ECONOMIC ANALYSIS

A.   Introduction

1.   Guilin, a prefecture-level city in the northeast of the Guangxi Zhuang Autonomous Region, remains one of the poorer provinces in the People's Republic of China (PRC). In 2021, the total registered population of Guilin was 5.4 million and its gross domestic product (GDP) was CNY231 billion.[1] The per capita GDP was CNY46,767, which is less than the provincial per capita GDP of CNY49,206[2] and the national per capita GDP of CNY80,976.[3] The continued development of tourism along with growing urbanization has created challenges that need to be addressed to ensure environmentally sustainable and inclusive growth. These challenges include (i) degraded water quality because of inadequate waste management along the Li River and its major tributaries, (ii) inadequate river management capacity and sustainable tourism development such as the lack of nonmotorized transport along the river banks, (iii) insufficient capacity to absorb flood water and inadequate flood control facilities, (iv) limited capacity of the tourism infrastructure, and (v) the lack of income-generating activities for villagers in Guilin's mountainous regions.

B.   Costs

2.   The estimates of base costs for capital investments and annual operation and maintenance (O&M) costs were obtained from the project feasibility study reports. The economic costs include (i) capital costs, including civil works and installation, equipment and installation, land acquisition and resettlement, project preparation, management and evaluation, capacity development, and physical contingencies; and (ii) the cost of O&M. The economic costs exclude taxes and duties, price contingencies, and interest during construction. Imported inputs are adjusted to the domestic price numeraire by applying a shadow exchange rate factor of 1.01. A shadow wage rate factor of 0.89 was used to convert the financial wage rate to an economic opportunity cost of labor.

C.   Benefits

3.   The project consists of 14 subprojects, comprising (i) water pollution control and ecological rehabilitation along the Li River to contribute to the livelihood of residents and tourists, (ii) flood control measures to protect lives and properties along the Li River, and (iii) improved tourism infrastructure to meet the growing number of tourists. Some subprojects have multiple benefits, e.g., tourism and health benefits. The methodology used to calculate these benefits is described in paras. 4–6.[4]

4.   **Improved water quality.** The Li River and its tributaries are important to the economy and general well-being of the project area. However, the river and its major tributaries suffer from degraded water quality because of inadequate or nonexistent wastewater treatment facilities. The development of tourism and increased urbanization are exacerbating the problem. The project

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[1]   National Bureau of Statistics of China. 2021. *Guilin Statistical Bulletin of National Economic and Social Development*. Beijing.

[2]   National Bureau of Statistics of China. 2021. *Guangxi Zhuang Autonomous Region Statistical Bulletin of National Economic and Social Development*. Beijing.

[3]   National Bureau of Statistics of China. 2021. *People's Republic of China Statistical Bulletin of National Economic and Social Development*. Beijing.

[4]   Additional detail can be found in the Detailed Economic Analysis (available from the list of linked documents in Appendix 2 of the report and recommendation of the President).

includes subprojects that will improve water quality by improving the collection and treatment of wastewater. The subprojects will generate benefits from improved health arising from reduced incidence of disease. Benefits from the improvement of water quality are estimated by calculating the reduction in the loss of disability adjusted life years (DALYs). Based on World Health Organization statistics on disease burden of selected waterborne diseases, it is calculated that 68.87 DALYs are lost for every 1,000 people because of cardiovascular diseases related to water quality. It is estimated that the morbidity and mortality of these diseases can be reduced by 30% by using cleaner water. The economic value of the reduced loss of DALYs is calculated using GDP per capita data for the subproject areas. Annual DALY-based quantifiable benefits from improved water quality are expected to be about CNY87 million in the initial years following project completion.

5. **Avoided flood damage.** The project area suffers from frequent floods. Flood control facilities in the project area are degraded because of accumulated damage. In 2020, flooding in Guilin affected 2.24 million people, including 247,600 people who were urgently relocated and resettled and 114,300 people who required emergency living assistance. The direct economic losses caused by floods was CNY11.2 billion, accounting for about 94% of the direct economic losses of all disasters triggered by natural hazards in 2020. The direct economic losses caused by floods in 2020 were 57.5% higher than the average during 2015–2020.[5] The project will finance flood prevention measures through three subprojects, which will provide benefits to about 82,000 people. Economic benefits comprise the avoided property damage and losses. A large proportion of the river restoration subproject areas lies below the one-in-5-year flood levels. The rehabilitation of river embankments and other flood mitigation solutions to be implemented under the project are designed to provide protection against one-in-20-year or greater flood levels. It is assumed that the project area suffers from floods once every 5 years in the without-project scenario and once every 20 years in the with-project scenario. Based on data on historical flooding, population, and economic losses, the average per capita economic loss caused by a flood is calculated as CNY2,670. Annual benefits from avoided flood damage are expected to be about CNY59 million in the initial years following project completion.

