



## Completion Report

---

Project Number: 39652-033  
Loan Number: 2408  
April 2013

### People's Republic of China: Gansu Heihe Rural Hydropower Development Investment Program— Dagushan Hydropower Project

Asian Development Bank

## CURRENCY EQUIVALENTS

Currency Unit      –      yuan (CNY)

		<b>At Appraisal</b> (26 November 2007)	<b>At Project Completion</b> (13 March 2012)
CNY1.00	=	\$0.136	\$0.160
\$1.00	=	CNY7.37	CNY6.33

## ABBREVIATIONS

ADB	–	Asian Development Bank
CAIDI	–	consumer average interruption duration index
CDM	–	Clean Development Mechanism
CDSP	–	community development strategy and plan
CER	–	certified emission reduction
DHC	–	Dagushan Hydropower Company
DHP	–	Dagushan Hydropower Project
EHC	–	Erlongshan Hydropower Company
EHP	–	Erlongshan Hydropower Project
EIA	–	environmental impact assessment
EMP	–	environmental management plan
EMU	–	environmental management unit
EIRR	–	economic internal rate of return
FIRR	–	financial internal rate of return
GPEPB	–	Gansu Provincial Environment Protection Bureau
GPG	–	Gansu provincial government
HHDC	–	Heihe Hydropower Development Company
HPP	–	hydropower plant
ICB	–	International competitive bidding
LIBOR	–	London interbank offered rate
MFF	–	multitranche financing facility
NCB	–	national competitive bidding
O&M	–	operation and maintenance
PMO	–	project management office
PPTA	–	project preparatory technical assistance
PRC	–	People's Republic of China
QNNR	–	Qilian Mountain National Nature Reserve
TA	–	technical assistance
UNFCCC	–	United Nations Framework Convention on Climate Change
WACC	–	weighted average cost of capital
WTP	–	willingness to pay
XHC	–	Xiaogushan Hydropower Company
XHP	–	Xiaogushan Hydropower Project
ZCG	–	Zhangye city government
ZEMS	–	Zhangye Environmental Monitoring Station

## WEIGHTS AND MEASURES

GWh	–	gigawatt-hour
km	–	kilometer
kV	–	kilovolt
mu	–	Chinese unit of measurement (1 mu = 666.67 square meters)
MW	–	megawatt
ton	–	1,000 kg

## NOTES

- (i) The fiscal year (FY) of the government ends on 31 December.
- (ii) In this report, “\$” refers to US dollars.

<b>Vice President</b>	S. Groff, Operations 2
<b>Director General</b>	R. Wihtol, East Asia Department (EARD)
<b>Country Director</b>	H. Sharif, People’s Republic of China (PRC) Resident Mission, EARD
<b>Team leader</b>	X. Liu, Senior Project Officer (Energy), PRC Resident Mission, EARD
<b>Team members</b>	F. Wang, Senior Project Officer (Financial Management), PRC Resident Mission, EARD
	W. Zhu, Senior Safeguards Officer (Resettlement), PRC Resident Mission, EARD
	Z. Niu, Senior Project Officer (Environment), PRC Resident Mission, EARD
	Y. Tao, Associate Project Analyst, PRC Resident Mission, EARD
	J. Li, Operations Assistant, PRC Resident Mission, EARD

In preparing any country program or strategy, financing any project, or by making any designation of or reference to a particular territory or geographic area in this document, the Asian Development Bank does not intend to make any judgments as to the legal or other status of any territory or area.

## CONTENTS

	Page
BASIC DATA	i
I. PROJECT DESCRIPTION	1
II. EVALUATION OF DESIGN AND IMPLEMENTATION	1
A. Relevance of Design and Formulation	1
B. Project Output	2
C. Project Costs	3
D. Disbursements	4
E. Project Schedule	4
F. Implementation Arrangements	4
G. Conditions and Covenants	5
H. Consultant Recruitment and Procurement	5
I. Performance of Consultants, Contractors, and Suppliers	5
J. Performance of the Borrower and the Executing Agency	6
K. Performance of the Asian Development Bank	6
III. EVALUATION OF PERFORMANCE	6
A. Relevance	6
B. Effectiveness in Achieving Outcome	7
C. Efficiency in Achieving Outcome and Output	7
D. Preliminary Assessment of Sustainability	8
E. Impact	8
IV. OVERALL ASSESSMENT AND RECOMMENDATIONS	11
A. Overall Assessment	11
B. Lessons	11
C. Recommendations	12
APPENDIXES	
1. Project Framework	13
2. Chronology of the Major Events in the Project's History	15
3. Project Cost and Financing Plan	16
4. Projected and Actual Contract Awards and Disbursements	17
5. Planned and Actual Implementation Schedule	18
6. Organization Chart of Erlongshan Hydropower Company	19
7. Status of Compliance with Loan Covenants	20
8. Summary of Contract Packages	27
9. Financial Reevaluation	28
10. Economic Reevaluation	32
11. Environmental Impact Analysis	34
12. Evaluation of Land Acquisition and Resettlement Activities	38
13. Social Impact, Poverty Reduction, and Community Development	42

## BASIC DATA

### A. Loan Identification

1.	Country	People's Republic of China
2.	Loan Number	2408-PRC
3.	Project Title	Gansu Heihe Rural Hydropower Development Investment Program – Dagushan Hydropower Project
4.	Borrower	People's Republic of China
5.	Executing Agency	Gansu provincial government
6.	Amount of Loan	\$28,000,000.00
7.	Project Completion Report Number	PCR: PRC 1386

### B. Loan Data

1.	Fact-finding (appraisal waived)	
	– Date Started	17 July 2006
	– Date Completed	1 August 2006
2.	Loan Negotiations	
	– Date Started	10 January 2008
	– Date Completed	11 January 2008
3.	Date of Board Approval	Multitranchise financing facility approved by the Board on 13 December 2006 Loan 2408-PRC approved on 28 January 2008
4.	Date of Loan Agreement	4 March 2008
5.	Date of Loan Effectiveness	
	– In Loan Agreement	1 June 2008
	– Actual	27 June 2008
	– Number of Extensions	1
6.	Closing Date	
	– In Loan Agreement	31 December 2012
	– Actual	13 March 2012
	– Number of Extensions	0
7.	Terms of Loan	
	– Interest Rate	London interbank offered rate (LIBOR)–based
	– Maturity	24 years
	– Grace Period	4 years

8. Terms of Relending (if any)
- Interest Rate LIBOR-based
  - Maturity 24 years
  - Grace Period 4 years
  - Second-Step Borrower Gansu Zhangye Dagushan Hydropower Company

9. Disbursements

a. Dates

Initial Disbursement	Final Disbursement	Time Interval
23 October 2008	19 October 2011	36 months
Effective Date	Original Closing Date	Time Interval
27 June 2008	31 December 2012	54 months

b. Amount (\$)

Category	Original Allocation	Last Revised Allocation	Net Amount Available	Amount Disbursed
Civil Works – Headrace Tunnel	12,020,000	13,596,227	13,596,227	13,596,227
Civil Works – Surge Shaft	5,660,000	6,079,424	6,079,424	6,079,424
Civil Works – Power House	4,060,000	3,876,717	3,876,717	3,876,717
Equipment – Power Plant	5,330,000	4,447,632	4,447,632	4,447,632
Equipment – Hydromechanical	430,000	0	0	0
Equipment – Environment Protection	400,000	0	0	0
Consulting Services	100,000	0	0	0
<b>Total</b>	<b>28,000,000</b>	<b>28,000,000</b>	<b>28,000,000</b>	<b>28,000,000</b>

10. Local Costs (Financed): None

**C. Project Data**

1. Project Cost (\$ million)

Cost	Appraisal Estimate	Actual
Foreign Exchange Cost	28.00	28.00
Local Currency Cost	33.92	43.99
<b>Total</b>	<b>61.92</b>	<b>71.99</b>

Note: The project cost increase was mainly due to the appreciation of the yuan, which appreciated by 16.4% during project implementation.

## 2. Financing Plan (\$ million)

Source	Appraisal				Actual			
	Foreign	Local	Total	%	Foreign	Local	Total	%
<b>A Loans</b>								
1. ADB	28.00	0.00	28.00	45.2	28.00	0.00	28.00	38.9
2. Domestic Banks		21.47	21.47	34.7		29.07	29.07	40.4
<b>Subtotal (A)</b>	<b>28.00</b>	<b>21.47</b>	<b>49.47</b>	<b>79.9</b>	<b>28.00</b>	<b>29.07</b>	<b>57.07</b>	<b>79.3</b>
<b>B Equity Capital</b>	<b>0.00</b>	<b>12.45</b>	<b>12.45</b>	<b>20.1</b>	<b>0.00</b>	<b>14.92</b>	<b>14.92</b>	<b>20.7</b>
<b>Total</b>	<b>28.00</b>	<b>33.92</b>	<b>61.92</b>	<b>100.0</b>	<b>28.00</b>	<b>43.99</b>	<b>71.99</b>	<b>100.0</b>

ADB = Asian Development Bank.

## 3. Cost Breakdown, by Project Component (\$ million)

Component	Appraisal			Actual		
	Foreign	Local	Total	Foreign	Local	Total
<b>A. Base Cost</b>						
1. Civil Works			21.74 14.22 35.96			23.57 29.30 52.88
2. Power Plant Equipment			5.33 2.86 8.19			4.43 6.18 10.61
3. Hydromechanical and Service Equipment			0.43 2.92 3.35			0.00 0.00 0.00
4. Environment Protection			0.40 0.00 0.40			0.00 0.80 0.80
5. Power Transmission and Distribution			0.00 0.90 0.90			0.00 0.73 0.73
6. Design and Supervision			0.10 3.14 3.24			0.00 3.99 3.99
7. Land Acquisition and Other Charges			0.00 0.00 0.00			0.00 0.14 0.14
<b>Total Project Base Cost</b>	<b>28.00</b>	<b>24.04</b>	<b>52.04</b>	<b>28.00</b>	<b>41.15</b>	<b>69.15</b>
<b>B. Contingencies</b>						
1. Physical Contingencies			0.00 2.60 2.60			0.00 0.00 0.00
2. Price Contingencies			0.00 1.06 1.06			0.00 0.00 0.00
<b>C. Financial Charges during Development</b>	<b>0.00</b>	<b>6.22</b>	<b>6.22</b>	<b>0.00</b>	<b>2.84</b>	<b>2.84</b>
<b>Total Project Cost</b>	<b>28.00</b>	<b>33.92</b>	<b>61.92</b>	<b>28.00</b>	<b>43.99</b>	<b>71.99</b>

## 4. Project Schedule

Item	Appraisal Estimate	Actual
Date of Contract with Consultants		July 2007
Completion of Engineering Designs	February 2007	February 2007
Civil Works Contract		
Date of Award	June 2008	June 2008
Completion of Work	July 2009	July 2009
Equipment and Supplies		

Dates		
First Procurement	June 2008	June 2008
Last Procurement	November 2008	November 2008
Completion of Equipment Installation	December 2011	December 2008
Start of Operations		
Completion of Tests and Commissioning	June 2012	July 2009
Beginning of Start-Up	June 2012	July 2009

#### 5. Project Performance Report Ratings

Implementation Period	Rating	
	Development Objectives	Implementation Progress
28 June 2008 to 31 December 2008	Satisfactory	Highly Satisfactory
1 January 2009 to 30 June 2009	Satisfactory	Highly Satisfactory
1 July 2009 to 31 December 2009	Satisfactory	Highly Satisfactory
1 January 2010 to 31 December 2010	Satisfactory	Highly Satisfactory
1 January 2011 to 31 December 2011	Green/On Track	Green/On Track
1 January 2012 to 13 March 2012	Green/On Track	Green/On track

#### D. Data on Asian Development Bank Missions

Name of Mission	Date	No. of Persons	No. of Person-Days	Specialization of Members
Fact-Finding Mission for Multitranche Financing	17 July–1 August 2006	6	36	a, b, c, d, e, f
Facility Appraisal Mission	6–22 August 2007	3	28	b, e, g
Loan Inception Mission	16–21 July 2008	2	10	e, g
Midterm Review Mission	9–16 March 2009	3	21	e, f, g
Loan Review Mission	8–15 October 2010	4	25	c, f, g, h
Loan Review Mission	8–12 August 2011	3	12	c, f, g
Project Completion Review	9–16 October 2012	4	24	c, f, g, h

a = financial analyst, b = counsel, c = environment specialist or consultant, d = social development specialist or consultant, e = energy specialist, f = project officer, g = project analyst, h = resettlement officer, i = project assistant.



## I. PROJECT DESCRIPTION

1. The Heihe River, originating between Qilian Mountain and Datong Mountain, is the second-largest inland river in the People's Republic of China (PRC) and the largest in the Hexi corridor. The Dagushan Hydropower Project (DHP) was part of the Heihe River Cascade Hydropower Development Scheme<sup>1</sup> in Zhangye City, Gansu Province. The hydropower plant is the fifth cascade hydropower plant in the scheme as its upstream intake is connected with the tailwater of the Erlongshan Hydropower Project (EHP), and its downstream outlet is connected with Xiaogushan Hydropower Project (XHP). The project consisted of the construction of a medium-sized<sup>2</sup> hydropower plant with a design capacity of 65 megawatts (MW) and average annual generation of 216 gigawatt-hours (GWh) of electricity, and 110 kilovolt (kV) transmission lines connecting the power plant to the Heihe grid substation. The project was built in the remote and impoverished rural area of Zhangye City, in the middle part of the Heihe Valley in Sunan County.

2. The project was the second tranche of the Gansu Heihe Rural Hydropower Development Investment Program financed by the Asian Development Bank (ADB) as a multitranche financing facility (MFF).<sup>3</sup> ADB approved the \$50.0 million investment program to finance two tranches for the construction of the EHP and the DHP on 13 December 2006. The investment program was aimed at providing an environmentally friendly power supply to support economic growth in the rural areas of Gansu Province. This was to be achieved by providing hydropower generation closer to the rural areas of Zhangye City and the Hexi corridor. The first tranche (\$22 million) under Loan 2296-PRC was approved on 18 December 2006, fully implemented in April 2008, and rated *highly successful* by ADB in its project completion report in 2011. The second tranche (\$28 million) under Loan 2408-PRC (the project)<sup>4</sup> was approved on 28 January 2008 and the loan took effect on 27 June 2008. Appendix 1 shows the project framework at appraisal and the achievements at completion, and Appendix 2 presents the history of the project.

## II. EVALUATION OF DESIGN AND IMPLEMENTATION

### A. Relevance of Design and Formulation

3. Heavy dependence on coal as an energy source causes substantial harm to the environment. Recognizing that fossil fuel dominance is neither environmentally sustainable nor economically desirable, the Government of the PRC (the government) is strongly committed to

---

<sup>1</sup> The scheme is a large infrastructure project with seven discrete run-of-the-river medium-sized hydropower projects in Zhangye City. Construction of the scheme was started in 1996, to develop an aggregate of 645.5 megawatts (MW) of hydropower capacity. The 102 MW Xiaogushan Hydropower Project (XHP), the sixth cascade hydropower plant in the scheme, was supported by the Asian Development Bank (ADB) under the Gansu Clean Energy Development Project (Loan 2032-PRC). The 50.5 MW Erlongshan Hydropower Project (EHP, the fourth cascade hydropower plant in the scheme, supported under Loan 2296-PRC) and the 65 MW DHP (the fifth cascade hydropower plant in the scheme, supported under Loan 2408-PRC), were packaged as two tranches of the Gansu Heihe Rural Hydropower Development Investment Program multitranche financing facility (MFF). The XHP was fully completed in October 2007 and the EHP in April 2008, and both projects were rated *highly successful* by ADB in its project completion reports.

<sup>2</sup> In the PRC, hydropower plants of less than 50 MW are classified as small, and those between 50 MW and 300 MW are classified as medium-sized.

