ECONOMIC ANALYSIS

A. Macroeconomic and Sector Context

1. The project is located in Pingxiang municipality, a poverty-stricken and resource-depleted coal mining city in Jiangxi Province, in the People's Republic of China (PRC). Pingxiang municipality covers a total area of 3,827 square kilometers (km), with hills, mountains, and plains. The municipality's population is 1,870,000, with 597,000 residents in Anyuan district's urban area, the municipality's core city. Pingxiang has a low-wage industrial economy, and is historically dependent on mining and associated industries. The urbanization ratio is at 31.6%, significantly lower than the national average of 53.7%, and there is significant rural poverty (18.6%).[1] Lianhua county is a national poverty county, and within the municipality there are 113 designated poverty villages.[2]

2. In 2008, Pingxiang was among 12 cities in the PRC to be classified as a resource-depleted city eligible for central government support for economic and industrial transformation. The Pingxiang municipal government Resource-Depleted Transitional Development Plan (2013–2020) promotes sustainable socioeconomic development. The overall urban–rural development strategy of Pingxiang municipal government includes plans to develop an expanded central urban core area in Anyuan and Xiangdong districts, and three subcenters in Lianhua, Luxi, and Shangli counties. Infrastructure linkages are needed to enable stronger commuting relationships and reduce rural–urban migration.

B. Rationale

3. Flood risk reduction is a top priority for Pingxiang, because both flood frequency and severity have increased significantly especially since 1998. A major flood affected Pingxiang on 25 May 2014 and caused severe damage to public safety and health, and massive loss of assets and income.[3] Present flood defense levels along the rivers are low. Flow capacity is affected by sediment accumulation, uncontrolled vegetation, and obstructions. The overall river environment has deteriorated in urban areas and near rural settlements as development has encroached on wetland areas and floodplains. Riverbank erosion and degradation are serious in some river sections. Illegal solid waste disposal at the riverbanks is common, particularly in rural areas.

4. Most domestic wastewater is untreated, and wastewater from mining and industry, and non-point source pollutants contribute to poor surface water quality. Many urban areas and towns and villages lack or have incomplete wastewater systems and currently use poorly managed septic tanks, with effluent being discharged into rivers, or percolating into the ground water. Some of Pingxiang's rivers are drinking water sources, and water pollution consequently poses serious risks to public health.

5. Pingxiang's rural areas suffer from limited access to markets, jobs, training, education, and services in towns and cities. The lack of roads and public transport is a major constraint to improving rural opportunities, incomes, and livelihoods. Except for the main east–west and north–south corridors that are served by highways and national roads, many existing rural roads in Pingxiang are narrow and poorly maintained.

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[1] All figures related to Pingxiang are sourced from: Pingxiang Municipal Government. 2012. *Pingxiang Statistical Yearbook, 2011*. Pingxiang. The poverty threshold is based on the national standard of CNY2,300 per year.

[2] In 2011, Pingxiang's average urban income was CNY18,646, compared to the national average of CNY21,810.

[3] Floods in 1998, 2001, 2002, 2010 and 2014 affected 496,000 people and caused the collapse of 2,682 houses, with significant economic losses in the agricultural sector because of flooded farmland.

C. Project Description and Least-Cost Options Analysis

6. The proposed project will support infrastructure and capacity building to address pressing development challenges, including flooding, degraded river environments, the low wastewater treatment rate, and lack of rural–urban connectivity. The project will enhance environmental sustainability in urban and rural areas through improvements in wastewater collection and treatment and water safety. The infrastructure supported by the project includes integrated flood risk management and river rehabilitation, wastewater collection networks and wastewater treatment facilities, and a rural–urban road.

7. **Output 1: Flood risk management and river rehabilitation improved and integrated**. This component comprises works on 71 km of eight rural–urban rivers in Lianhua, Luxi, and Shangli counties; and Xiangdong District including (i) river widening and removal of sediments, (ii) new and rehabilitated embankments, (iii) about 90 hectares of riparian revegetation, (iv) about 46 hectares of wetland protection and rehabilitation, (v) construction or reconstruction of 35 small adaptable weirs for farmland irrigation, and (vi) construction of two new pedestrian bridges (Lianhua and Luxi) and reconstruction of one local bridge (Luxi). Nonstructural measures included in output 4 enhance the effectiveness of the flood protection infrastructure.[4]

8. **Output 2: Wastewater collection and treatment improved**. This component includes improvement and expansion of sewer pipe networks in subcenters of Lianhua County and Xiangdong District and construction of two sewer networks and WWTPs in two townships. A total of about 184 km of new sewer mains, secondary sewers, and interceptors will be installed.[5] A new WWTP and pump station with 5,000 cubic meters (m^3) per day capacity will be built in Xuanfeng Town in Luxi County, and a new WWTP and pump station with 2,500 m^3 per day capacity will be built in Tongmu Town in Shangli County.