6. **Tourism.** Guilin has a number of significant tourist attractions, and tourism has been growing in recent years. The number of tourists visiting the Li River is about 600,000 per year.[6] However, future growth is constrained by insufficient facilities in some areas. The project will facilitate increased tourism through financing improvement of tourism facilities, preservation of old villages that are culturally and historically significant, and other related activities. Eleven subprojects generate tourism-related benefits. These benefits have been calculated using the use value for projected tourists and non-use value for affected residents derived from the willingness to pay (WTP), using assumptions derived from surveys carried out in Guilin and elsewhere in the PRC on similar activities. Based on these surveys, average annual payments per person for non-use value of CNY155 and for use value of CNY90 for tourists were assumed. For two subprojects, benefits from incremental tourism revenues have also been calculated, arising from about 120,000 additional tourists for the smart Li River pilot subproject and 65,000 additional tourists for the Longsheng county subproject. Annual benefits from improved tourism facilities are expected to be about CNY283 million in the initial years following project completion, with increased non-use value totaling CNY136 million, increased use value totaling CNY96 million, and incremental tourism totaling CNY51 million.

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[5] Department of Emergency Management of GZAR. 2021. *The Basic Information of Natural Disasters in GZAR 2020*. Nanning.

[6] Tengxun Network. Guilin tourism suffered from shanshui dependence: weak growth, debt repayment pressure, and subsidiaries dragging their feet (qq.com)

D.   Least-Cost Analysis

7.   Least-cost analysis was conducted on inputs and techniques to be used in various subprojects, including types of sewage and drainage pipe, riverbank protection measures, and restoration techniques for structures in ancient villages. The analysis was conducted by comparing the average incremental economic costs of two alternatives using a discount factor of 9%. The analysis shows that the options selected for the project are the least-cost options.

E.   Cost–Benefit Analysis

8.   The net present value (NPV) and economic internal rate of return (EIRR) were calculated for all subprojects. A summary of results for the subprojects is in Table 1. The overall project EIRR is 14.08% and the NPV is CNY772.07 million. The benefit and cost streams of the overall project are shown in Table 2.

Table 1: Summary of Economic Evaluation

Item	EIRR (%)	NPV (CNY million)
Overall project	**14.08**	**772.07**
Subprojects		
1 Construction of NMT system and improvement of surrounding environment in XiuFeng	14.21	40.91
2 Ecological restoration and landscape improvement along Li River banks in Yangshuo	12.65	24.91
3 Chaoyang River comprehensive treatment in Qixing district	9.45	1.26
4 Water environment comprehensive treatment in Yanshan segment of Liangfeng River	11.84	70.81
5 Li River ecological comprehensive treatment in Lingui district	9.76	6.80
6 Drainage pipeline retrofit in Dongling area	9.32	1.06
7 Upgrading the Li River ecological landscape in Xiangshan district	16.21	224.14
8 Comprehensive improvement of Daxu town	17.59	84.81
9 Comprehensive treatment of Linqu water system at the source of Li River	13.19	29.34
10 Renovation of villages (Dongyao, Jiangtou, etc.) along the Li River in Diecai district	15.29	119.68
11 Improvement of Mopanshan Tourist Distribution Centre, Li River	13.71	41.13
12 Improvement of Caoping Tourist Distribution Centre, Li River	18.71	33.28
13 Smart Li River Information System pilot project	15.40	59.94
14 Protection and renovation of 11 ancient villages in Longsheng county	13.21	33.99

EIRR = economic internal rate of return, NMT = nonmotorized transport, NPV = net present value.
Source: Asian Development Bank estimates.

Table 2: Economic Internal Rate of Return for the Project
(CNY million)

	Costs			Benefits					
Year	Investment	O&M	Total	WTP for Non-Use Value	WTP for Use Value	DALY Benefits	Other Benefits	Total Benefits	Net Benefits
2022	238	0	238						(238)
2023	734	0	734						(734)
2024	683	0	683						(683)

2025	298	19	316	39	5	32	37	113	(203)
2026	46	22	68	69	91	72	45	276	208
2027	0	23	23	136	96	86	68	386	363
2028	0	23	23	136	96	86	72	390	367
2029	0	23	23	136	96	86	77	395	372
2030	0	23	23	136	96	86	82	400	377
2031	0	23	23	136	96	86	88	406	383
2032	0	23	23	136	96	86	95	412	390
2033	0	23	23	136	96	86	102	420	397
2034	0	23	23	136	96	86	110	427	405
2035	0	14	14	136	96	86	30	347	334
2036	0	14	14	136	96	86	30	347	334
2037	0	14	14	136	96	86	30	347	334
2038	0	14	14	136	96	86	30	347	334
2039	0	14	14	136	96	86	30	347	334
2040	0	14	14	136	96	86	30	347	334
2041	0	14	14	136	96	86	30	347	334
2042	0	14	14	136	96	86	30	347	334
2043	0	14	14	136	96	86	30	347	334
2044	0	14	14	136	96	86	30	347	334
2045	0	14	14	136	96	86	30	347	334
2046	0	14	14	136	96	86	30	347	334
NPV									**772**
EIRR									**14.08%**