<sup>3</sup> ADB. 2006. *Report and Recommendation of the President to the Board of Directors: Proposed Multitranchise Financing Facility to the People's Republic of China for the Gansu Heihe Rural Hydropower Development Investment Program*. Manila (MFF 0008-PRC).

<sup>4</sup> ADB. 2008. *People's Republic of China: Gansu Heihe Rural Hydropower Development Investment Program (MFF)—Periodic Financing Request 2 Report*. Manila.

improving energy efficiency, developing renewable sources to diversify the country's energy supply mix, reducing emissions, and lessening the adverse effects of global warming and climate change. To achieve these objectives, the government has set mandatory targets and incentive-based policies.

4. The energy sector has been a priority area for ADB since it started operations in the PRC in 1986. In Strategy 2020, ADB's long-term strategic framework for 2008–2020,<sup>5</sup> ADB identifies the energy sector as a core operational sector and environmental sustainability as a key strategic priority. ADB has introduced new initiatives to augment its assistance for developing member countries to acquire low-carbon technologies and implement energy efficiency projects. Further, ADB's country partnership strategy (CPS) 2011–2015<sup>6</sup> emphasizes clean and efficient technologies to promote the use of renewable energy and help reduce greenhouse gas emissions in the PRC, consistent with the strategic priorities of ADB and the PRC in the energy sector.

5. The development of the Heihe River scheme is consistent with Gansu provincial government (GPG) objectives to promote hydropower development to meet growing electricity demand in an environmentally sustainable manner. The scheme is an integral part of the power system planning and least-cost generation expansion plan in Gansu Province to provide additional generation capacity. The scheme is a core infrastructure project included in the investment plan of the Zhangye city government (ZCG) for 2006–2010. To accelerate the development of the scheme, the ZCG established Heihe Hydropower Development (HHDC)<sup>7</sup> in 2000. The ZCG and GPG requested ADB's assistance in 2001 for the Xiaogushan Hydropower Project (XHP) in the Heihe River Cascade Hydropower Development Scheme and its construction was fully completed in October 2007. The ZCG and GPG were committed to accelerating the implementation of the Cascade Hydropower Development Scheme and sought ADB's further assistance through the MFF investment program to develop the Erlongshan and Dagushan hydropower projects.

6. The project preparatory technical assistance (PPTA)<sup>8</sup> was approved on 28 April 2006 and was implemented sequentially in two parts to prepare the two tranches for the EHP and the DHP. The first tranche for the EHP was approved on 18 December 2006 following the first phase of the PPTA, which was completed in July 2006. The second phase of the PPTA for the DHP was completed in October 2007. The PPTA was satisfactory and provided the input needed to prepare the project for ADB financing.

## B. Project Output

7. **Dagushan Hydropower Project.** The DHP consisted of construction of a medium-sized hydropower project with a designed installed capacity of 65 MW (2×26 MW + 1×13 MW) and designed annual generation of 216 GWh of electricity, and 110 kV transmission lines connecting the power plant to the Heihe grid substation. The project comprised the following: civil works, power plant equipment, hydromechanical equipment and metal structures, environmental management, and 13 kilometers (km) of 110 kV power transmission lines. The project was

<sup>5</sup> ADB. 2008. *Strategy 2020: The Long-Term Strategic Framework of the Asian Development Bank, 2008–2020*. Manila.

<sup>6</sup> ADB. 2012. *Country Partnership Strategy: People's Republic of China, 2011–2015*. Manila.

<sup>7</sup> HHDC is the parent company of both Erlongshan Hydropower Company (EHC, the implementing agency for the EHP) and Dagushan Hydropower Company (DHC, the implementing agency for the DHP).

<sup>8</sup> ADB. 2006. *Technical Assistance to the People's Republic of China for Preparing the Gansu Heihe Hydropower Development Project*. Manila (TA 4783-PRC, approved on 28 April 2006 for \$500,000).

completed in July 2009 and all three units were put into operation, more than 2 years ahead of the planned schedule. The DHP generated 162.3 GWh of electricity in 2009, 254.2 GWh in 2010, 259.1 GWh in 2011, and 270.1 GWh in 2012. The actual electricity output has exceeded the design capacity<sup>9</sup> and the plant has been operating satisfactorily since its commissioning in July 2009.

8. **Expanded and improved rural power network.** A parallel rural grid improvement project to renovate, modernize, and strengthen the 10 kV and 35 kV electricity distribution network was financed by the ZCG to provide an improved and more reliable electricity supply to rural consumers in five counties in Zhangye City. All the parallel rural grid renovation work was fully completed by 31 December 2009.

9. **Capacity development.** This component was mainly aimed at boosting the capacity of HHDC and Dagushan Hydropower Company (DHC) to seek carbon revenues under the Clean Development Mechanism (CDM) and integrating environmental and social issues into the project cycle. Training was provided to the GPG, the ZCG, the HHDC, and the DHC in strengthening environmental and social assessment and managing cascade hydropower development. Training was also provided to the HHDC and the DHC to strengthen their technical and marketing skills to seek carbon revenues. The DHP was successfully registered with the Executive Board of the United Nations Framework Convention on Climate Change (UNFCCC) as a CDM project on 9 May 2010,<sup>10</sup> with 170,015 certified emission reductions (CERs) estimated to be generated yearly. The British EcoSecurities Group signed a CER purchase agreement with the DHC for the purchase of CERs generated before 8 May 2017. The project actually over-generated and was issued with 195,751 CERs from the start of the crediting period from 9 May 2010 to 31 March 2011, with carbon revenues of CNY16.70 million, which significantly improved the financial performance of the DHC.

### C. Project Costs

10. The actual project cost in US dollar terms was \$71.99 million, compared with \$61.92 million estimated at appraisal (16.3% increase). The increase was mainly due to the appreciation of the yuan.<sup>11</sup> In local currency terms, the project cost at appraisal was CNY456.4 million, compared with the actual cost of CNY455.7 million (actual savings of CNY700,000). The actual ADB financing was \$28.0 million and the counterpart funds amounting to \$43.99 million were mobilized from stockholders and local banks in a timely manner, ensuring smooth project implementation.

11. There was no significant discrepancy between the financing plan at appraisal and actual financing in regard to the ADB loan, domestic loans, or equity capital. The equity capital accounted for 20.73% of the total funding, compared with the 20.11% estimated at appraisal. The detailed project cost and summary financing plan is in Appendix 3.

<sup>9</sup> The designed annual power generation was 216 GWh. The major reasons for actual higher power generation could be: (i) there was more water flow in the past few years; (ii) turbine-generator efficiency improved, due to good water quality resulting from completion and operation of upstream four hydropower stations; (iii) water head loss decreased as a result of lowered tunnel lining roughness factor due to reduced tunnel lining thickness and improved design during construction, and (iv) optimal operation and management of the project to make best use of water resources.

<sup>10</sup> CDM Board registration number CN-3045.

<sup>11</sup> The exchange rate used at appraisal was \$1 = CNY7.37 (26 November 2007), while the exchange rate used at project completion was \$1 = CNY6.33 (13 March 2012). The yuan appreciated by 16.4% during project implementation.

## **D. Disbursements**

12. Loan proceeds were withdrawn in accordance with ADB's standard disbursement procedures. Disbursements totaled \$28 million, which was 100% of the net ADB loan. The reimbursement procedure was adopted for equipment procurement and civil works contracts. From the ADB loan, \$25.6 million (91.4% of the loan amount) was paid in 2008 and 2009 based on the condensed construction schedule. Most of the contracts, including the civil works contracts, the major equipment purchases, and installment contracts, were implemented during that period. Overall, disbursement was consistent with the physical implementation schedule and annual disbursement projections. Appendix 4 shows the actual contract awards and disbursements.

## **E. Project Schedule**

13. ADB approved the investment program as an MFF of \$50.0 million on 13 December 2006. The MFF included two tranches for the construction of the Erlongshan and Dagushan hydropower projects.<sup>12</sup> On 28 January 2008, ADB approved a \$28 million loan from its ordinary capital resources for the second tranche to construct the DHP. The loan and project agreements were signed on 4 March 2008 and the loan took effect on 27 June 2008. Preconstruction activities, such as the feasibility study, preliminary design, preparation of bidding documents, and tendering, began in November 2006. The main construction works started from April 2007, and the civil works were completed in July 2009. The 110 kV transmission line connecting the DHP to the Heihe grid substation was completed in November 2007. All three generating units of the DHP were commissioned in July 2009. By the end of July 2009, the project was fully completed and all three units were put into operation, more than 2 years ahead of the schedule envisaged at appraisal. The original project physical completion date was 30 June 2012, and the original loan closing date was 31 December 2012. The loan account was closed on 13 March 2012 with full disbursement of the loan amount of \$28 million. Appendix 5 compares the actual project implementation schedule with the schedule envisaged at appraisal.

## **F. Implementation Arrangements**

14. The GPG was the executing agency for the project. The implementing agency was the DHC, a joint stock company set up by HHDC (89.4%) and one private sector shareholder (10.6%), in line with the Company Law of the PRC, to undertake project development. The DHC's five board members hold 3-year terms, and the board chairman is also chairman of the HHDC. The board of supervisors has three members. A project management office (PMO) was set up within the DHC to facilitate land acquisition issues, carry out social and environmental protection measures, and address local concerns.

15. The DHC has its head office in Zhangye City and set up a project office at the power station site as well. In addition to the PMO, the DHC set up six departments – financial, comprehensive, technical, planning, material, and human resource departments. The PMO was responsible for ADB loan application, liaison, negotiation, and compiling annual audit reports, while the financial department had overall responsibility for disbursement and financial management. Close coordination between the PMO and the finance department contributed to the smooth implementation of the project.

<sup>12</sup> The first tranche for the EHP was approved on 18 December 2006 under Loan 2296-PRC. The EHP was fully implemented and completed by April 2008, and the loan account was closed on 1 April 2012.

16. The implementation arrangements were satisfactory and were followed as envisaged at appraisal. The DHC's project management, financial management, environmental and social assessment and management, performance management capacity, and technical and marketing skills to seek carbon revenues were strengthened through domestic training, overseas study tours, and consulting services. An organization chart of the DHC is in Appendix 6.

## **G. Conditions and Covenants**

17. All major loan covenants concerning implementation arrangements, environmental protection, social and resettlement issues, and economic and financial performance were generally complied with. Project reporting was adequate, except for social safeguard monitoring where delayed recruitment of an external monitor resulted in late report submission and inadequate baseline and implementation information. Project audit was conducted by the Gansu Provincial Audit Office and four audit reports were submitted on time. The reports were useful in identifying and correcting issues and weaknesses in project implementation and DHC operation. Appendix 7 presents the status of compliance with the loan covenants.

## **H. Consultant Recruitment and Procurement**

18. An international consulting firm was hired by the DHC with domestic funds. The contract for the consulting services was signed between the DHC and the Consultant in July 2008.

19. ADB approved advance action to expedite the procurement of civil works and critical equipment and retroactive financing up to 20% of the loan for equipment and civil works for the period between 21 January 2008 and 28 June 2008. Nine contract packages financed by ADB, including four for civil works and five for equipment packages, were procured according to ADB's Procurement Guidelines 2007 (as amended from time to time) using advanced actions. The DHC hired a procurement agent to help handle procurement activities using international competitive bidding (ICB) and national competitive bidding (NCB). The DHC procured all ADB-financed components comprising five ICB packages and four NCB packages for the project in a timely manner with the assistance of the procurement agent. A summary of the procurement undertaken is in Appendix 8.

## **I. Performance of Consultants, Contractors, and Suppliers**

20. The performance of the consultants, contractors, and suppliers was *satisfactory*. The international consulting firm for the project provided strong support in the construction, and organized training on financial management, project management, and ADB loan policies and procedures, and overseas studies to introduce advanced knowledge and share good practices and experiences in construction and operation management for hydropower plants for DHC staff at various levels. The international consulting firm also assisted the DHC in preparing and submitting quarterly progress reports, which strengthened project implementation. The supervision company capably supervised project quality and progress, and controlled and coordinated project funding. It also prepared monthly supervision reports, which provided suggested measures to address problems and ensure timely action by the DHC. Its key role in assisting DHC to ensure the achievement of project construction targets was acknowledged by the DHC and the construction companies. Civil works constructed by national contractors were completed satisfactorily and complied with the contract specifications and quality requirements.

The suppliers of equipment also performed satisfactorily with timely delivery and installation of equipment and facilities, which are operating satisfactorily.

#### **J. Performance of the Borrower and the Executing Agency**

21. The borrower<sup>13</sup> and the GPG provided full support to project implementation. The loan signing and requirements for loan effectiveness were completed in reasonable time and thus done efficiently. The DHC had a strong and experienced team to implement the project efficiently with the support of key staff from the HHDC, Xiaogushan Hydropower Company (XHC), and Erlongshan Hydropower Company (EHC). The schedule, quality, and cost of construction were managed well, and adequate counterpart funds were provided in a timely manner. In general, the performance of the borrower, the GPG as the executing agency, and the DHC as the implementing agency was *highly satisfactory*.

#### **K. Performance of the Asian Development Bank**

22. ADB *satisfactorily* managed and administered the project, which was the second and last tranche of the first investment program developed under an MFF modality in the PRC. Its seven missions, involving 156 person-days, are considered adequate. ADB delegated the project administration to the PRC Resident Mission on 16 March 2009. During project implementation, ADB cooperated well with the GPG and the DHC, and provided clear guidance and action plans to resolve key issues in financial management, environment and resettlement monitoring, benefit monitoring, and reporting. Further, ADB officials visited the project site, and provided guidance and timely advice in packaging the project contracts and preparing documents for loan disbursements, and training project staff in procurement, contract management, and disbursements. These efforts helped to facilitate the smooth implementation and early commissioning of the hydropower facilities. The borrower, the GPG, and the DHC recognized the assistance and cooperation extended to them by ADB.<sup>14</sup>

### **III. EVALUATION OF PERFORMANCE**

#### **A. Relevance**

23. The project was highly relevant to the government's long-term strategic objectives, as well as those of ADB's country partnership strategy. It was consistent with the priorities of the government and ADB at the time of appraisal and completion, which concentrated on achieving balanced and sustainable growth with more efficient use of resources and more stringent protection of the environment. Environmental improvements related to clean energy were its strength. The project was aimed at and achieved an increased, more efficient, reliable, and sustainable power supply for Zhangye City and the Hexi corridor through an additional 65 MW of clean hydropower. With the improved electricity supply and displacement of emissions from coal-fired power plants, the local environmental quality was improved, and economic growth was supported. Through its capacity development program, the project improved the capacity of the DHC and its staff, making it an effective and efficient implementing and operating company. The project has substantially reduced greenhouse gas emissions and was successfully

<sup>13</sup> The PRC acting through the Ministry of Finance (MOF).

<sup>14</sup> One ADB official was granted the Dunhuang Award by the GPG in September 2008. The Dunhuang Award is the top award issued by the GPG every year since 1996 to foreign experts who have made valuable contributions to Gansu Province.

registered as a CDM project and realized carbon CER revenues. The project is therefore rated *highly relevant*.

## **B. Effectiveness in Achieving Outcome**

24. The implementation of the project followed the arrangements envisaged at appraisal. The development of clean energy has resulted in increased energy generation, and more reliable and affordable energy supply to rural consumers in Zhangye City and the Hexi corridor in Gansu Province. The project (i) encouraged greater use of indigenous renewable energy, (ii) improved corporate governance and management in the implementing agency, (iii) provided opportunities for job creation and income growth, (iv) increased fiscal revenues, (v) upgraded local infrastructure, and (vi) protected the regional ecology, and thus contributed to poverty reduction and sustainable development in the project area. By the time the project was put into operation in 2009, (i) the rural consumer average interruption duration index (CAIDI) in Zhangye City had improved by 82%,<sup>15</sup> (ii) a uniform urban–rural power tariff had been implemented, and (iii) the annual rural power consumption in Zhangye City had reached 313 GWh, a 38.5% increase over the 226 GWh in 2005. All expected outcomes and outputs of the project have been achieved, and the project has been commissioned more than 2 years ahead of schedule. The project is therefore rated *highly effective* in achieving its outcome.