9. **Output 3: Rural–urban linkages improved**. This component includes a 44 km rural–urban class II road with a width of 10 meters (m), six bridges with a total length of 953 m, and a 482 m tunnel. The road is one of the four bypass roads in the Pingxiang Integrated Transport Plan (2012). The road will link towns and villages to urban and industrial areas in Luxi and Shangli counties, and Anyuan District; and expand the existing road network in the project area to improve traffic capacity, and reduce transport costs and travel time for people and goods. Alternative road alignments were considered and an unnecessary grade-separated junction was eliminated during the review.

D. Economic Analysis

10. The analysis is in accordance with Asian Development Bank guidelines and other good practice guides.[6] All predicted project costs and benefits are measured in 2014 economic prices. An exchange rate of CNY6.21 = $1 and the world price system have been used. Traded goods are measured at world prices. Construction costs are largely non-traded and are converted to world prices using a standard conversion factor (SCF) of 0.98. Land is valued at its compensation price less taxes, times the SCF. Unskilled labor is treated as being in surplus and is converted to economic prices using a shadow wage rate factor of 0.8 and the SCF. Skilled labor is treated as scarce and converted using the SCF. Labor costs are assumed to rise by 1% annually in real terms throughout the evaluation period, a common assumption in economic

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[4] It will meet government requirements for flood protection for (i) urban areas for 20-year flood events (occurring once every 20 years), (ii) rural villages for 10-year flood events, and (iii) farmland for 5-year flood events.

[5] Sewer connections of titled properties will be installed by property owners or developers. For all other households, connections will be installed under the project.

[6] ADB. 1997. *Guidelines for the Economic Analysis of Projects.* Manila.

evaluation. Real wages in the PRC have risen faster, but the position in individual work units is more complex and depends on changes in productivity and hiring practices. The price of fuel is based on forecast crude oil prices from 2015 to 2025. Construction takes place over an assumed 5-year period (2016–2020); the evaluation period is 25 years from start of operation. Physical contingencies are set at 5%.

E. Flood Risk Management and River Rehabilitation Component Benefits

11. Quantified benefits are based on average avoided annual flood damage to tangible assets. In addition, there are non-quantified benefits, including environmental improvements to the river, water quality and riparian ecology and protected wetlands; benefits for residents and agri-tourists from the recreational value of the riverfront greenway system with continuous pathways; and intangible benefits in the form of reduced anxiety and illness. The average annual damage avoided is estimated by (i) using historic reference-case flood-event damage and estimates of flood probabilities to construct a reference case damage-frequency curve, (ii) constructing a project damage-frequency curve for each alternative level of flood defense, and (iii) calculating the area between the curves for each project case and the reference case. Historic event damage at each site is based on values provided by local governments (in almost all cases for 2014), standardized using values transposed from estimates elsewhere in the PRC.

12. Most survey respondents rated the 2014 flood as the most damaging. Using national flood damage data for 2000–2010, an extreme value distribution was used to estimate the return period of the 2014 damage at 13 years. Event damage at other return periods is estimated from flood envelopes generated by the design institute. In all cases, it is assumed that the first damage occurs at a return period of 5 years.

F. Wastewater Component Benefits

13. The contingent valuation technique was used to quantify benefits from the wastewater component using results of closed-ended contingent valuation questions during the household social survey. Two contingent valuation questions were asked: (i) willingness to pay (WTP) a one-time charge to connect, and (ii) WTP a monthly amount following connection. The mean WTP to connect through a one-time charge is CNY850 (spread over 5 years in the evaluation), with mean WTP through a monthly payment of CNY15/month.[7] The latter is close to the actual wastewater charge, currently CNY0.8/m^3 for residential consumers in most towns in Jiangxi. The relevant population for each subcomponent is the number of direct beneficiary households.