( ) = negative, DALY = disability adjusted life year, EIRR = economic internal rate of return, NPV = net present value, O&M = operation and maintenance, WTP = willingness to pay.
Source: Asian Development Bank estimates.

F. Distribution Analysis

9. A distribution analysis was carried out for the whole project, based on the above results and the financial analysis (Table 3). At the 9% economic discount rate applied to the costs and benefits streams in both analyses, the NPV of the economic net benefits of the project to the economy as a whole is CNY2,119.34 million. The largest beneficiary will be users and households in the project area, whose net gain in NPV is CNY1,895.26 million. The economic benefits of the project accrued to government are CNY221.62 million and to labor CNY2.46 million.

Table 3: Results of Distribution Analysis
(CNY million)

	Accounts			Project Area	Government/		
Item	Financial Accounts	Economic Accounts	Difference	Population	Economy	Labor	Total
Benefits							
Total benefits	621.99	2,517.25	1,895.26	1,895.26			
Costs							
Investment costs	1,637.73	1,603.89	(33.84)		33.84		
O&M costs	90.05	86.24	(3.80)		3.80		
Labor	58.12	55.66	(2.46)			2.46	
Taxes	183.98		(183.98)		183.98		
Total costs	**1,969.87**	**1,745.79**	**(224.08)**				
Net benefits	**(1,347.88)**	**771.46**	**2,119.34**	**1,895.26**	**221.62**	**2.46**	**2,119.34**

( ) = negative, O&M = operation and maintenance.
Source: Asian Development Bank estimates.

G.   Sensitivity Analysis

10.   The sensitivity analysis was undertaken to test the robustness of the economic viability of the overall project to adverse changes in key variables. The sensitivity analysis tested the impact on the EIRR of decreases of each of the three largest sources of benefits—WTP for non-use value, WTP for use value, and DALY-based health benefits—by 10%, 20%, and 30%. The analysis also tested an increase of 10% in investment cost, delay in implementation by 1 year, and a combination of a 30% reduction in major benefits, 10% increase in capital cost, and delay in implementation by 1 year. A summary of sensitivity tests for the overall project is presented in Table 4. The results indicate that the overall project's viability is robust to all tested adverse shocks, with exception of the combination of shocks, which is considered unlikely to occur. The capital cost would have to increase by 48% or total benefits would have to decrease by 30% for the rate of return to decrease to the threshold. It is projected that the coronavirus disease will not pose a significant negative risk to the project and tourism will recover to the pre-pandemic level by 2023.

Table 4: Sensitivity Test Results for Overall Project
(CNY million)

Scenario	EIRR (%)	NPV (CNY million)	Switching Value[a]
Base case	**14.08**	**772.07**	
i. Benefits from WTP for non-use decline 10%	13.56	684.35	88
ii. Benefits from WTP for non-use decline 20%	13.02	596.63	88
iii. Benefits from WTP for non-use decline 30%	12.48	508.90	88
iv. Benefits from WTP for use decline 10%	13.70	708.69	>100[b]
v. Benefits from WTP for use decline 20%	13.32	645.30	>100[b]
vi. Benefits from WTP for use decline 30%	12.93	581.92	>100[b]
vii. Benefits from DALYs decline 10%	13.73	714.21	>100[b]
viii. Benefits from DALYs decline 20%	13.38	656.35	>100[b]
ix. Benefits from DALYs decline 30%	13.02	598.49	>100[b]
x. Total benefits decline 10%	12.53	805.09	30
xi. Total benefits decline 20%	10.88	530.71	30
xii. Total benefits decline 30%	9.12	256.33	30
xiii. Investment cost increases 10%	12.76	611.68	48
xiv. Delay in implementation of 1 year	12.74	589.02	
xv. Combination of benefits decline 30%, cost increase, and implementation delay	7.07	(302.28)	

( ) = negative, DALY = disability adjusted life year, EIRR = economic internal rate of return, NPV = net present value, WTP = willingness to pay.
[a] The percentage change in the parameter required for the EIRR to decrease to 9.0%.
[b] Even if benefits from this source declined to zero, the EIRR for the overall project would remain above 9.0%.
Source: Asian Development Bank estimates.