## **C. Efficiency in Achieving Outcome and Output**

### **1. Efficiency of Investments**

25. The project's financial internal rate of return (FIRR) was reevaluated on the basis of the final cost estimates and financing plan, operation and maintenance (O&M) costs, and tariffs. The recalculated FIRR after tax was 6.07% without CER revenues and 6.90% with CER revenues, compared with the FIRRs estimated at appraisal of 5.65% without CER revenues and 6.59% with CER revenues. The slightly higher FIRR was mainly attributed to the higher amount of electricity generation. The after-tax weighted average cost of capital (WACC) was calculated on the basis of the actual capital mix and cost of various sources of financing. The London interbank offered rate (LIBOR) 10-year fixed swap rate plus a spread of 0.4% for the ADB loan, the actual interest rate of 7.05% for domestic loans, and 10% for the cost of equity investment were used in the calculation. The recalculated WACC was 3.03%. The project's FIRR was higher than the WACC, making the project financially viable. Sensitivity analysis indicated that the project would remain viable with a 10% decrease in revenues or a 10% increase in O&M costs. Therefore, the project is rated financially *efficient*. Appendix 9 provides a detailed financial evaluation.

26. The reevaluated EIRR for the project was 21.2%, compared with 19.3% estimated at appraisal. The higher EIRR was attributed to the larger power generation volume and consumers' willingness to pay (WTP). Sensitivity analysis was carried out to test the impact of (i) an increase in O&M costs, (ii) a decrease in benefits, and (iii) a combination of (i) and (ii). The sensitive analysis shows that the project would continue to be economically robust under these conditions and is, therefore, rated economically *efficient*. A detailed economic evaluation is presented in Appendix 10.

<sup>15</sup> From 2006 to 2009, the rural CAIDIs in Zhangye City improved from 14h to 2.53h. Zhangye City got rid of its power shortage problem after 2009.

## **2. Efficiency of Process**

27. ADB's internal processing and support during implementation was efficient and satisfactory. The organization and management of the GPG and the DHC were highly effective and timely. The hydropower plant was commissioned more than 2 years ahead of schedule. The actual electricity output exceeded the design capacity. On this basis, the project is rated *efficient*.

### **D. Preliminary Assessment of Sustainability**

28. Under the project, power generation increased in Zhangye City and a stable supply of electricity, especially to the rural areas, was guaranteed. With increased supply and consumption of electricity, local industries have in turn been optimized and the development of the local economy has been stimulated. The statistical data show that socioeconomic conditions in the project areas have improved rapidly in recent years. From 2006 to 2011, per capita gross domestic product (GDP) in Zhangye City increased by 114%, or by an annual average of 16.5%, from CNY9,972 to CNY21,357. Per capita government fiscal revenues increased by 238%, or by an annual average of 27.6%, from CNY614 to CNY2,076. The annual income of rural farmers and herders in the project area has significantly increased during project implementation and operation. Per capita rural net income increased by 70%, or by 11.1% annually from CNY4,754 to CNY8,062. The FIRR and EIRR results meet the relevant evaluation criteria set by ADB. All financial indicators are in line with the requirements set forth in the Loan Agreement, and the financial targets established at appraisal are achievable in the long run. The project passed domestic official completion acceptance on 23 September 2011. The project facilities were built according to the required standards and specifications, and they were considered to be of sufficient quality to ensure that the project benefits could be sustained. The DHC staff have been adequately trained and have demonstrated capacity to operate and maintain the facilities to achieve the benefits over the long term. The project is therefore rated *highly likely* to be sustainable.

### **E. Impact**

#### **1. Environmental Impact**

29. The project was classified as environmental category A. As envisaged at appraisal, the project has yielded substantial positive environmental impact and benefits from a reduction in air pollution and greenhouse gas emissions by employing an alternative energy source. The project has provided a more reliable electricity supply to rural areas in Zhangye City to meet the growing electricity demand in an environmentally sustainable manner; reduced pressure on wood collection for fuel; and provided an alternative to burning coal for cooking and heating.

30. The project was successfully registered with the Executive Board of the United Nations Framework Convention on Climate Change as a CDM project on 9 May 2010, with 170,015 CERs to be generated annually, reducing greenhouse gas emissions from the use of carbon-intensive fossil fuels. The British EcoSecurities Group signed a CER purchase agreement with the DHC for the purchase of CERs of the project. The project actually over-generated and was issued with 195,751 CERs from the beginning of the crediting period of 9 May 2010 to 31 March 2011, with carbon revenues of CNY16.70 million received by DHC. The project achieved actual emission reductions of 232,859 CERs for the period of 1 April 2011 to 28 April 2012, and credits for this period are expected to be issued in early 2013.



31. During construction, all the contractors fulfilled their obligations to protect the environment and implemented mitigation measures in their construction schemes. The adverse effects of the project construction on the surrounding environment were thus minimized. The operation of the hydropower plant has had very little negative impact on the environment as the DHC has taken effective measures to manage solid waste and control groundwater pollution. Necessary environmental management approaches have been integrated into the regular operation of the plant. In addition, the project will produce significant environmental benefits by providing clean energy and reducing air pollution from conventional coal-fired power plants. It is estimated that the project can replace 82,771 tons of coal equivalent annually, with the expected avoided emissions of 174 tons of particulate matter, 173 tons of sulfur dioxide, and 415 tons of nitrogen oxides. Four environmental monitoring reports were posted on ADB website. Appendix 11 provides a summary assessment of the impact of the project on the environment.

## **2. Resettlement Impact**

32. According to the resettlement plan, a total of 35.1 mu<sup>16</sup> of grassland was permanently acquired, affecting one household with five people in Louzhuangzi Village of Mati Township, and 113.59 mu of grassland was temporarily occupied during project construction. In addition, one affected seasonal herding camp was reconstructed. The local people are mainly Tibetans and Sunan County is also home to the Yugur ethnic group. Requirements for both social safeguards were addressed in the short resettlement plan and the ongoing community development strategy and plan<sup>17</sup> set up for the XHP and the EHP and continuously implemented under the project to directly benefit the local minorities in the project area.

33. Land acquisition and resettlement began in November 2006 and was completed by January 2010. In total, 88.5 mu of land was permanently acquired and 200 mu was temporarily used. The permanent land acquisition affected only four Tibetan households in Louzhuangzi, Sidalong, and Hongwozi villages. In addition, one seasonal herding camp was demolished and rebuilt. Compared with the impact estimated in the resettlement plan, the project impact increased because additional lands were required during the construction of the power station structure, borrow pits, and office and accommodation buildings.

34. According to the resettlement plan, the compensation rates for permanent land acquisition, including land compensation and resettlement subsidies, were to be calculated on the basis of 10 times the average annual output per mu for grasslands. The total actual cost of land acquisition and resettlement was CNY174,826, 96% higher than estimated in the resettlement plan, because of the increased amount of land acquisition. The land acquisition and resettlement costs were totally funded by the DHC.

35. In general, the project land acquisition and resettlement activities were implemented well. Direct negotiations between the DHC and the affected herder families were efficient and

<sup>16</sup> The mu is a Chinese unit of measurement (1 mu = 666.67 square meters).

<sup>17</sup> A community development strategy and plan (CDSP) was prepared during the preparation of ADB financed Xiaogushan Hydropower Project (Loan 2032) in 2003. The implementation of CDSP was much appreciated by local ethnic communities and highly recognized by local authorities as well as implementing agency, which decided to continually implement the measures committed in the CDSP for the subsequent ADB financed MFF project in the same project area. During the preparation of loan 2408, the CDSP was being implemented well under loan 2296 (the first tranche), both the project team and Regional Sustainable Development Department (RSDD) agreed that additional specific measures were deemed not necessary but continually implement the CDSP to address ethnic minority issues under loan 2408.

culturally sensitive, and ensured transparency of land acquisition and resettlement implementation. The compensation funds were delivered to the affected persons on time. The affected households were satisfied with the resettlement implementation and their income has increased. Details of land acquisition and resettlement are in Appendix 12.

### **3. Social Impact and Minority Development**

36. The project has contributed to regional sustainable socioeconomic development, poverty reduction, and community development in the project area. The project area is a poor area of Gansu Province with an energy supply deficit. The supply shortage had seriously affected regional socioeconomic development in Sunan County. The construction and operation of the Dagushan Hydropower Project (DHP), in addition to the XHP and the EHP, has eased the energy supply deficit and improved the reliability of power supply during peak hours, thereby contributing to regional economic growth. In addition, the taxes paid by the project during construction and operation have also contributed to local government fiscal revenues, which could be used to improve social services and increase investment in economic development activities. The DHC has paid an average of CNY10 million yearly to the local government since the start of project operation. Various taxes paid by the XHC, the EHC, and the DHC have directly contributed to the growth of local government fiscal revenues, and indirectly to poverty reduction in Sunan County and Zhangye City. The statistical data show that socioeconomic conditions in project areas have improved rapidly in recent years. From 2006 to 2011, per capita gross domestic product in Sunan County increased by 228%, or by an annual average of 26.8%, from CNY15,872 to CNY52,006. Per capita government fiscal revenues increased by 258%, or by an annual average of 29%, from CNY3,234 to CNY11,562. The annual income of rural farmers and herders in the project area has significantly increased during project implementation and operation. From 2006 to 2011, the per capita annual net income in the rural areas of Sunan County increased by 70%, from CNY4,754 to CNY8,062.

37. A community development strategy and plan (footnote 16) was prepared and implemented during the previous ADB-financed XHP and EHP, and the DHC has continued to implement the measures identified under the plan to enhance project benefits to local communities. For example, the DHC widened and reconstructed the main road from Dayekou to Louzhuangzi Village and other villages during the early stage of project construction, making it more convenient for local people to go to the Zhangye downtown center for shopping, medical care, and livestock products trading.

38. The construction of the DHP created 30 temporary employment opportunities daily for local people with an average monthly salary of CNY 900 during the construction period. Since it started operation, DHP has generated approximately 30 permanent jobs with an annual income of CNY26,400, of which six full-time jobs have been assigned to women. Nearly 60% of the temporary employment opportunities during construction were provided to the poor. With the skills gained in civil works from the DHP, many of the laborers were hired in other projects after the project construction.

39. Gender development has been supported and promoted under the project, particularly with the improvements made in electricity supply, transportation, and telecommunication. Before the project, few people, especially women, left their communities in search of jobs. Now most young people do, and over 30% of migrants are female. Female employees enjoy wages equal to those of male employees for similar jobs. Women also participated actively in land acquisition and resettlement, particularly during the consultations on resettlement policies and compensation standards, land measurement, and family discussions on the use of the

compensation funds. A summary of social impact, poverty reduction, and ethnic minority development is in Appendix 13.

#### IV. OVERALL ASSESSMENT AND RECOMMENDATIONS

##### A. Overall Assessment

40. The project was *highly relevant* to the government's development strategy and ADB's energy sector policy for the PRC. It was successfully implemented and its objective of providing environmentally clean energy to support economic growth in the rural areas of Gansu was fully achieved. The implementation process was efficient. The social safeguard issues were managed satisfactorily. The environmental impact of the project is substantially positive, and all necessary mitigation measures were undertaken. Overall, the project's impact was *highly satisfactory*, and will continue to benefit the local people.

41. Through the joint efforts of project owners, the construction companies, supervision agents, and financial institutions including ADB, the project was completed and started producing electricity more than 2 years ahead of the schedule envisaged at appraisal. Project implementation was in line with the PRC's rules and regulations, as well as ADB's requirements and loan covenants. The plant has been operating smoothly since it was commissioned. No incidents of malfunctioning have been reported in the headworks, water diversion tunnels, plant equipment, power transmission line, or public utilities. The actual annual power generation exceeds the design capacity. The successful construction of the project has increased the power generation in the city and guaranteed stable electricity supply, especially in the rural areas. The increase in electricity supply and consumption has in turn allowed the local industry to maximize output as electricity is available 24 hours. The project has also allowed for all villages in rural areas to benefit from electricity supply leading to income growth for the poor. Through the project implementation, the institutional capacity of the DHC has been greatly strengthened and the managerial and operational competence of the company's managers and staff has improved considerably. The financial and economic viability of the project has been confirmed, with tariff revenues covering O&M costs, depreciation, and debt service. The expected project benefits have been fully realized and will be successfully maintained in the long run.

42. Overall, the project is rated *highly successful*. It was *highly relevant*, *highly effective*, and *efficient*, and its benefits are *highly likely* to be sustainable. The anticipated output was fully achieved, and the budget was well controlled.

##### B. Lessons

43. The strong government ownership is critical to the successful construction of the project and important to facilitate effective implementation and delivery of development results in ADB-financed projects. The DHC was consistently proactive and took initiative in solving problems, including the provision of design documents, timely delivery of equipment, approach to dealing with issues, and other areas. DHC's initiative guaranteed appropriate procedures and timely action for key tasks.

44. **Project management.** Deviations between the final project costs and the appraisal estimates were small. The results were achieved through coordinated efforts made by all parties involved in project implementation. Advance actions were taken to expedite the procurement of civil works and critical equipment. Effective bidding processes were vital in obtaining

advantageous bid offers. Proactive project management, both in equipment procurement and in construction, enabled capital cost savings and ensured the quality of construction and equipment supply. The selection and hiring of competent international and national consultants ensured that the quality standards required for the project were met.

45. **Counterpart financing.** The project funds comprised international funds and domestic funds. The timely availability of counterpart funds is a key factor for smooth project implementation. For the project, the actual ADB financing was \$28 million while the counterpart funds mobilized from stockholders and local banks amounted to \$43.99 million that was provided in a timely manner, assuring smooth project implementation and early project commissioning.

46. **Social development.** The project has contributed to sustainable socioeconomic development, poverty reduction, and ethnic minority development in the project area. The good practices under the project include (i) the continued implementation of the CDSP, which promotes the development of the local ethnic minority communities, and enables local people to benefit from the project in a manner compatible with their culture; and (ii) the great attention paid by the DHC to social issues throughout project implementation and operation, which strengthened its relationship with the local communities.

## C. Recommendations

### 1. Project Related

47. While the hydropower plant is operating efficiently, its long-term sustainability will require regular maintenance. Day-to-day monitoring and inspection works should be undertaken for the head station, water tunnel, and powerhouse. These include data analysis, daily maintenance, and repair work. Raising staff awareness of safety and security should be a regular activity of the DHC.

48. **Carbon revenues.** The project was successfully registered as a CDM project and was able to source significant amounts of revenues from the sale of carbon credits, thereby making it financially viable. This is a successful demonstration project that offers valuable lessons for other clean-energy developers in the region.

49. **Timing of the project performance evaluation report.** The project was the second and last tranche of the first MFF investment program developed in the PRC.<sup>18</sup> All the facilities under the project are fully operational. ADB could undertake a project performance evaluation review for the project in 2014.

### 2. General

50. The favorable experience with the project demonstrates that the development of clean and renewable energy can support sustainable development. ADB may consider supporting similar renewable energy projects in the PRC that are designed to minimize adverse environmental and social impact and effectively reduce greenhouse gas emissions.

---

<sup>18</sup> ADB. 2008. *Mainstreaming the Multitranchise Financing Facility*. Manila.