14. Beyond the significant number of direct beneficiaries, all residents of the four cities and towns as well as downstream communities will benefit from the improved river environment and water quality. In the absence of any project survey results, values were taken from results of several comparable WTP scenarios elsewhere in the PRC, and a mean WTP for improved environmental water quality of CNY10/month was used. The comparable WTP scenarios for 2011–2013 related to lake and watercourse rehabilitation are included in the consultant report. The benefits they enjoy are referred to as non-user benefits.

15. With increased income, people's WTP for improved wastewater management and improved river water quality may increase. It is assumed that WTP grows at an annual rate of 4% per year, applied at intervals of 5 years, implying an income elasticity of 0.2–0.39. Increasing WTP is supported by substantial tariff increases since 2008, and in January 2015 the

[7] Mean WTP is estimated using a probit regression approach. It involves deriving a regression between the dependent binary WTP and regressors such as bid amount and household income.

government announced that domestic wastewater tariffs nationwide must reach CNY0.95/m³ in urban areas by the end of 2016. The current tariff for residential wastewater in Pingxiang is CNY0.80/m³. The new tariff will represent an increase of 19% for urban residents, and 6% for rural residents. Residents connecting to Xuanfeng and Tongmu WWTPs are charged a tariff; there was no tariff previously, as these are new facilities.

G. Rural–Urban Road Component Benefits

16. Benefits are savings in road user costs (RUCs) for normal traffic and generated traffic benefits. The main benefit is RUC savings from traffic diversion from national highways G319 and G320. RUCs comprise vehicle cost and travel time savings. Accident cost savings are not included for lack of reference-case data. RUCs and non-investment road agency costs are calculated using HDM4 (a highway evaluation software package). The “rule of half” is used to value benefits for generated traffic. The evaluation adopts a network approach, whereby total transport costs are compared across a limited network with and without the rural–urban road.

17. **Traffic.** Existing project road corridor weighted average traffic is very low—about 260 vehicles/day (v/d), excluding motorcycles. The expected source of traffic that will divert to the project road is two congested trunk roads: G319 has 12,500 v/d, and the G320 10,200 v/d. Diverted traffic is estimated from a turning count at the G319–G320 junction; 3,200 v/d (excluding motorcycles) now make the turn; it is conservatively estimated that 1,400 v/d will use the new road. Price elasticities of –0.3 and –0.2 are applied to changes in perceived cost to estimate percentages of generated traffic at 18% for passenger and 12% for goods traffic; these are applied to the reference-case traffic on minor project area roads. Forecast normal and generated traffic on the road is in Table 1. Normal traffic growth is estimated based on gross domestic product growth and income elasticities. Goods traffic is projected to rise at 4.0% per annum to 2030, and thereafter at 3.0%. Projected passenger vehicle traffic increase is 7.1% to 2020, 6.0% to 2030, and 4.0% thereafter. A ramp-up during 2021–2024 is assumed.

Table 1: Traffic on the Project Road, 2021–2040

Item	2021	2024	2030	2035	2040
Vehicles/day excluding motorcycles	1,149	3,242	3,851	4,244	4,676

Source: Asian Development Bank estimates.

H. Evaluation

18. The overall project is economically viable (EIRR of 17.8%); individual EIRRs are 18.6% (river component), 12.4% (wastewater component), and 18.8% (road component). Only the Lianhua wastewater subcomponent has an EIRR below 12% (at 9.7%, not including non-quantified benefits). Lianhua is a national-level poverty county, targeted for development-oriented poverty reduction. Base case and sensitivity evaluation are shown below.

Table 2: Subcomponent Evaluation Results

Components	Flood risk management and river rehabilitation					Wastewater collection and treatment				Road	All
Subcomponents	Lianhua	Luxi	Shangli (Lishui)	Shangli (Jinshan)	Xiangdong	Lianhua	Luxi (Xuanfeng)	Shangli (Tongmu)	Xiangdong		
NPV (CNY million)	12.5	175	95.6	3.3	156	-10.9	5.3	7.1	5.5	254	704
EIRR (%)	12.9	18.6	28.6	12.4	25.4	9.7	13.0	13.9	13.4	18.8	17.8

CNY = yuan, EIRR = economic internal rate of return, NPV = net present value.
Source: Asian Development Bank estimates.

