (1); Procurement	S	S

	Date (month/year)	No. of persons	Specializations represented	Implemen. progress	Develop. objective
			Specialist (1)		
	11/14/2003	3	Co-TTL Wr Engineer (1); Co-TTL Irrigation Spec (1); Sidd/Wua Spec (1)	HS	HS
	12/04/2004	4	Water Resources Spec.(1); Irrigation Engin. (1); Social Devl. Spec. (1); Agri. Economist (1)	HS	HS
ICR	03/2005	4	Irrigation Spec. (2); Water Resour. Spec (1)	HS	HS

Other Project Data

Borrower/Executing Agency:

FOLLOW-ON OPERATIONS

Operation	Credit no.	Amount (US$ million)	Board date
NONE			