## PROJECT FRAMEWORK

Design Summary	Performance Indicators and Targets		Monitoring Mechanisms	Assumptions and Risks
	Appraisal	Actual		
<b>Impact</b>  Environmentally clean power supply supporting economic growth in the rural areas of Gansu Province	<p>Contribution of clean and renewable hydropower production increased from 19% in 2005 to 23% by 2015</p> <p>Rural economic growth sustained at an average of 6% up to 2015</p> <p>More than 99% of villages electrified by 2015</p>	<p>The share of hydropower production increased to 23% in 2011 in Gansu Province.</p> <p>From 2006 to 2011, rural per capita income increased by 10% annually in Zhangye City.</p> <p>All villages in Zhangye City had been electrified by 2011.</p>	<p>Statistical yearbook of Gansu Province and the PRC</p> <p>Statistical yearbook of Gansu</p> <p>Statistical yearbook of Gansu</p>	<p><b>Assumptions</b></p> <p>The PRC remains committed to promoting clean and renewable energy.</p> <p>Sound macroeconomic conditions continue in the PRC and Gansu.</p>
<b>Outcome</b>  Reliable, clean, and affordable hydropower supplied to rural consumers in Zhangye City of Gansu Province	<p>50% improvement in rural CAIDI by 2012</p> <p>Uniform urban–rural power tariffs enforced by 2012</p> <p>Increases in rural power consumption from 226 GWh in 2005 to more than 300 GWh by 2012</p>	<p>By 2009, rural CAIDI in Zhangye City had improved by 82%.</p> <p>By 2009, a uniform urban–rural power tariff (for urban and rural residences) had been implemented in Zhangye City.</p> <p>By 2009, rural power consumption in Zhangye City had reached 313 GWh.</p>	<p>Zhangye power bureau data, supported by consumer surveys at project completion</p> <p>Zhangye tariff schedule</p> <p>Zhangye power bureau data</p>	<p><b>Assumptions</b></p> <p>The priority given by the PRC to rural development is maintained and supported by adequate funds allocation.</p> <p>Ongoing tariff reforms continue and supply cost reductions due to efficiency gains are passed on to consumers.</p> <p>Rural grid improvement projects are implemented.</p>

Design Summary	Performance Indicators and Targets		Monitoring Mechanisms	Assumptions and Risks
	Appraisal	Actual		
<b>Output</b>				<b>Risks</b>
1. Dagushan Hydropower Project	65 MW incremental hydropower capacity and 216 GWh additional annual power produced by 2012	65 MW incremental hydropower capacity was added in July 2009 and the project generated 162.3 GWh of electricity in 2009, 254.2 GWh in 2010, 259.1 GWh in 2011, and 270.1 GWh in 2012.	Quarterly progress report, loan review missions, PPRs	Project costs increase and implementation is undermined by weak site geology.
2. Expanded and improved rural power network	35 kV and 10 kV rural power grid renovated in five counties in Zhangye City by 2009	By 2009, all power grid renovation work had been completed.	Zhangye power bureau data	Energy production decreases because of inaccurate hydrological data.
3. Developed capacity to seek carbon revenues from clean energy development, and integrate environment and social issues into the project cycle	On-the-job training provided to mainstream environmental and social issues in project development, design and implementation by 2007	Safeguard training programs had been conducted by project preparatory TA team by 2007, and the safeguard issues were managed satisfactorily during project implementation.	Consultants' final report and TA review missions	<b>Assumptions</b> Feasibility reports for each project are approved on time.
	Reinforced capacity to seeking carbon revenues from clean energy project development by 2007	DHP was successfully registered with the Executive Board of UNFCCC as a CDM project in May 2010.	Quarterly progress report, loan review missions, PPRs  CMI documentation	110kV grid substation is constructed on time.  Phases 2 and 3 of the ZCG's ongoing rural grid improvements are carried out.  Trained staff stay with the PIAs long enough to promote CDM and sale of residual CERs.

CAIDI = consumer average interruption duration index, CER = certified emission reduction, CDM = Clean Development Mechanism, CMI = Carbon Market Initiative, EHP = Erlongshan Hydropower Project, GWh = gigawatt-hour, kV = kilovolt, MW = megawatt, PIA = project implementation agency, PPR = project performance report, PRC = People's Republic of China, TA = technical assistance, UNFCCC = United Nations Framework Convention on Climate Change, ZCG = Zhangye city government.

### CHRONOLOGY OF MAJOR EVENTS IN THE PROJECT'S HISTORY

Date	Project Events
28 April 2006	TA 4783-PRC: Technical Assistance to the PRC for Preparing Gansu Heihe Hydropower Development Project approved by ADB for \$500,000
6–22 August 2007	ADB loan appraisal mission
10–11 January 2008	Loan negotiations
28 January 2008	Loan approval
4 March 2008	Loan signing
27 June 2008	Loan effectiveness
30 June 2008	ADB approved two ICB contract packages: (i) turbine generator, and (ii) crane. It also approved four NCB contract packages: (i) headrace tunnel (phase 1), (ii) surge shaft and penstocks, (iii) main power house construction, and (iv) headrace tunnel (phase 2).
8 July 2008	DHC signed a consulting service contract and the consultants began their services.
16–21 July 2008	ADB loan inception mission
24 November 2008	ADB approved three ICB contract packages: (i) main and station transformer, (ii) high-voltage equipment, and (iii) monitoring and control equipment.
9–16 March 2009	ADB midterm MFF review and loan review mission
16 March 2009	Transfer of MFF project administration responsibility to ADB PRC Resident Mission
21 July 2009	Generating unit no. 1 started operation.
23 July 2009	Generating unit no. 2 started operation.
26 July 2009	Generating unit no. 3 started operation.
8–15 October 2010	ADB loan review mission
8–12 August 2011	ADB loan review mission
19 October 2011	Final disbursement of loan proceeds
13 March 2012	Effective date of loan closing
9–16 October 2012	Project completion review mission
31 December 2012	Original loan closing date

ADB = Asian Development Bank, ICB = international competitive bidding, kV = kilovolt, MFF = multitranches financing facility, NCB = national competitive bidding, PRC = People's Republic of China, TA = technical assistance.

Source: Asian Development Bank.

## PROJECT COST AND FINANCING PLAN

Table A3.1: Detailed Project Cost  
(\$ million)

Component	Appraisal			Actual		
	Foreign	Local	Total	Foreign	Local	Total
<b>A. Base Cost</b>						
1. Civil Works	21.74	14.22	35.96	23.57	29.30	52.88
2. Power Plant Equipment	5.33	2.86	8.19	4.43	6.18	10.61
3. Hydromechanical and Service Equipment	0.43	2.92	3.35	0.00	0.00	0.00
4. Environment Protection	0.40	0.00	0.40	0.00	0.80	0.80
5. Power Transmission and Distribution	0.00	0.90	0.90	0.00	0.73	0.73
6. Design and Supervision	0.10	3.14	3.24	0.00	3.99	3.99
7. Land Acquisition and Other Charges	0.00	0.00	0.00	0.00	0.14	0.14
<b>Total Project Base Cost</b>	<b>28.00</b>	<b>24.04</b>	<b>52.04</b>	<b>28.00</b>	<b>41.15</b>	<b>69.15</b>
<b>B. Contingencies</b>						
1. Physical Contingencies	0.00	2.60	2.60	0.00	0.00	0.00
2. Price Contingencies	0.00	1.06	1.06	0.00	0.00	0.00
<b>C. Financial Charges during Development</b>	<b>0.00</b>	<b>6.22</b>	<b>6.22</b>	<b>0.00</b>	<b>2.84</b>	<b>2.84</b>
<b>Total Project Cost</b>	<b>28.00</b>	<b>33.92</b>	<b>61.92</b>	<b>28.00</b>	<b>43.99</b>	<b>71.99</b>

Sources: Asian Development Bank and Heihe Hydropower Development Company.

Table A3.2: Summary Financing Plan  
(\$ million)

Source	Appraisal				Actual			
	Foreign	Local	Total	%	Foreign	Local	Total	%
<b>A. Loans</b>								
1. ADB	28.00	0.00	28.00	45.2	28.00	0.00	28.00	38.9
2. Domestic Banks		21.47	21.47	34.7		29.07	29.07	40.4
<b>Subtotal</b>	<b>28.00</b>	<b>21.47</b>	<b>49.47</b>	<b>79.9</b>	<b>28.00</b>	<b>29.07</b>	<b>57.07</b>	<b>79.3</b>
<b>B. Equity Capital</b>	<b>0.00</b>	<b>12.45</b>	<b>12.45</b>	<b>20.1</b>	<b>0.00</b>	<b>14.92</b>	<b>14.92</b>	<b>20.7</b>
<b>Total</b>	<b>28.00</b>	<b>33.92</b>	<b>61.92</b>	<b>100.0</b>	<b>28.00</b>	<b>43.99</b>	<b>71.99</b>	<b>100.0</b>

ADB = Asian Development Bank.

Sources: Asian Development Bank and Heihe Hydropower Development Company.



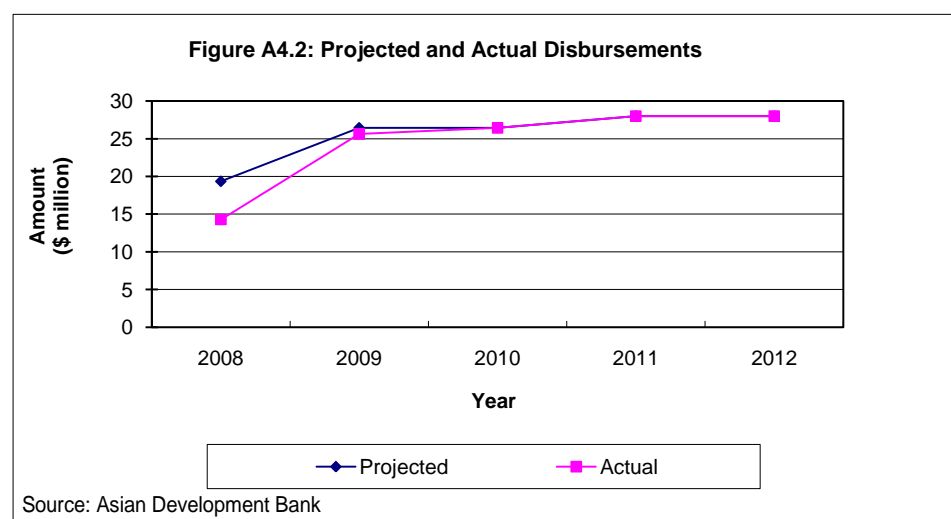
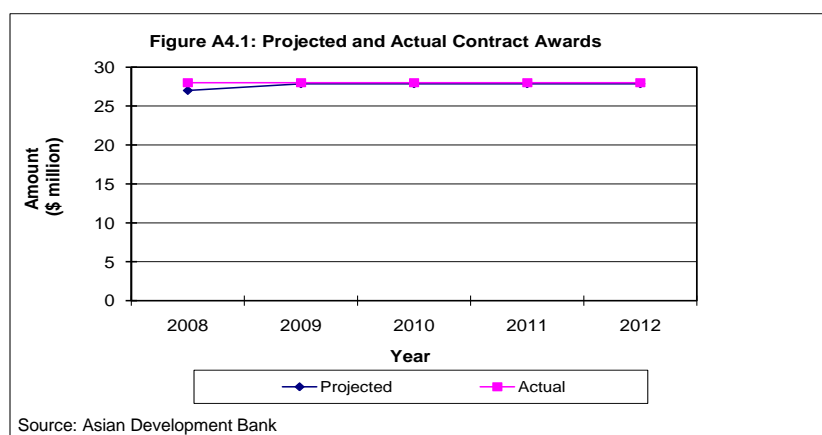
## PROJECTED AND ACTUAL CONTRACT AWARDS AND DISBURSEMENTS

**Table A4: Cumulative Contract Awards and Disbursements**  
(\$ million)

Year	Contract Awards		Disbursement	
	Projected <sup>a</sup>	Actual	Projected <sup>a</sup>	Actual
2008	27.00	28.0	19.34	14.28
2009	27.86	28.0	26.45	25.64
2010	27.86	28.0	26.45	26.45
2011	27.86	28.0	28.00	28.00
2012	27.86	28.0	28.00	28.00
Total	<b>27.86</b>	<b>28.0</b>	<b>28.00</b>	<b>28.00</b>

<sup>a</sup> Figures shown are cumulative.

Source: Asian Development Bank.

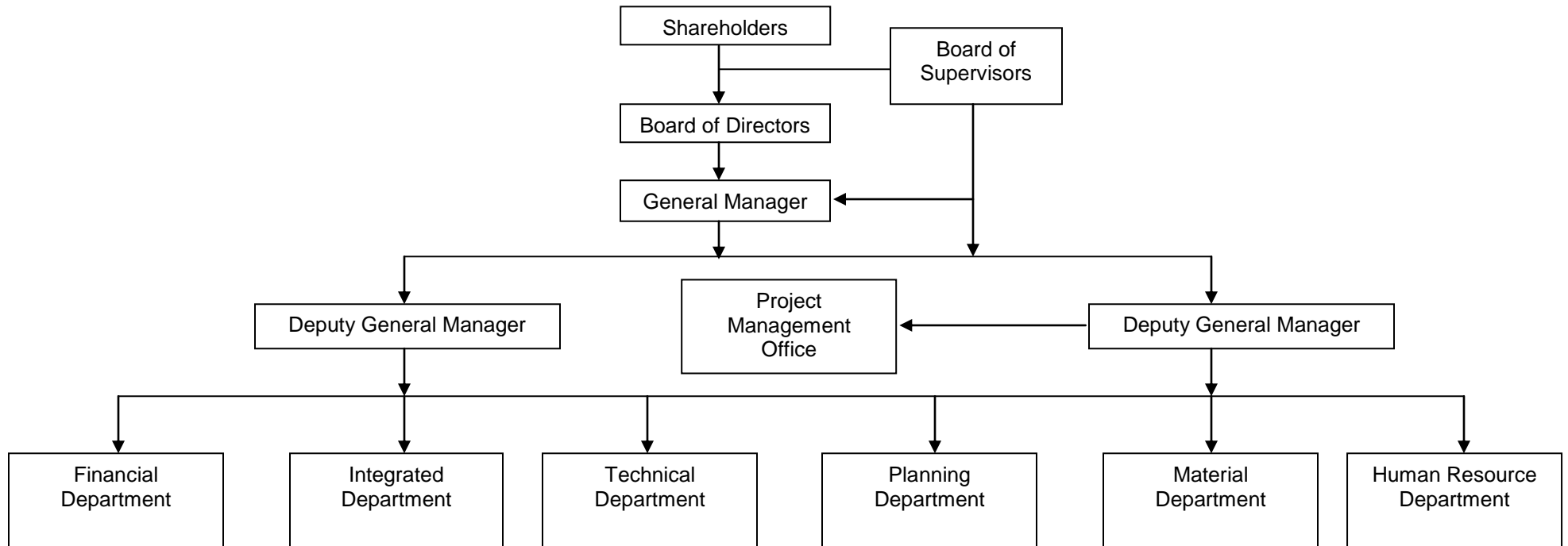


### PLANNED AND ACTUAL IMPLEMENTATION SCHEDULE



Source: Dagushan Hydropower Company.

## ORGANIZATION CHART OF DAGUSHAN HYDROPOWER COMPANY



Source: Dagushan Hydropower Company.