Table 3: Evaluation of All Components

Year	Investment & O&M Costs (CNY million) River (1)	WW (2)	Road (3)	Benefits (CNY million) River (1)	WW (2)	Road (3)	Net benefit (CNY million)
2016	48.2	12.3	22.2	0.0	0.0	0.0	(83.0)
2017	133.0	39.0	63.0	0.0	0.0	0.0	(238.0)
2018	241.1	73.9	132.9	0.0	0.0	0.0	(448.0)
2019	252.7	76.0	132.9	0.0	0.0	0.0	(462.0)
2020	289.3	45.1	88.7	129.0	0.0	0.0	(294.0)
2021	1.3	1.1	0.1	164.0	22.3	57.0	241.0
2022	1.3	1.6	0.1	173.0	26.3	76.0	272.0
2023	1.3	1.9	0.1	182.0	39.1	94.0	312.0
2024	1.3	2.0	0.1	192.0	39.1	111.0	338.0
2025	6.9	2.1	0.1	203.0	41.0	115.0	350.0
2026	1.4	2.2	0.1	214.0	40.3	121.0	371.0
2027	1.4	2.3	0.1	225.0	38.5	129.0	389.0
2028	1.4	2.4	0.1	237.0	44.6	138.0	416.0
2029	1.4	2.4	0.1	250.0	43.4	148.0	438.0
2030	7.0	2.3	0.1	264.0	42.7	161.0	458.0
2031	1.4	9.1	0.1	269.0	42.6	169.0	470.0
2032	1.4	2.3	5.6	275.0	42.6	173.0	481.0
2033	1.5	2.4	0.1	281.0	51.8	192.0	520.0
2034	1.5	2.4	0.1	286.0	51.9	162.0	496.0
2035	7.1	2.4	0.1	292.0	52.4	166.0	501.0
2036	1.5	2.4	0.1	299.0	52.8	155.0	502.0
2037	1.5	2.4	0.1	305.0	53.2	156.0	510.0
2038	1.5	2.5	0.1	311.0	65.3	153.0	525.0
2039	1.6	2.5	2.2	318.0	65.9	153.0	531.0
2040	7.2	2.5	7.9	324.0	66.5	154.0	528.0
2041	1.6	9.1	0.1	331.0	64.2	200.0	584.0
2042	1.6	2.5	0.1	338.0	64.6	209.0	607.0
2043	1.6	2.5	0.1	345.0	79.0	218.0	638.0
2044	1.6	2.5	2.2	353.0	79.4	229.0	655.0
2045	(282)	(71.4)	(133)	360.0	79.9	242.0	1,168
PVs at 12%	**646.0**	**177.0**	**297.0**	**1,088.0**	**184.0**	**554.0**	**704.0**
EIRR							**17.8%**

( ) = negative, EIRR = economic internal rate of return, O&M = operation and maintenance, PVs = present values, WW = wastewater.
Source: Asian Development Bank estimates.

Table 4: Sensitivity Test Results

Test	River EIRR %	River NPV (CNY million)	Wastewater EIRR %	Wastewater NPV (CNY million)	Road EIRR %	Road NPV (CNY million)	All EIRR %	All NPV (CNY million)
Base case	18.6	443	12.4	7.1	18.8	254	17.8	704
Costs +20%	16.1	314	10.6	(28.3)	16.6	194	15.4	480
Benefits –20%	15.5	225	10.2	(29.7)	16.1	143	14.9	339
Costs +20% & benefits –20%	13.3	96	8.5	(65.0)	14.1	84	12.9	115
Switching value on costs, %	65%		10%		85%		65%	
Switching value on benefits, %	60%		91%		54%		61%	

CNY = yuan, EIRR = economic internal rate of return, NPV = net present value.
Source: Asian Development Bank estimates.

19. The project switching value for a cost overrun is 65%, and 61% for a decrease in consumer benefits. The degree of uncertainty of the economic analysis is high for wastewater subcomponents but low for the road. This is shown by the switching values for the wastewater subcomponent, indicating vulnerability to relatively small adverse shifts in costs or benefits.

20. A distributional analysis estimating the project's economic net present value that benefits the poor yields a poverty impact ratio of 0.3, i.e., the poor receive 30% of benefits.

21. **Fiscal sustainability.** The project is financially sustainable with average annual O&M costs as a percent of revenues of less than 0.05%. Further details are in the Financial Analysis.[8]

[8] Financial Analysis (accessible from the list of linked documents in Appendix 2).