ECONOMIC ANALYSIS

A. Introduction

1. The economic analysis covers two of the three project outputs: (i) Akesu-Duolang wetland rehabilitation and (ii) improved urban infrastructure services. The economic analysis is carried out to determine whether the expected benefits of the project are sufficient to cover the investment costs of the two physical project outputs and their components, and the overall project.[1] Economic benefits are quantified based on (i) the incremental output in the wetlands restoration and rehabilitation component, and partly in the component parts concerned with the improvement of public green spaces and establishment of a tree nursery; (ii) cost savings in the component parts concerned with urban roads and underpass as well as partly in the improved central heating component; and (iii) willingness to pay in all other components. The economic analysis was conducted in accordance with Asian Development Bank (ADB) guidelines.[2]

B. Rationale and Least-Cost Analysis

2. The level and quality of many urban services in Akesu City is inadequate, which burdens the day-to-day life of a large portion of the population. The poor condition of roads increases the time spent on routine daily activities and impairs the overall urban environment. Lack of or substandard central heating has a negative impact on health—not least because people are forced to use alternative sources of heat that pollute the air. In general, the poor quality of all services lessens the quality of life in the city and substantially reduces the rate of economic growth. Significant improvements in local services are expected from the project, including a smoother, more rapid, and safer road system thanks to adding traffic lanes and separating motorized and nonmotorized traffic. Urban living conditions will be improved by sealing community lanes, boosting water supply and central heating, and strengthening wastewater treatment and solid waste management. The urban environment will also gain from the creation and improvement of public parks and green areas.

3. Least-cost options, including for the type of pipelines to be used, were considered by the local design institute during project preparation. The comparison of pipeline options centered on the respective capital costs because the maintenance costs are not vastly different, and the least-cost method was selected.

C. Main Assumptions and Methodology

4. The economic analysis is based on the difference between without- and with-project scenarios, as required in ADB's guidelines (footnote 2). The main assumptions are

(i) the project implementation period is 5 years starting in 2015, and the project life is 25 years including the project implementation period;
(ii) financial costs and benefits are in prevailing mid-2014 prices and are expressed in constant 2014 terms;
(iii) an exchange rate of $1.00 = CNY6.24 is used for the conversion of US dollar prices to the Chinese yuan (CNY);

[1] This summary is based on Extended Economic Analysis, which differentiates each component part (Supplementary Document accessible from the list of linked documents in Appendix 2).

[2] ADB. 1997. Guidelines for the Economic Analysis of Projects. Manila; ADB. 2013. Cost–Benefit Analysis for Development: A Practical Guide. Manila; ADB. 2013. Key Areas of Economic Analysis of Investment Projects – An Overview. Manila.

(iv) economic prices and benefits are expressed in CNY using the domestic price numeraire;
(v) economic costs and benefits are derived from financial costs and benefits by (a) excluding taxes and duties (as these are transfer payments), (b) applying a shadow exchange rate factor of 1.014 to all tradable items; (c) applying a shadow wage rate factor of 0.8 to all unskilled labor and 1.0 for skilled labor;[3]
(vi) the economic value of agricultural land to be acquired for project purposes is assessed based on the net economic value of crops currently grown on that land and based on the same project life as used for the overall project. All other costs associated with land acquisition and resettlement were treated as nontradable, and the financial costs were converted to economic values accordingly; and
(vii) the economic opportunity cost of capital is assumed to be 12%.

D. Cost–Benefit Analysis

1. Economic Costs

5. Costs in the economic analysis of each component include (i) investment costs such as civil works, equipment, equipment installation, indirect costs of project preparation and implementation (including costs associated with traffic delays during road rehabilitation), and physical contingencies; and (ii) recurrent costs, particularly for operation and maintenance (O&M) of the investments. The cost of land acquisition and resettlement was allocated between the road component and the wetlands output based on an assessment of the allocation indicated in the detailed cost tables. The cost of project management and capacity building was allocated pro rata across all components. The economic investment costs exclude price contingencies and financing charges during implementation since these are transfer fees.

6. Recurrent costs are estimated for each component part based on expected incremental O&M costs provided by the project management office and based on extensive experience with similar facilities. Specific costs were provided for the improvement of public green spaces and provision of a plant nursery; improvements to the central heating, water supply, and sewerage networks; and community lanes. With the exception of the community lane element, a detailed breakdown into unskilled labor, skilled labor, and equipment and material costs was provided (Table 1). These are used for conversion to economic values.

Table 1: Operation and Maintenance Costs for Individual Components

		Of which		
Subproject	**Annual O&M Cost**	**Unskilled Labour** (CNY)	**Skilled Labour** (CNY)	**Equipment and Materials** (CNY)
Public parks	499,200	350,000	49,360	99,840
Road landscaping (street parks)	654,048	500,000	23,238	130,810
Plant nursery (2020)	1,000,000	700,000	100,000	200,000
Central heating network	1,500,000	400,000	100,000	1,000,000
Water supply network	1,200,000	600,000	100,000	200,000
Sewerage network	800,000	400,000	100,000	1,300,000
Community lanes	300,000	not available	not available	not available

CNY = Chinese yuan, O&M = operation and maintenance.
Source: Project management office estimates.