**STATUS OF COMPLIANCE WITH LOAN COVENANTS**

<b>Covenant</b>		<b>Reference in Loan and Project Agreement</b>	<b>Status of Compliance</b>
<b>General</b>			
1.	DHC shall carry out the project in accordance with plans, design, standards, specifications, work schedules and construction methods acceptable to ADB. DHC shall furnish, or cause to be furnished, to ADB, promptly after their preparation, such plans, design standards, specifications and work schedules, and any material modifications subsequently made therein, in such detail as ADB shall reasonably request.	PA, Section 2.04	Complied with.
2.	Power Purchase Agreement. DHC shall enter into power purchase agreement with Zhangye Electric Power Company (ZEPC) and such power purchase agreement shall provide, among other things, that ZEPC shall purchase all of the electricity generated by the project's Power Plant at the tariff determined based on principles described in paragraph 10 of this Schedule.	PA, Schedule, para. 2	Complied with.
3.	Except as ADB may otherwise agree, DHC shall not sell, lease or otherwise dispose of any of its assets which shall be required for the efficient carrying on of its operations or the disposal of which may prejudice its ability to perform satisfactorily any of its obligations under this Project Agreement.	PA, Section 2.12	Complied with. DHC did not sell, lease, or dispose of any of its assets.
4.	DHC shall furnish to ADB quarterly reports on the execution of the project and on the operation and management of the project facilities. Such reports shall be submitted in such form and in such detail and within such a period as ADB shall reasonably request, and shall indicate, among other things, progress made and problems encountered during the quarter under review, steps taken or proposed program of activities and expected progress during the following quarter.	PA, Section 2.08(b)	Complied with. Quarterly progress reports were submitted on time and were of good quality.
5.	Promptly after physical completion of the project, but in any event not later than twelve (12) months thereafter or such later date as ADB may agree for this purpose, DHC shall prepare and furnish to ADB a report, in such form and in such detail as ADB shall reasonably request, on the execution and initial operation of the project, including its cost, the performance of DHC of its obligations under this Project Agreement and the accomplishment of the purposes of the Loan.	PA, Section 2.08(c)	Complied with. The project passed domestic official completion acceptance on 23 September 2011. The loan was actually closed on 13 March 2012. The domestic completion report was submitted to ADB in March 2012.
6.	The Borrower shall ensure that the Project is carried out in accordance with the FFA and all the Schedules (including Annexes) attached thereto.	LA, Schedule 5, para. 1; PA, Schedule, para. 1	Complied with.
7.	GPG shall be the Project Executing Agency (EA) responsible for the overall implementation of the Project.	LA, Schedule 5, para. 2	Complied with.
8.	DHC shall be the Implementing Agency, responsible for the day-to-day implementation of the project, in particular for coordinating and monitoring all	LA, Schedule 5, para. 3	Complied with.

Covenant	Reference in Loan and Project Agreement	Status of Compliance
construction activities of the project. DHC shall set up a Project Implementing Unit for the implementation of the project. A Project lead group shall be set up within ZCG to oversee and assist in the implementation of the project.		
9. The Borrower shall, through GPG and ZCG, cause DHC to carry out the project with due diligence and efficiency and in conformity with sound administrative, financial, engineering, environmental, and hydropower practices.	LA, Section 4.01(a) PA, Section 2.01(a)	Complied with.
10. The Borrower shall make available to GPG, and cause GPG and ZCG to make available to DHC, promptly as needed and on terms and conditions acceptable to ADB, the funds, facilities, services, land and other resources which are required, in addition to the proceeds of the Loan, for the carrying out of the project.	LA, Section 4.02 PA, Section 2.02	Complied with.
11. Prior to construction of each Project, Heihe Hydropower Development Co (HHDC) will set up an environmental management unit (EMU) who will be responsible for implementing the Environmental Management Plan (EMP) including implementation of soil erosion control plan during construction and operation, including environmental supervision of contractors. The EMU will ensure that the EMP is updated periodically during construction and operation, as required.	FFA, Attachment 1, paras. 4 and 8	Complied with.
12. The Borrower shall take all action which shall be necessary on its part to enable GCG, ZCG and DHC to perform their respective obligations under the project Agreement, and shall not take or permit any action which would interfere with the performance of such obligations.	LA, Section 4.04	Complied with.
13. The Borrower shall through GPG cause ZCG to exercise its rights under the Onlending Agreement in such a manner as to protect the interests of the Borrower and ADB and to accomplish the purposes of the Loan. No rights or obligations under the Onlending Agreement shall be assigned, amended, abrogated or waived without the prior concurrence of ADB.	LA, Section 4.05(a) and 4.05(b)	Complied with.
14. The Borrower shall ensure that the activities of its departments and agencies with respect to the carrying out of the project and operation of the project facilities are conducted and coordinated in accordance with sound administrative policies and procedures.	LA, Section 4.03	Complied with.
15. If (i) any change in ownership of the project facilities, or (ii) sale, transfer, or assignment of DHC's interest in the Project Power Plant is anticipated, the Borrower shall cause GPG, ZCG and DHC to consult with ADB at least six months before such change, sale, transfer or assignment. The Borrower shall ensure that any proposed change in ownership of the project facilities be carried out in a legal and transparent manner.	LA, Schedule 5, para. 5	Complied with. No change in ownership of the project facilities has so far happened.
16. Except as ADB may otherwise agree, the Borrower shall apply quality- and cost-based selection for selecting and	LA, Schedule 4, para. 6	Complied with. The borrower used its

Covenant		Reference in Loan and Project Agreement	Status of Compliance
	engaging consulting services.		own funds to hire consultants.
<b>Financial Performance</b>			
17.	Except as ADB shall otherwise agree, DHC shall earn, for each fiscal year commencing from the year of commercial operation of the Project Power Plant, an annual return of not less than six (6) percent of the average current net value of DHC fixed assets in operation.	PA, Schedule, para. 3(a)	Generally complied with. DHC's actual financial performance and the projections indicated that DHC would be able to comply with this covenant except in 2010, when the return of net fixed assets was slightly below 6%.
18.	Debt Service Coverage Ratio. Except as ADB shall otherwise agree, DHC shall not incur any debt unless a reasonable forecast of the revenues and expenditures of DHC shows that the estimated net revenues of DHC for each fiscal year shall be, (i) commencing from the year of the start of the commercial operation of the Project Power Plant, at least 1.2 times, and (ii) within 5 years of commercial operation of the Project Power Plant, at least 1.3 times, the maximum estimated debt service requirements of DHC in such year on all debt of DHC including the debt to be incurred.	PA, Schedule, para. 4(a)	Complied with. DHC's actual financial performance and the projections indicate that DHC will be able to comply with this covenant.
19.	Debt to Equity Ratio. Except as ADB shall otherwise agree, DHC shall maintain for each year, (i) commencing from the year of the start of the commercial operation of the Project Power Plant, a ratio of debt to equity not greater than 80:20; and (ii) within 5 years of commercial operation of the Project Power Plant, a ratio of debt to equity not greater than 75:25.	PA, Schedule, para. 5(a)	Complied with. DHC's actual financial performance and the projections indicate that DHC will be able to comply with this covenant.
20.	ZCG and DHC shall ensure that internal controls of DHC are in accordance with national accounting standards and an independent and autonomous internal audit department is set up in the DHC within 6 months of the Effective Date. DHC shall adopt acceptable computerized accounting and management information systems, and prepare financial statements and reports in accordance with national accounting standards.	PA, Schedule, para. 12	Complied with.
21.	A midterm review of the project shall be undertaken two years after the Effective Date. Such review shall cover all institutional, administrative, organizational, technical, environmental, social, poverty reduction, resettlement, economic, financial, and other relevant aspects that may have an impact on the performance of the project and its continuing viability. The review shall examine progress in sector reforms and evaluate the development, resettlement, environmental and poverty impacts, and status of compliance with assurance of the Loan and Project Agreements. The review shall also undertake a comprehensive review of potential Loan	LA, Schedule 5, para. 6	Complied with. Midterm review was undertaken in March 2009.

<b>Covenant</b>		<b>Reference in Loan and Project Agreement</b>	<b>Status of Compliance</b>
	savings and identify areas for reallocation of Loan proceeds, as appropriate.		
22.	Accounts Receivable Turnover. Except as ADB shall otherwise agree, DHC shall ensure that for each year, commencing the year of the start of the commercial operation of the Project Power Plant, the accounts receivables are at most equal to the value of two months of sales.	PA, Schedule, para. 6(a)	Complied with.
<b>Environment</b>			
23.	The EMU shall submit a safeguard compliance status report for Dagushan and Erlongshan Hydropower Project.	FFA, Attachment 1, para. 6	Complied with.
24.	ZCG shall cause DHC to ensure that Project is designed, constructed, operated, maintained and monitored in accordance with the requirements of the national and local environmental regulations, procedures and guidelines, and ADB's Environment Policy (2002) and the project is designed, constructed, maintained and monitored in accordance with the EMP as reflected in the EIA, SEIA and EARP.	PA, Schedule, para. 7(a) and 7(b)	Complied with. During construction and operation, all the contractors fulfilled their obligation to protect the environment and to implement mitigation measures in their construction schemes.
25.	ZCG shall cause DHC to ensure that environmental performance reports are submitted to ADB twice annually during the construction period and during first two years of operation, including progress made on the mitigation measures, monitoring data, problems encountered, enforcement plan and any violations.	PA, Schedule, para. 7(e)	Complied with. Four EMRs were prepared by PMO and submitted to ADB in accordance with ADB requirements.
26.	The EMP is updated in accordance with the Heihe river hydropower cascade cumulative environmental impact assessment and detained engineering design.	FFA, Attachment 1, para. 9 PA, Schedule, para. 7(c)	Complied with. The EMP was updated.
27.	ZCG shall cause DHC to ensure that EMP will be incorporated in the bidding documents and civil work contracts.	PA, Schedule, para. 7(d)	Complied with. The EMP was incorporated in all bidding documents and civil works contracts.
<b>Land Acquisition</b>			
28.	GPG, ZCG and DHC will ensure that: (a) all land, rights-of-way, easements, privileges and approvals required for the project will be made available in a timely manner; (b) prior to the commencement of any civil works for any Project facility, all land acquisition, compensation, resettlement and rehabilitation activities will have been completed in accordance with ADB's Policy on Involuntary Resettlement (1995), the RF and the SRP, and the project site will be free and clear of all obstructions; (c) the SRP, prepared in full consultation with and disclosed to the affected persons, will be updated based on the detailed design and submitted to ADB for review and approval; and (e) an external consultant acceptable to ADB will be engaged to carry out monitoring and evaluation, and report to ADB in	PA, Schedule, para. 8	Complied with. Land acquisition and resettlement activities were implemented well. Direct negotiations between the DHC and the affected herder families were efficient and culturally sensitive, and ensured transparency of land acquisition and resettlement. However, delayed recruitment of an external monitor

<b>Covenant</b>		<b>Reference in Loan and Project Agreement</b>	<b>Status of Compliance</b>
	accordance with the requirements of the SRP.		resulted in late report submission and inadequate baseline and implementation information. The external monitoring agency submitted one report; it was posted on the ADB website.
<b>Anticorruption</b>			
29.	(a) GPG, ZCG and DHC shall comply with ADB's Anticorruption Policy (1998, as amended to date) and the Policy relating to Enhancing ADB's Role in Combating Money Laundering and the Financing of Terrorism (2003). GPG, ZCG and DHC (i) acknowledge ADB's right to investigate, directly or through its agents, any alleged corrupt, fraudulent, collusive or coercive practices relating to the Project; (ii) agree to cooperate fully with any such investigation and to extend all necessary assistance, including providing access to all relevant books and records, as may be necessary for the satisfactory completion of any such investigation; and (iii) agree to refrain from engaging in money laundering activities or financing of terrorism and shall allow ADB to investigate any violation or potential violation of these undertakings. (b) Without limiting the generality of the preceding paragraph, GPG, ZCG and DHC shall (i) conduct periodic inspections on the contractors' activities related to fund withdrawals and settlements and (ii) ensure that all contracts financed by ADB in connection with the Project include provisions specifying the right of ADB to audit and examine the records and accounts of all contractors, suppliers, consultants and other service providers as they relate to the Project. (c) In addition to these requirements, to deter corruption and increase transparency, the GPG, ZCG and DHC shall disclose, at the designated official website, information about public procurements, including those related to the Project. For each contract, the website shall include information on, among others, the list of participating bidders, name of the winning bidder, basic details on bidding procedures adopted, amount of contract awarded, and the list of goods/services, including consulting services, procured.	PA, Schedule, para. 9	Complied with.
<b>Tariff</b>			
30.	GPG and ZCG shall ensure that the formulated tariff of electricity generated by the project is adequate to cover operating costs, maintenance and depreciation, financing cost and allow an acceptable return on the net fixed asset.	PA, Schedule, para.10	Complied with. Electricity tariff is adequate for cost recovery, etc.
<b>Policy Change</b>			
31.	GPG shall consult with ADB in due course of any	PA, Schedule,	Complied with.



<b>Covenant</b>		<b>Reference in Loan and Project Agreement</b>	<b>Status of Compliance</b>
	changes in power pricing, load dispatch and similar other policies that may adversely affect the financial viability of the project.	para. 11	
<b>Gender</b>			
32.	GPG, ZCG and DHC shall cause the contractors to maximize their employment of local people who meet the job requirements for the construction of the project facilities. The contractors shall be required to give due consideration to the manner in which local women in the communities of the project area can contribute to the construction, operation and maintenance of the project facilities. GPG will also cause ZCG and DHC shall take all necessary actions to encourage women living in the project area to participate in planning and implementing the project activities. GPG shall cause ZCG and DHC to monitor the project effects on women during the project implementation, through, where relevant, gender-disaggregated data collected pursuant to the monitoring and evaluation system referred to in the project performance monitoring system.	PA, Schedule, para. 13(a) and 13(b)	Complied with.
<b>Sexually Transmitted Diseases</b>			
33.	With the assistance of the relevant local authorities, GPG, through ZCG, and DHC will cause contractors to distribute information on the risks of sexually transmitted diseases to those employed during the project construction and to the local communities living in the vicinity of the project.	PA, Schedule, para. 14	Complied with. Information was provided to local communities and construction workers.
<b>Women and Child Labor</b>			
34.	GPG, through ZCG, and DHC will ensure that: (i) there is no differential payment between men and women for work of equal value and (ii) civil works contractors do not employ child labor in the construction and maintenance activities in accordance with the relevant laws and regulations of the Borrower.	PA, Schedule, para. 15	Complied with.
<b>Community Development</b>			
35.	ZCG shall ensure that five (5) percent tax revenue, which it receives from the sale of power generation under the project, will be allocated, in a manner acceptable to ADB, as additional revenue to the project affected area within the Sunan County, as described in the EIA, for their community economic development purpose.	PA, Schedule, para. 16	Complied with. Five percent of annual tax payments to the Zhangye municipal government go into a special fund to be used to maintain and improve ecological functions in the reservoir area and the Qilian Mountain Nature Reserve. The Zhangye Financial Bureau has issued financial management regulations specifically to manage the funds collected.

<b>Covenant</b>		<b>Reference in Loan and Project Agreement</b>	<b>Status of Compliance</b>
<b>Change in Ownership</b>			
36.	If (i) any change in ownership of the Project facilities, or (ii) sale, transfer, or assignment of DHC's interest in the Project Power Plant is anticipated, GPG, ZCG and DHC shall consult ADB at least six months before such change, sale, transfer or assignment. GPG, ZCG and DHC shall ensure that any proposed change in ownership of the Project facilities be carried out in a legal and transparent manner.	PA, Schedule, para. 17	Complied with. No change in ownership of the project facilities or sale, transfer, or assignment of DHC's interest in the power plant has happened so far.
<b>Monitoring and Evaluation</b>			
37.	GPG, through ZCG, and DHC shall monitor, evaluate and report to ADB the Project's impact through a project performance monitoring system to ensure that the Project facilities are managed effectively and the benefits, particularly to the poor, are maximized. GPG, through ZCG, and DHC shall collect the data agreed with ADB, prior to the Project implementation and Project completion, and annually thereafter for three years after Project completion.	PA, Schedule, para. 18	Complied with. Project reporting was adequate, except for social safeguard monitoring, where delayed recruitment of an external monitor resulted in late report submission and inadequate baseline and implementation information.
<b>Auditing and Accounting</b>			
38.	GPG, ZCG and each PIA shall ensure that proper accounts and records are maintained and audited in a timely manner to adequately identify the use of Loan proceeds in such manner and detail as may be specified under each Loan Agreement and Project Agreement(s).	FFA, Schedule 3	Complied with. Project audit was conducted by Gansu Provincial Audit Office and four audit reports were submitted on time.

ADB = Asian Development Bank, FFA = framework financing agreement, GPG = Gansu provincial government, HHDC = Heihe Hydropower Development Company, PRC = People's Republic of China, RP = resettlement plan, DHC = Dagushan Hydropower Company, ZCG = Zhangye city government.

Source: Asian Development Bank.

### SUMMARY OF CONTRACT PACKAGES

PCSS No.	Item	Mode of Procurement	Date of Contract	Name of Contractor	Contract Amount (CNY)	ADB Financing Amount (\$)
0001	Headrace Tunnel (Phase 1)	NCB	21 Jan 08	No. 1 Engineering of No. 18 China Railway Bureau Group	39,208,702	5,724,661
0002	Surge Shaft and Penstocks	NCB	23 Jan 08	Sinohydro 1st Engineering Bureau	35,603,666	6,079,424
0003	Main Powerhouse Construction	NCB	23 Jan 08	Sinohydro 1st Engineering Bureau	26,229,407	3,876,717
0004	Generator and Turbine Equipment	ICB	25 Jan 08	Hangzhou Resource Power Equipment	22,980,000	2,892,713
0005	Crane Equipment	ICB	24 Jan 08	Jiangsu Wudong Machinery	1,057,500	128,265
0006	Headrace Tunnel (Phase 2)	NCB	21 Jan 08	No. 3 Engineering of No. 23rd China Railway Bureau Group	48,265,512	7,871,566
0007	Main and Station Transformer	ICB	08 Oct 08	Hubei Machinery & Equipment Import & Export	5,853,120	737,821
0008	High Voltage Equipment	ICB	09 Oct 08	Yishang Innovation Technology	2,614,500	329,574
0009	Monitoring and Control Equipment	ICB	08 Oct 08	Nari Group	2,131,800	359,260
<b>Total</b>					<b>183,944,207</b>	<b>28,000,000</b>

ADB = Asian Development Bank, ICB = international competitive bidding, NCB = national competitive bidding.

Note: Amounts may not add up to the totals given because of rounding.

Source: Asian Development Bank.

## FINANCIAL REEVALUATION

### A. Basic Assumptions

1. The financial internal rate of return (FIRR) was reevaluated on the basis of financial and operational information obtained from Dagushan Hydropower Company (DHC) and certain revenue and cost assumptions. Capital cost was based on actual expenditures incurred for the project, excluding interest and other financial charges during construction. The calculation period covered the construction period and 20 years of operation period. No major equipment replacement or infrastructure rehabilitation was anticipated during the calculation period. Residual value of the project was assumed to be 20% of the capital cost. All revenues and expenses were expressed in constant 2012 prices for FIRR calculation.
2. DHC started operation in 2009 with installed capacity of 65 MW. Net generation reached 159.3 GWh in 2009, 250.9 GWh in 2010, 255.7 GWh in 2011, and 266.8 GWh in 2012. An annual net generation of 253.3 GWh is assumed for 2013 and the rest of the operation period.
3. The Gansu Provincial Price Bureau approved a tariff rate of CNY0.2227/KWh for DHC, which has been applied since 2009. The Price Bureau used these main criteria to arrive at a tariff for a generator: (i) the tariff shall ensure full cost recovery; (ii) the rate of return should not be more than 3% above the interest rate of loans; and (iii) the tariff shall ensure repayment of loans. The tariff is reviewed every 3–5 years. In the reevaluation, the tariff is assumed to remain constant in real terms considering the fact that it is generally adequate for full cost recovery. In addition to the revenues from power generation, DHC obtained CNY22.6 million in 2010–2011 from the sale of certified emission reductions (CERs) and is expected to get CNY3 million every year in 2012–2016, according to the CER purchase agreement signed between DHC and the British EcoSecurities Group. The operation and maintenance (O&M) costs are based on the actual figures of DHC and are assumed to remain constant in real terms.
4. Sales-related taxes include the value-added tax (VAT) of 17% on sales and city construction tax (1%) and education tax (3%) charged on the value of VAT. DHC is also subject to income tax at the rate of 15%.

### B. Financial Internal Rate of Return

5. The recalculated FIRR is 6.07% without CER revenues and 6.90% with CER revenues (see Table A9.1), compared with the FIRRs of 5.65% and 6.59% estimated at appraisal. The slightly higher FIRR is mainly attributed to the higher amount of electricity generation.
6. The after-tax weighted average cost of capital (WACC) is based on the actual capital mix and cost of various sources of financing. The London interbank offered rate (LIBOR) 10-year fixed swap rate as of January 2013 plus a spread of 0.4% for the ADB loan and actual interest rate of 7.05% for domestic loans, and 10% for cost of equity investment were used in the calculation. The recalculated WACC is 3.03%. Since the project's FIRR is higher than the WACC, the project is considered financially viable.
7. Sensitivity analysis indicate that with the contribution of CER revenues, the project will remain viable with a 10% decrease in revenue or a 10% increase in O&M costs, and when these adverse conditions are combined.

**Table A9.1: Financial Internal Rate of Return**  
(CNY million)

Year	Capital Costs	O&M	Income Tax	Net Sales	Net Cash Flow	CDM Benefits	Flow with CDM Benefits
2007	58	0	0	0	(58)	0	(58)
2008	166	0	0	0	(166)	0	(166)
2009	181	0	2	33	(150)	0	(150)
2010	17	2	3	41	19	17	36
2011	32	10	3	50	5	6	11
2012	0	10	3	49	36	3	39
2013	0	10	1	49	38	3	41
2014	0	10	1	49	38	3	41
2015	0	10	3	49	36	3	39
2016	0	10	4	49	35	3	38
2017	0	10	4	49	35	0	35
2018	0	10	4	49	35	0	35
2019	0	10	4	49	35	0	35
2020	0	10	4	49	35	0	35
2021	0	10	4	49	35	0	35
2022	0	10	4	49	35	0	35
2023	0	10	4	49	35	0	35
2024	0	10	4	49	35	0	35
2025	0	10	4	49	35	0	35
2026	0	10	4	49	35	0	35
2027	0	10	4	49	35	0	35
2028	0	10	4	49	35	0	35
2029	(91)	10	4	49	126	0	126
<b>FIRR without CER = 6.07%</b>							
<b>FIRR with CER = 6.90 %</b>							

( ) = negative, FIRR = financial internal rate of return, CER = certified emission reduction (revenue).  
Source: ADB staff estimates.

**Table A9.2: Sensitivity Analysis**

Case	FIRR without CER	FIRR With CER
Base case	6.07%	6.90%
(i) Energy sales reduced by 10%	4.86%	5.68%
(ii) Operation and maintenance cost increased by 10%	5.83%	6.58%
(iii) Combination of (i) and (ii)	4.60%	5.44%

FIRR = financial internal rate of return, CER = certified emission reduction (revenue).

Source: ADB staff estimates.

**C. Financial Performance of Dagushan Hydropower Company**

8. DHC, a subsidiary of Heihe Hydropower Development Company (HHDC), was formed to undertake the project. As the implementing agency, DHC is a joint-share company set up in line with the Company Law of China by two shareholders, HHC (89.4%) and a private sector shareholder (10.6%). The Dagushan hydropower plant started operation in 2009 on a trial basis and its operation reached normal status in 2010. The financial projections for DHC were prepared on the basis of the initial performance and assumptions highlighted in this appendix. The financial projections in current terms are presented in Table A9.3.

9. As covenanted in the project agreement, DHC should maintain (i) a debt service coverage ratio of 1.2; (ii) a debt–equity ratio of 80:20; (iii) return on net fixed assets of 6%; and (iv) accounts receivable not exceeding 2 months' sales. DHC's actual financial performance in 2009–2011 and projections indicated that DHC would be able to comply with all these financial covenants except in 2010, when the return on net fixed assets was slightly below 6%.

**Table A9.3: Dagushan Hydropower Company Financial Statements**

	(in CNY million)												
<b>Income Statement</b>	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Power sold out (GWh)	159.3	250.9	255.7	266.8	257.8	257.8	257.8	257.8	257.8	257.8	257.8	257.8	257.8
Sales	30.4	57.7	58.6	62.4	62.1	63.9	65.9	67.8	69.9	72.0	74.1	76.4	78.6
Sales-related Taxes	0.0	8.8	9.0	9.6	9.6	9.8	10.1	10.4	10.8	11.1	11.4	11.8	12.1
<b>Net Sales</b>	<b>30.4</b>	<b>49.0</b>	<b>49.6</b>	<b>52.8</b>	<b>52.5</b>	<b>54.1</b>	<b>55.7</b>	<b>57.4</b>	<b>59.1</b>	<b>60.9</b>	<b>62.7</b>	<b>64.6</b>	<b>66.5</b>
Operating Expenses	9.4	25.9	32.0	32.7	33.0	33.6	34.2	34.9	35.6	36.3	37.1	38.0	38.9
Operating Profit	21.0	23.0	17.6	20.1	19.5	20.5	21.5	22.5	23.5	24.5	25.6	26.6	27.7
Interest Expenses	7.1	14.7	7.0	12.4	11.6	10.8	9.9	9.1	8.3	7.4	6.6	5.7	4.8
Income from CERs Fund	0.0	16.7	5.9	3.0	3.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0
Income before Tax	13.9	25.0	16.5	10.7	10.9	12.7	14.5	16.4	15.2	17.1	19.0	20.9	22.9
Income Tax Payable	0.0	0.0	2.3	0.8	0.8	1.0	2.2	2.5	2.3	2.6	2.9	3.1	3.4
<b>Net Profit</b>	<b>13.9</b>	<b>25.0</b>	<b>14.2</b>	<b>9.9</b>	<b>10.1</b>	<b>11.8</b>	<b>12.4</b>	<b>13.9</b>	<b>13.0</b>	<b>14.6</b>	<b>16.2</b>	<b>17.8</b>	<b>19.5</b>
<b>Balance Sheet</b>													
Cash	15.4	20.6	31.4	52.2	72.7	94.9	118.6	143.9	167.8	193.1	219.8	247.8	277.0
Accounts Receivable	8.4	23.3	48.7	51.9	51.6	53.2	54.8	56.4	58.1	59.9	61.6	63.5	65.4
Inventories	5.4	8.6	9.6	10.3	10.2	10.5	10.8	11.1	11.5	11.8	12.2	12.5	12.9
Total Current Assets	29.2	52.5	89.7	114.3	134.6	158.6	184.2	211.5	237.4	264.8	293.6	323.8	355.3
Gross Fixed Assets	364.6	421.7	454.0	454.0	454.0	454.0	454.0	454.0	454.0	454.0	454.0	454.0	454.0
Accumulated depreciation	8.1	26.4	48.2	70.1	92.0	113.9	135.9	157.8	179.7	201.6	223.5	245.5	267.4
Net Fixed Assets	356.5	395.3	405.9	383.9	362.0	340.1	318.2	296.3	274.3	252.4	230.5	208.6	186.7
<b>Total Assets</b>	<b>476.9</b>	<b>478.2</b>	<b>496.2</b>	<b>498.8</b>	<b>497.1</b>	<b>499.2</b>	<b>503.0</b>	<b>508.3</b>	<b>512.3</b>	<b>517.7</b>	<b>524.7</b>	<b>533.0</b>	<b>542.6</b>
Total Current Liabilities	23.4	11.4	22.2	5.1	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.9	6.0
Total Long Term Liabilities	345.1	345.2	331.4	278.2	266.0	253.5	240.8	227.8	214.4	200.7	186.5	171.6	156.0
Paid-in Capital	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0
Retained Earnings	14.4	27.7	48.5	121.5	132.1	146.5	162.9	181.2	198.3	217.4	238.5	261.5	286.6
Total Equity	108.4	121.7	142.5	215.5	226.1	240.5	256.9	275.2	292.3	311.4	332.5	355.5	380.6
<b>Total Equity and Liabilities</b>	<b>476.9</b>	<b>478.2</b>	<b>496.2</b>	<b>498.8</b>	<b>497.1</b>	<b>499.2</b>	<b>503.0</b>	<b>508.3</b>	<b>512.3</b>	<b>517.7</b>	<b>524.7</b>	<b>533.0</b>	<b>542.6</b>
<b>Cash Flow Statement</b>													
<b>Net Cashflow from Operating Activities</b>	<b>22.8</b>	<b>32.0</b>	<b>29.0</b>	<b>45.0</b>	<b>44.4</b>	<b>45.4</b>	<b>46.4</b>	<b>47.4</b>	<b>45.4</b>	<b>46.5</b>	<b>47.5</b>	<b>48.5</b>	<b>49.6</b>
<b>Net Cashflow from Investing Activities</b>	<b>-0.3</b>	<b>-0.4</b>	<b>-2.9</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>
Proceeds from borrowings	0.0	0.0	9.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Loan Principal Repayment	0.0	0.0	15.0	11.8	12.3	12.5	12.7	13.0	13.3	13.7	14.2	14.9	15.6
Interest Payment	7.1	26.4	10.3	12.4	11.6	10.8	9.9	9.1	8.3	7.4	6.6	5.7	4.8
<b>Net Cashflow from Financing Activities</b>	<b>(7.1)</b>	<b>(26.4)</b>	<b>(15.4)</b>	<b>(24.2)</b>	<b>(23.9)</b>	<b>(23.2)</b>	<b>(22.6)</b>	<b>(22.1)</b>	<b>(21.6)</b>	<b>(21.2)</b>	<b>(20.8)</b>	<b>(20.5)</b>	<b>(20.4)</b>
<b>Net increase/(decrease) for period</b>	<b>15.4</b>	<b>5.2</b>	<b>10.8</b>	<b>20.8</b>	<b>20.5</b>	<b>22.2</b>	<b>23.7</b>	<b>25.3</b>	<b>23.8</b>	<b>25.3</b>	<b>26.7</b>	<b>28.0</b>	<b>29.2</b>
<b>Balances at beginning</b>	<b>0.0</b>	<b>15.4</b>	<b>20.6</b>	<b>31.4</b>	<b>52.2</b>	<b>72.7</b>	<b>94.9</b>	<b>118.6</b>	<b>143.9</b>	<b>167.8</b>	<b>193.1</b>	<b>219.8</b>	<b>247.8</b>
<b>Balances at end</b>	<b>15.4</b>	<b>20.6</b>	<b>31.4</b>	<b>52.2</b>	<b>72.7</b>	<b>94.9</b>	<b>118.6</b>	<b>143.9</b>	<b>167.8</b>	<b>193.1</b>	<b>219.8</b>	<b>247.8</b>	<b>277.0</b>
<b>Financial Indicators</b>													
Return on Net Fixed Assets	11%	5%	6%	6%	6%	7%	7%	7%	8%	9%	11%	12%	14%
Debt-equity Ratio (% of Total Asset)	72%	72%	67%	56%	53%	51%	48%	45%	42%	39%	36%	32%	29%
Debt Service Coverage Ratio	1.21	1.15	1.86	1.86	1.95	2.05	2.15	2.10	2.20	2.28	2.36	2.43	5.63

Sources: 2009-2012 figures are provided by DHC, 2013-2025 figures are ADB staff estimates.