[3] The conversion factors for skilled and unskilled labor are the same as those used in similar projects in the western region of the PRC, such as: ADB. 2012. *Report and Recommendation of the President to the Board of Directors for a Proposed Loan to the People's Republic of China: Gansu Urban Infrastructure Development and Wetland Project*. Manila.

2. Economic Benefits

7. The economic benefits of each component of output 1 (integrated urban development) are estimated separately, including benefits of new and upgraded roads. The economic benefits of output 2 (wetland rehabilitation) are estimated for the overall output of all of its components. Benefits are estimated using a base year of 2015, the first project year, and in constant mid-2014 values. With- and without project benefits are projected beyond 2015 to reflect the expected build-up of benefits after project completion. All contingent valuation surveys are based on a subset of 150 beneficiary households during the household socioeconomic survey.

8. **Wetland rehabilitation.** Wetland rehabilitation benefits comprise (i) production values, including agricultural production, other wetland products, and fish; (ii) regulating services such as water supply, water purification, climate regulation, and air regulation; (iii) supporting services such as biodiversity maintenance and nutrient cycle; (iv) cultural services such as leisure and recreation; (v) reduction in the sediment levels of the water that will eventually be used for drinking water and other purposes; and (vi) research and education. The economic value of item (v) is considered substantial since a reduction in sediments both improves the environment and reduces the cost of water treatment prior to distribution. Although other sources frequently assume such benefits to be in excess of CNY1.00 per cubic meter, the current analysis uses a conservative assumption of only CNY0.10 per cubic meter.

9. **Integrated urban development.** This output has six components: (i) improvement of the urban road network, including landscaping and a pedestrian overpass benefiting two of the road components, and upgrades to community lanes; (ii) upgrade of a public park and greening of areas along five roads that are not upgraded under the project, along with establishment of a plant nursery; (iii) expansion of the water supply network; (iv) expansion of the sewerage network; (v) expansion of the central heating network; and (vi) improvement of solid waste management.

10. Benefits from improving the urban road network are based on estimates by the local design institute of the base traffic and/or pedestrian flows, and traffic growth for each of the component parts—used to estimate incremental benefits from time savings. Benefits are assumed to reach a maximum in 2024 and to decline through to 2028, when they are assumed to be only 10% of the unrestricted amount. Reduced vehicle operating costs represent an additional benefit that could be quantified if the required data were available. Combining the new and upgraded road components into a single road component yields an economic internal rate of return (EIRR) of 29.5% and an economic net present value (ENPV) of CNY555.9 million, well above the cut-off point for economic viability.

11. Benefits from upgrading community lanes include (i) improved and increased traffic flow; (ii) lower vehicle operating costs; (iii) fewer accidents; (iv) better access; (v) less dust and air pollution, which will improve public health; (vi) more safety due to installation of lights; and (vi) improvement in the local aesthetics. Due to difficulties in quantifying these benefits in a conventional market framework, a contingency valuation approach was used. Benefits from improved water supply, sewerage, and central heating networks, and solid waste management, were assessed via a contingent valuation sub-survey of 150 respondents in the household socioeconomic survey. In addition, a contingent valuation sub-survey of 100 respondents was conducted to quantify the benefits of upgrades to public parks and green spaces. Other benefits used for the analysis included (i) the expected value of production from the proposed plant nursery, and (ii) reduced operational costs due to decommissioning of local heat-generating plants after completion of the improved central heating network.

E. Project Economic Viability

12. The economic analyses of the wetlands output resulted in an EIRR of 13.3% and an ENPV of CNY20.7 million (Table 3); those of the integrated urban development output yielded an EIRR of 26.0% and an ENPV of CNY878.5 million (Table 4). Combining the two outputs into the overall project economic analysis (Table 5) indicates that the project is economically viable with an EIRR of 23.6% and an ENPV of CNY99.1 million.

13. Standard sensitivity tests assumed (i) a 10% cost increase; (ii) a 10% benefit decrease; (iii) a 10% cost increase combined with a 10% benefit decrease; (iv) a 1-year benefit lag; and (v) a 10% increase in recurrent costs. In addition to EIRRs and ENPVs, the sensitivity analysis includes estimation of switching values for cost increases and benefit decreases. While the tests have not been defined for any specific risks, they cover the main impacts of such risks. The results for both outputs and the overall project are in Table 6.

14. Most notably, the overall project EIRR of 23.6% falls to 21.3% under a 10% cost increase, to 21.1% under a 10% benefit decrease, to 19.0% under a 10% cost increase combined with a 10% benefit decrease, and to 19.5% under a 1-year lag in benefits. A 10% increase in recurrent costs will reduce the EIRR by less than 0.1 percentage points, indicating that recurrent costs are not critical to overall project viability even if they increase by 100%. While the project is most sensitive to a benefit lag, none of these values suggests that overall viability is critical.