## **ECONOMIC REEVALUATION**

### **A. Scope and Methodology**

1. The economic reevaluation recalculated the economic internal rate of return (EIRR) of the Dagushan hydropower plant and compared the results with the appraisal estimates. Project costs and benefits were reassessed on the basis of information provided by Dagushan Hydropower Company (DHC). Economic costs and benefits valued with the domestic price numeraire were expressed in constant 2012 prices. A shadow exchange rate factor of 1.01 was used to adjust the financial costs of traded goods to their respective economic values. The shadow wage rate for unskilled labor was estimated at 0.80 of the prevailing wage rate, and a conversion factor of 1.0 was estimated for skilled labor, other costs, and benefits. The EIRR was compared with the economic opportunity cost of capital (EOCC), which was assumed to be 12%. Sensitivity analysis was undertaken to assess the robustness of the EIRR calculation.

### **B. Costs**

2. The project costs consisted of capital and operation and maintenance (O&M) costs. To convert the actual capital costs into economic values, taxes and duties, interests, and financial charges were deducted and relevant conversion factors were applied. Actual O&M costs for the Dagushan hydropower plant in earlier years were applied and were assumed to remain constant in real terms during the evaluation period. No major equipment replacement or infrastructure rehabilitation was anticipated.

### **C. Benefits**

3. As envisaged at appraisal, the main benefit of the project was power generation to meet the electricity demand in Zhangye City. Incremental power generated by Dagushan Hydropower Plant was estimated on the basis of annual net power generation of 253.3 GWh. The valuation of economic benefits was based on end users' willingness to pay (WTP), which was estimated at CNY0.66/kWh. The value was higher than that estimated at appraisal (CNY0.61/kwh), mainly because of the increased fuel price.

4. The project also provided environmental benefits, but these were not included in the reevaluation in the absence of a methodology for their quantification. These benefits included the avoidance of pollution, through the use of an alternative energy source, and the improvement of human health and welfare as a result, and positive impact on environmental resources due to avoided emissions of carbon dioxide.

### **D. Economic Internal Rate of Return**

3. The reevaluated EIRR for the project was 21.2%, compared with 19.3% at appraisal. The higher EIRR is attributed to the larger power generation volume and higher value of WTP. The economic reevaluation result is presented in Table A10.1.

4. Sensitivity analysis was carried out to test the impact of (i) increased O&M costs, (ii) a decrease in benefits, and (iii) a combination of these two scenarios. According to this analysis, the project will continue to be economically robust under any of these conditions. The project EIRR is more sensitive to changes in benefits than to O&M costs. The results of the sensitivity analysis are set out in Table A10.2.



**Table A10.1: Economic Reevaluation**  
(CNY million)

Year	Capital Costs	O&M	Benefits	Net Benefits
2007	50.66			(50.66)
2008	152.41			(152.41)
2009	165.76			(165.76)
2010	11.98			(11.98)
2011	28.73	9.19	130.03	92.10
2012		9.27	128.81	119.54
2013		9.48	128.81	119.33
2014		9.69	128.81	119.12
2015		9.92	128.81	118.89
2016		10.14	128.81	118.67
2017		10.38	128.81	118.43
2018		10.63	128.81	118.18
2019		10.88	128.81	117.93
2020		11.15	128.81	117.66
2021		11.42	128.81	117.39
2022		11.71	128.81	117.10
2023		12.00	128.81	116.81
2024		12.31	128.81	116.50
2025		12.63	128.81	116.18
2026		12.96	128.81	115.85
2027		13.30	128.81	115.51
2028		13.66	128.81	115.15
2029	(89.90)	14.03	128.81	204.69
<b>NPV @</b>	<b>12.00%</b>		<b>ENPV =</b>	<b>252.7</b>
			<b>EIRR =</b>	<b>21.2%</b>

O&M = operation and maintenance, EIRR = economic internal rate of return.

Source: ADB staff estimates.

**Table A10.2: Sensitivity Analysis**

Case	EIRR	NPV (CNY million)
Base case	21.2%	252.7
(i) Energy generation reduced by 20%	18.4%	159.7
(ii) Willingness to pay decreased by 10%	19.8%	206.2
(iii) Operation and maintenance costs Increased by 20%	21.0%	248.7
(iv) Combination of (i), (ii), and (iii)	17.0%	118.7

EIRR = economic internal rate of return, NPV = net present value.

Source: ADB staff estimates.

## ENVIRONMENTAL IMPACT ANALYSIS

### A. Introduction

1. The Dagushan Hydropower Project (DHP) was the second tranche of the multitranche financing facility (MFF) for the Gansu Heihe Rural Hydropower Development Investment Program, which was approved by the Asian Development Bank (ADB) in January 2008. The project consisted of a 65 megawatt (MW) hydropower facility (2x26 MW and 1x13 MW units) and its associate facilities at Dagushan in the cascade development of hydraulic power along Heihe River<sup>1</sup> in Zhangye City of Gansu Province.

2. The project was classified as category A under ADB's environmental classification criteria. The Gansu Provincial Environment Protection Bureau (GPEPB) approved a domestic Dagushan hydropower plant (HPP) environmental impact assessment (EIA) report in March 2007. At appraisal, a summary environmental impact assessment (SEIA) report was prepared under ADB's Environmental Assessment Guidelines (2003) and circulated within ADB for approval in April 2007. The SEIA concluded that the project would generate substantial positive environmental benefits through avoided ambient air pollution by averting an increase in particulate matter, sulfur dioxide, nitrogen oxides, carbon dioxide, and other air pollutants from alternative energy sources. According to the national laws and regulations, GPEPB conducted the environmental protection completion review, and the environmental protection completion report was endorsed in August 2011.

### B. Environmental Protection and Management

3. The president of Heihe Hydropower Development Company (HHDC)<sup>2</sup> chaired the environmental management leading group within the company. An environmental management unit (EMU) was also created within Dagushan Hydropower Company (DHC) to coordinate the implementation of the environmental management plan, including environmental monitoring. A deputy general manager of DHC was appointed to head the EMU. The Zhangye Environmental Monitoring Station (ZEMS) was engaged to monitor air, water, noise, and ecological impact in the project area. According to the records, the DHC submitted four environmental monitoring reports for the period 2009–2011, which drew comments from ADB staff. All the environmental monitoring reports were posted on ADB website.

4. At appraisal, it was estimated that the total cost of environmental protection and mitigation measures would be about CNY3 million. According to the DHC's completion report, the actual total investment for environmental protection was CNY5 million, which included investments in environmental quality monitoring, wastewater treatment facilities, spoil site and revegetation for soil and water conservation, among others. In addition, CNY472,500 was raised

---

<sup>1</sup> The Heihe River cascade hydropower development scheme is a large infrastructure project with seven discrete run-of-river medium hydropower plant (HPP) projects. Among the seven cascade HPPs, Xiaogushan HPP (102 MW), the sixth cascade HPP in the scheme, was supported by ADB under Loan 2032-PRC: Gansu Clean Energy Development Project. Erlongshan HPP (50.5 MW) under Loan 2296-PRC and Dagushan HPP (65 MW) under Loan 2408-PRC, the fourth and fifth cascade HPPs in the scheme, were packaged as two tranches of the MFF 0008-PRC: Gansu Heihe Rural Hydropower Development Investment Program. For the Xiaogushan and Erlongshan HPPs, ADB conducted a project completion review in 2009 and 2011, and both projects were rated highly successful.

<sup>2</sup> HHDC is the parent company of both Erlongshan Hydropower (EHC) and DHC.

for the special fund for Qilian Mountain Nature Reserve conservation<sup>3</sup> in 2011. Such institutional arrangements have provided an effective financing instrument for the sustainable support of long-term ecological conservation.

## **C. Environmental Impact and Mitigation Measures Undertaken**

### **1. Soil**

5. The HPP occupies 288.5 mu,<sup>4</sup> including plant and weir diversion structures, disposal sites, and borrow pits. During construction, topsoil layers were replaced and slope stabilization measures undertaken effectively to control erosion. Retaining walls and revegetation measures were employed to protect disposal piles. Drainage facilities were built into roads, excavated slopes, and spoil piles. Vegetative measures, including planting of shrubs, grass, and trees, were also taken. All borrow and spoil disposal sites have been re-covered with soil and replanted with shrubs and grasses, and sediment runoff control devices have been installed to minimize soil erosion. According to the water and soil erosion prevention certification issued by the Gansu Soil and Water Conservation Bureau in July 2011, the soil erosion prevention plan is being implemented well and successfully follows national regulations and standards. Oil separators and secondary safety devices that have been installed also prevent soil contamination. All hazardous waste and materials are stored in areas specifically designed for this purpose.

### **2. Water Quality**

6. According to the monitoring results, inflow and outflow water quality all meet class I standards of the National Standard for Surface Water Environmental Quality (GB3838-2002). Wastewater and raw sewage from the substation and the staff living area are all treated before discharge.

### **3. Air Pollution**

7. During construction, mitigation measures were conducted effectively on the construction sites to reduce the emission of pollutants from construction machinery, tunnel and adit construction, rock blasting, foundation excavation, cement mixing, and minor access road construction. During operation, DHP does not generate any significant air pollution. In winter, clean energy generated from the HPP provides residential buildings with heating, replacing the small coal-fired heating boilers and thereby reducing air pollution emissions.

### **4. Noise**

8. During construction, workers were exposed to noise from excavation, vehicles, rock material processing, concrete mixing, and other processes involving machinery. Standard occupational health and safety tools such as protective gear were provided. During operation, noise from ventilators and air compressors in the central control room is minor and does not affect workers in the station. A greenbelt buffer zone was established around the power station,

<sup>3</sup> As started in Xiaogushan HPP, 5% of HHDC's annual tax payments to the Zhangye municipal government go into a special fund to be used to maintain and improve ecological functions in the reservoir area and the Qilian Mountain Nature Reserve. Projects are implemented jointly by the Zhangye Forestry Bureau and the local county-level government. The Zhangye Financial Bureau has issued financial management regulations specifically to manage the funds collected.

<sup>4</sup> The mu is a Chinese unit of measurement (1 mu = 666.67 square meters).

as required in the EIA. The monitored levels of noise were 43.1 Leq[dB(A)] in daytime and 41.2 at night—lower than the requirements in the national standard (GB12348-2008).

## 5. Solid Waste

9. Solid waste yield during operation is insignificant, coming mainly from the residential area. Solid waste from the hydropower station and subsidiary facilities<sup>5</sup> could be disposed of at approved sites. A solid waste collection system has been set up on-site and is already in use. The DHC classifies hazardous waste, stores it separately, and then transports such materials to the Zhangye City solid waste treatment center for processing. The EMU is now checking the process regularly and the system is working well. The DHC and the construction unit effectively deal with waste disposal as national and local laws and regulations require.

## 6. Ecology and the Environment

10. The HPP is in the experimental zone of the Qilian Mountain National Nature Reserve (QNNR). Three regulations currently govern the QNNR: (i) State Regulation for Natural Reserves (1994); (ii) Gansu Provincial Regulation for Natural Reserves (1999); and (iii) Regulation for Management of QNNR (1997; revised in 2002). The QNNR Management Bureau is authorized to be the competent administrative department for nature reserves under 1994 regulations. The HPP is about 29 kilometers (km) away from the QNNR buffer zone at its nearest point, and about 30 km away from the core zone. The Sidalong Protection Station manages the QNNR in the project area. The QNNR Management Bureau approved the construction of the project in the experimental zone of QNNR in April 2007. The bureau agreed that the approval of all DHP activities would follow national policies. The compensation contract was signed before project construction.

11. To avoid impact on terrestrial vegetation and aquatic flora and fauna species along the 12 km section of the Heihe River, environmental flow should be maintained above 4.34 cubic meters per second (m<sup>3</sup>/s) during the operational period in line with the requirements of the Notice on Environmental Flows for Run-of-the-River Hydropower Plants (2006) issued by the State Environmental Protection Administration (SEPA; formerly the Ministry of Environmental Protection). According to DHC data, river flow has been maintained at least at 4.4 m<sup>3</sup>/s during operation. So far no significant impact on aquatic species has been reported. The local monitoring station has also reported that the number of fish in the reservoir area has increased in the last 2 years. The environmental monitoring station has agreed to monitor the flow rate and its impact continuously in the future.

## 7. Cumulative Impact on Heihe River

12. The HPP project was the fifth planned under the cascade hydropower development scheme. An EIA prepared by Lanzhou University in July 2007 concluded that the cascade development along the Heihe River would generate substantial positive environmental benefits through avoided ambient air pollution from alternative energy sources and that all potential environmental impact could be mitigated to acceptable levels through adequate measures during project construction and operation. Therefore, the cascade does not significantly affect the annual flow discharge patterns for downstream users. According to the environmental monitoring report prepared by ZEMS, Heihe River's water quality is still grade II surface water quality, both at the inlet of Erlongshan HPP and at the outlet of Dagushan HPP, downstream

---

<sup>5</sup> Including the residential area and other facilities, such as storage and parking lots.

from the project. In consultation with ZEMS, a post evaluation of environmental impact has been proposed for 2014. So far no significant impact on biodiversity and protected species has been reported by the QNNR Management Bureau.

13. In accordance with the project completion verification conducted by the Gansu Provincial Environment Protection Bureau (GPEPB), the project has produced significant environmental benefits and no adverse environmental impact during construction and operation.

#### **D. Environmental Benefits**

14. The project has yielded substantial environmental benefits from a reduction in air pollution and greenhouse gas emissions by employing an alternative energy source. The hydropower plant also provides a more reliable electricity supply in the project area, reduces pressure on fuelwood collection, and provides an alternative to burning coal for cooking and heating.

15. According to the average heat rates of coal-fired power plants within the Northwest Power Grid, the project could save 82,771 tons of coal equivalent, or 105,345 ton of raw coal. The avoided emissions were therefore estimated at a yearly average of 174 tons of particulate matter, 173 tons of sulfur dioxide, and 415 tons of nitrogen oxides.

16. The project was registered with the Executive Board of the United Nations Framework Convention on Climate Change (UNFCCC) as a Clean Development Mechanism (CDM) project on 9 May 2010, with 170,015 certified emission reductions (CERs) estimated to be generated yearly. Its benefits in CERs have been successfully traded. The British EcoSecurities Group signed a CER purchase agreement with the DHC for the purchase of the project's CERs. The project actually over-generated and was issued with 195,751 CERs from the start of the crediting period on 9 May 2010 to 9 May 2011. In addition, the project achieved actual emission reductions of 232,859 CERs for the period from 1 April 2011 to 28 April 2012.

#### **E. Conclusions**

17. During construction, all the contractors fulfilled their obligation to protect the environment and implement mitigation measures in their construction schemes. The adverse effects of the project construction on the surrounding environment were thus minimized. During operation, there has been little negative impact on the environment. The necessary environmental management approaches have been integrated into operations. Moreover, the project will have significant environmental benefits by providing clean energy and producing considerably less air pollution than conventional coal-fired power plants.

## EVALUATION OF LAND ACQUISITION AND RESETTLEMENT ACTIVITIES

### A. Scope of Land Acquisition and Resettlement

1. The Dagushan Hydropower Project (DHP) was the second tranche of the Gansu Heihe Rural Hydropower Development Investment Program. The local people are mainly Tibetans and Sunan County is also the home of the Yugur ethnic group. A short resettlement plan to address the requirements for both social safeguards was prepared by Dagushan Hydropower Company (DHC) and approved by the Asian Development Bank (ADB) in July 2007. In addition, a community development plan was formulated under the previous ADB-financed Xiaogushan Hydropower Project and Erlongshan Hydropower Project, and continuously implemented under the project to directly benefit the local minorities in the project area. A total of 35.1 mu<sup>1</sup> of grassland was permanently acquired according to the resettlement plan, affecting one household of five people in Louzhuangzi Village of Mati Township, and 113.59 mu of grassland was temporarily occupied during project construction. In addition, one affected seasonal herding camp was reconstructed.

2. Land acquisition and resettlement began in November 2006<sup>2</sup> and was completed by January 2010. In total, 88.5 mu of land was permanently acquired and 200 mu was temporarily used. The land acquisition actually affected 10 Tibetan households in Louzhuangzi, Sidalong, and Hongwozi villages. One seasonal herding camp was also demolished and rebuilt. Table A12.1 presents the actual project impact compared with the impact estimated in the resettlement plan. The increase in project impact was mainly due to the additional land requirement during the construction of the power station structure, borrow pits, and office and accommodation buildings.

**Table A12.1: Project Land Acquisition and Resettlement Impact**

Item	Unit	Amount
A. Permanent Land Acquisition		
Resettlement plan	mu <sup>a</sup>	35.1
Actual	mu	88.5
Actual versus resettlement plan	%	252%
B. Temporary Use of Land		
Resettlement plan	mu	113.59
Actual	mu	200
Actual versus resettlement plan	%	176%
C. Affected seasonal herding camp		
Resettlement plan	set	1
Actual	set	1
Actual versus resettlement plan	%	100%
D. Affected Households		
Resettlement plan	HH	5
Actual	HH	10
Actual versus resettlement plan	%	200%

<sup>a</sup> The mu is a Chinese unit of measurement (1 mu = 666.67 square meters).

Sources: Resettlement plan; project completion report; external monitoring report; and DHC.

<sup>1</sup> The mu is a Chinese unit of measurement (1 mu = 666.67 square meters).

<sup>2</sup> Some land acquisition and payments had begun, which was explained in the short resettlement plan.

## B. Resettlement Policy and Compensation Rates

3. Land acquisition and resettlement were implemented according to the resettlement plan and the Land Administration Law (2004) and Grassland Law (1985) of the People's Republic of China, as well as relevant local government regulations. According to the resettlement plan, the compensation rates for permanent land acquisition, including land compensation and resettlement subsidy, would be 10 times the average annual output per mu for grasslands. The actual land compensation rates were as mentioned in the resettlement plan, and the actual compensation rate for the temporary use of grasslands was the same as the rate indicated in the resettlement plan for permanent land use. Table A12.2 compares the actual compensation rates with those given in the resettlement plan.

**Table A12.2: Compensation Rates**  
(CNY)

Item	Resettlement Plan	Actual
A. Permanent land acquisition (per mu <sup>a</sup> )	600	600
B. Temporary land use (per mu)	600	600

<sup>a</sup> The mu is a Chinese unit of measurement (1 mu = 666.67 square meters).

Sources: Resettlement Plan, external monitoring report, and DHC.

## C. Resettlement Measures and Income Restoration

4. The land acquisition impact on affected households was small, given the extent of grassland user rights in the project area. Permanent land acquisition affected only four Tibetan households. The project completion review mission interviewed two affected households in Louzhuangzi Village of Mati Township in 2012. Hu Xingming and his wife had a total of 5,976.6 mu of grassland; only 12.216 mu (0.2%) of the total was acquired for the project. Another affected household, that of Hu Changlin, lost only 4 mu, or 0.09% of the 4,500 mu of grassland owned by the family. Both affected households declared themselves satisfied with the cash compensation, and used the money mainly to buy more lambs and better fodder, thereby increasing their annual household income significantly between 2007 and 2011. A comparison of annual household incomes before and after the project is presented in Table A12.3. In addition, Hu Changlin expressed his gratitude for the displaced herding camp built of bricks and concrete, which he obtained under the project. He said it was much better than the demolished stone-pile shanty and has greatly benefited his family.

**Table A12.3 Household Annual Income in 2007 and 2011**

HH No.	Name of Householder	No. of Sheep		Income from Herding (CNY)		Income from Migrant Job (CNY)		Total Annual HH Income (CNY)	
		2007	2011	2007	2011	2007	2011	2007	2011
1	Hu Xingming	300	320	40,000	120,000	0	0	40,000	120,000
2	Hu Changlin	280	340	40,000	80,000	30,000	70,000	70,000	150,000

HH = household.

Source: Interview with affected households in 2012.

5. The two interviewed households also confirmed that they are living a better life than before, as DHC helped to widen and rebuild the main road leading out of the affected villages. China Mobile, China Unicom, and China Telecom built signal towers for mobile phones in the project area as a result of the project, making communications much easier for the local people,

who have benefited from the significant improvements in transportation and communication facilities. The external resettlement monitor conducted a survey in December 2010 and also concluded that the land acquisition impact on affected households was minor, and the improvements in transportation and telecommunication facilities have contributed to the development of the local economy. The external monitor also concluded that affected persons were better off and that there were no remaining resettlement issues.

#### D. Land Acquisition and Resettlement Cost

6. The total cost of land acquisition and resettlement was CNY174,826, 96% higher than the estimate in the resettlement plan because of the increase in project impact. The land acquisition and resettlement costs were totally funded by the DHC. Table A12.4 provides the details of the resettlement costs.

**Table A12.4: Land Acquisition and Resettlement Costs**  
(CNY)

Item	Resettlement Plan	Actual	Actual versus Resettlement Plan (%)
1 Permanent land acquisition	21,060	48,926	232%
2 Temporary land use	68,154	124,200	182%
3. Demolition of seasonal herding camp	Replacement	1,700	Not applicable
<b>Total</b>	<b>89,214</b>	<b>174,826</b>	<b>196%</b>

Source: Resettlement plan and DHC.

#### E. Institutional Arrangements

7. The Sunan county government, the Mati township and Kangle township governments, and the DHC set up a resettlement office for the project. The staff of the resettlement office included three officials from the county and township governments, three members from the affected village committees, and three members from DHC. The office had a key role in the implementation of land acquisition and resettlement, including land measurement, finalization of land acquisition impact, and consultation and negotiation with affected households on compensation standards. Land acquisition agreements were signed between DHC and the affected households, in the presence of the Sunan County Grassland Administration representative. Compensation was paid to the affected households through the grassland administration.

#### F. Monitoring and Evaluation

8. Lanzhou University was hired in December 2010 to evaluate the implementation of land acquisition and resettlement. The evaluation report it submitted to ADB in January 2011 reviewed the process and, on the basis of interviews with 10 affected households, concluded that the impact on the affected households was minor. The report stated that the transportation and telecommunication improvements had contributed to local economic development. However, annual monitoring was not conducted during implementation in accordance with either the loan covenant or the short resettlement plan. ADB's resident mission in the country rectified this deficiency after the project was delegated to it. The delayed recruitment of an external monitor resulted in late report submission and inadequate baseline and implementation information.



## **G. Participation and Information Disclosure**

9. The resettlement plan indicated that consultation and participation activities were organized during project preparation in late 2006 and early 2007. Subsequently, DHC conducted numerous consultations with affected communities and affected people during the implementation stage from 2007 to 2009. The affected people were consulted on resettlement policies, compensation standards, and grievance procedures, among other matters. The scope of the land acquisition and resettlement was made clear to all the affected households and the compensation to which they were entitled in exchange for their land and asset losses was explained to them. All compensation was negotiated directly by the DHC with the affected herder families.

## **H. Lessons and Conclusions**

10. Land acquisition and resettlement activities were implemented well. Direct negotiations between the DHC and the affected herder families were efficient and culturally sensitive, and ensured transparency of land acquisition and resettlement. The compensation funds were delivered to the affected persons in a timely manner and used by the affected households to improve their incomes. On the other hand, the project demonstrated difficulties arising from the delayed hiring of an external monitor and, hence, the importance of hiring such a monitor before the start of land acquisition.

## SOCIAL IMPACT, POVERTY REDUCTION, AND ETHNIC MINORITY DEVELOPMENT

### A. Introduction

1. A community development strategy and plan (CDSP) was implemented during the Asian Development Bank (ADB)–financed Xiaogushan Hydropower Project (XHP) and Erlongshan Hydropower Project (EHP). Dagushan Hydropower Company (DHC) was to continue to implement further measures to enhance project benefits to local communities, including (i) hiring and training local workers for project construction; (ii) allowing access to project facilities (e.g., medical emergency facilities, transportation, electricity supply); (iii) supporting the purchase of local supplies and services from the local communities, and (iv) providing more reliable electricity supply to local towns after project completion. In addition, Sunan County was to receive tax revenue from DHC's operations, which could be used to improve social services, enhance the watershed environment, and invest in economic activities to reduce poverty.

### B. Sustainable Socioeconomic Growth in the Project Area

2. The project area is a poor area of Gansu Province with an energy supply deficit. The supply shortage has seriously affected regional socioeconomic development in Sunan County. The construction and operation of the Dagushan Hydropower Project (DHP), in addition to the XHP and EHP, has helped to fill the energy supply deficit and improve the reliability of supply during peak hours, and consequently contribute to regional economic growth. In addition, the taxes paid by the project during construction and operation have also contributed to local government fiscal revenues, which have been used to improve social services and increase investment in economic development activities. The statistical data show that socioeconomic conditions in project areas have improved rapidly in recent years. From 2006 to 2011, per capita gross domestic product in Sunan County increased by 228%, or by an annual average of 26.8%, from CNY15,872 to CNY52,006. Per capita government fiscal revenues increased by 258%, or by an annual average of 29%, from CNY3,234 to CNY11,562. Table A13.1 provides details.

**Table A13.1: Socioeconomic Growth in the Project Area**

(CNY/person)					
Region	Year	Per Capita GDP	Growth Rate (%)	Per Capita Fiscal Revenue	Growth Rate (%)
Countrywide	2006	16,032		2,949	
	2011	35,083	119%	7,700	161%
Gansu Province	2006	8,479		1,133	
	2011	16,031	89%	3,641	221%
Zhangye City	2006	9,972		614	
	2011	21,357	114%	2,076	238%
Shandan County	2006	9,193		409	
	2011	19,519	112%	1,103	170%
Minle County	2006	5,971		301	
	2011	12,220	105%	841	179%
Ganzhou District	2006	11,513		681	
	2011	22,649	97%	1,702	150%
Linze County	2006	10,738		561	
	2011	23,812	122%	1,297	131%
Gaotai County	2006	9,755		486	
	2011	22,066	126%	1,754	261%
Sunan County	2006	15,872		3,234	
	2011	52,006	228%	11,562	258%

GDP = gross domestic product.

Sources: Statistical yearbooks of Zhangye Prefecture for 2006 and 2011.

### C. Increased Rural Income and Poverty Reduction in the Project Area

3. The annual income of rural farmers and herders in the project area has significantly increased during project implementation and operation. From 2006 to 2011, the per capita annual net income in the rural areas of Sunan County increased by 70%, from CNY4,754 to CNY8,062. Table A13.2 provides details.

**Table A13.2: Increased Rural income in the Project Area**

Project Area	Per capita Rural Net Income (CNY/person)		Growth Rate (%)
	2006	2011	
Zhangye Prefecture	3,934	6,467	64%
Shandan County	3,839	6,298	64%
Minle County	3,534	5,503	56%
Ganzhou District	4,132	6,870	66%
Lingze County	4,006	6,875	72%
Gaotai County	3,965	6,499	64%
Sunan County	4,754	8,062	70%

Sources: 2006 and 2011 statistical yearbooks of Zhangye Prefecture.

4. The Zhangye city government has taken various measures to safeguard both the urban and the rural poor. The rural poor people have been protected under the government's Minimum Living Standard Security Program since 2007. A total of 74,818 rural poor in Zhangye City, including 4,380 persons in Sunan County, were subsidized with CNY59.61 million by the government in 2009. Each poor person received a monthly subsidy of CNY60. The subsidy standard was adjusted to CNY70 in 2010 and CNY89 in 2011. A total of 82,184 rural poor from across the city, including 4,880 persons in Sunan County, were supported in 2010. In addition, the municipal government provided an annual living subsidy of CNY3,900 to each five-guarantee household.<sup>1</sup>

5. Clean energy and higher government revenues contribute to social economic development in the project area. The DHC has paid an average of CNY10 million yearly to the governments of Zhangye City and Sunan County since the start of project operation. The various taxes paid by the Xiaogushan Hydropower Company (XHC), Erlongshan Hydropower Company (EHC), and DHC have directly contributed to the growth of local government fiscal revenues, and therefore indirectly to poverty reduction in Sunan County as well as Zhangye City.

### D. Ethnic Minority Development

6. The hydropower plant project is in Mati Township, Sunan County. At the time of project construction, there were 4,379 residents (1,141 families) in Mati Township, including 2,517 (59%) ethnic minority people, such as Tibetan (Zang), Yugur, Tu, Hui, and Mongol. A CDSP (footnote 16) was prepared and implemented during the previous ADB-financed XHP and EHP, and the DHC has continued to implement the measures identified under the plan to enhance project benefits to local communities. For example, the DHC widened and rebuilt the main road from Dayekou to Louzhuangzi Village and other villages at an early stage of project

<sup>1</sup> A special government social security policy providing solitary senior citizens with free food, clothing, medicine, housing, and funeral benefits.

construction, making it more convenient for local people to go to the Zhangye downtown center to shop, get medical care, and trade livestock.

7. DHC took measures to safeguard local minority communities during project construction, such as maintaining or watering the access road and providing the affected people in particular with short-term job opportunities. Besides restoring the temporarily used grassland, DHC spent over CNY166,000 building water cellars, laying water pipes, and planting trees in the local villages in 2009 and 2010. To protect and promote the cultural development of local ethnic minorities, the DHC donated CNY300,000 for the construction of a 9-meter-high Buddhism stupa for local Tibetans and invited the Lama to conduct religious ceremonies.

8. The DHC also worked with China Mobile, China Unicom, and China Telecom to expand the coverage of mobile signals in the project area. Local herders can now easily contact their families while herding in remote grasslands, and each herder now has at least one cell phone. The villagers can review market information any time, even while herding.

## **E. Labor and Employment**

9. The construction of DHP created around 30 temporary employment opportunities daily for local people with an average monthly salary of CNY900 during construction and about 30 formal jobs with an annual income of CNY26,400 at the start of operation. Among the temporary employment opportunities during construction, nearly 60% went to the poor. With the skills they gained in the civil works, many of the laborers were later hired for other projects after project completion.

## **F. Education**

10. The Tuition and Textbook Expenditures Remission Program of the Sunan county government provides free education for students in primary school and high school. The subsidy covers tuition, textbooks, and residence in the school dormitory. In addition, students receive living and travel allowances. The daily living allowance in school is CNY3 for primary school students, CNY5 for middle school students, and CNY7 for high school students, while the annual travel allowance ranges from CNY60 to CNY300 per student, depending on the distance from home to school. The implementation of such a preferential policy, which applies to all enrolled students in the county, has greatly improved local education. The enrollment rate for school-age children in Sunan County is now almost 100%.

## **G. Gender Development**

11. The project has supported and promoted gender development in the project area. The development of clean energy has significantly improved the lives of rural residents, especially the women, who generally take on major responsibilities in the home. They now have access to cleaner, convenient, and reliable electricity supply, reducing their workload and improving indoor air quality especially when cooking. The health of local women has improved and they now have more time to enjoy life.

12. Women have equal right to enjoy the benefits of better transportation and communication facilities, as well as other living comforts. Before the project, few people, especially women, left their home to seek migrant jobs. Now more and more people, 30% of them women, go out in search of migrant job opportunities. Thus, women are able to contribute more to their household incomes and their families even as their social status is enhanced.

13. Fifteen percent of the temporary unskilled work opportunities during the project construction period were provided to women and six full-time jobs have also been assigned to women during DHP operation. Women also participated actively in land acquisition and resettlement, particularly during the consultations on resettlement policies and compensation standards, land measurement, and family discussions on the use of the compensation funds.

## **H. Conclusions and Lessons**

14. The project has contributed to sustainable socioeconomic development, poverty reduction, and ethnic minority development in the project area. The good practices under the project include (i) the continued implementation of the CDSP, which promoted the development of the local ethnic minority communities, and enabled the local people to benefit from the project in a culturally appropriate manner; and (ii) the great importance given by the DHC to social issues throughout project implementation and operation, which strengthened its relationship with the local communities.