Table 3: Summary Economic Analysis of Wetlands Rehabilitation Output

(CNY million)

Year	Investment Cost	Recurrent Cost	Total Cost	Benefits	Net Benefits
2015	84.6	0.0	84.6	0.0	(84.6)
2016	30.8	0.0	30.8	0.0	(30.8)
2017	140.8	0.0	140.8	0.0	(140.8)
2018		2.6	2.6	42.5	39.9
2019		2.6	2.6	42.5	39.9
2020		2.6	2.6	42.5	39.9
2021		2.6	2.6	42.5	39.9
2022–2040		2.6	2.6	42.5	39.9
2041		2.6	2.6	42.5	39.9
EIRR					13.3%
ENPV	200.3	14.2	214.5	235.2	20.7

( ) = negative, EIRR = economic internal rate of return, ENPV = economic net present value.
Source: Asian Development Bank estimates.

Table 4: Summary Economic Analysis of Integrated Urban Development Output

Year	Investment Cost	Recurrent Cost	Total Cost	Benefits	Net Benefits
2015	449.5	0.0	449.5	0.0	(449.5)
2016	374.6	3.3	377.9	81.2	(296.6)
2017	250.9	8.1	259.0	197.0	(62.0)
2018		13.3	13.3	270.0	256.7
2019		13.1	13.1	292.3	279.3
2020		13.2	13.2	314.0	300.8
2021		13.2	13.2	338.3	325.1
2022		13.2	13.2	365.5	352.4
2023		13.2	13.2	393.5	380.3
2024		13.2	13.2	418.9	405.7
2025		13.2	13.2	414.6	401.5
2026		13.2	13.2	389.4	376.3
2027		13.2	13.2	319.0	305.9
2028		13.2	13.2	224.3	211.1

Year	Investment Cost	Recurrent Cost	Total Cost	Benefits	Net Benefits
2029–2040		13.2	13.2	167.5	154.4
2041		13.2	13.2	169.2	156.1
EIRR					26.0%
ENPV	878.5	81.3	959.8	1,838.3	878.5

[a] A gradual build-up of benefits and net benefits by about CNY0.1 million/year occurs between 2030 and 2040.
( ) = negative value, EIRR = economic internal rate of return, ENPV = economic net present value.

Table 5: Summary Economic Analysis of Overall Project

(CNY million)

Year	Investment Cost	Recurrent Cost	Total Cost	Benefits	Net Benefits
2015	534.1	0.0	534.1	0.0	(534.1)
2016	405.4	3.3	408.7	81.2	(327.4)
2017	391.7	8.1	399.8	197.0	(202.8)
2018		16.1	16.1	312.4	296.4
2019		15.6	15.6	334.8	319.2
2020		15.7	15.7	356.4	340.7
2021		15.7	15.7	380.8	365.0
2022		15.7	15.7	408.0	392.3
2023		15.7	15.7	435.9	420.2
2024		15.7	15.7	461.3	445.6
2025		15.7	15.7	457.1	441.3
2026		15.7	15.7	431.9	416.2
2027		15.7	15.7	361.5	345.8
2028		15.7	15.7	266.8	251.0
2029		15.7	15.7	210.0	194.3
2030		15.7	15.7	210.4	194.7
2031		15.7	15.7	210.5	194.8
2032		15.7	15.7	210.7	195.0
2033		15.7	15.7	210.8	195.1
2034		15.7	15.7	210.9	195.2
2035		15.7	15.7	211.0	195.3
2036		15.7	15.7	211.2	195.4
2037		15.7	15.7	211.3	195.5
2038		15.7	15.7	211.4	195.6
2039		15.7	15.7	211.5	195.8
2040		15.7	15.7	211.6	195.9
2041		15.7	15.7	211.7	196.0
EIRR					23.6%
ENPV	1,078.8	95.7	1,174.5	2,073.6	899.1

( ) = negative value, EIRR = economic internal rate of return, ENPV = economic net present value.
Source: Asian Development Bank estimates.

Table 6: Summary of Results of Sensitivity Tests

Item	Indicator	10% Cost Increase	10% Benefit Decrease	10% Cost Increase + 10% Benefit Decrease	1-Year Benefit Lag	10% Increase in Recurrent Costs
Wetlands restoration and rehabilitation output	EIRR (%)	12.0	11.8	10.5	11.6	13.2
	ENPV (CNY million)	(0.8)	(2.8)	(24.3)	(6.3)	19.1
	Switching value (%)	10	9			
Overall integrated urban development output	EIRR (%)	23.5	23.3	21.0	21.2	25.9
	ENPV (CNY million)	782.6	694.7	598.7	674.5	870.4
	Switching value (%)	92	48			
Overall project	EIRR (%)	21.3	21.1	19.0	19.5	23.5
	ENPV (CNY million)	781.6	691.7	574.3	668.1	889.5
	Switching value (%)	77	43			

( ) = negative value, EIRR = economic internal rate of return, ENPV = economic net present value.
Source: Asian Development Bank estimates.