

ECONOMIC ANALYSIS

1. Economic analysis was undertaken for all subprojects proposed under the project using preliminary design cost estimates and expected scope and benefits. The methodology adopted in the evaluation was essentially in accordance with the *Guidelines for the Economic Analysis of Projects* of the Asian Development Bank (ADB).¹ Economic analysis involved (i) determining the economic viability of the investments; (ii) testing the impact of changes in key input variables on their viability; and (iii) analyzing the distribution and impact of economic benefits brought about by the investments to various stakeholders, particularly the poor.
2. The economic viability of the subprojects was assessed by computing the economic internal rate of return (EIRR) and net present value from a stream of incremental benefits and costs attributable to the investments over 30 years. Using domestic price numeraire, economic costs were derived from the financial estimates of investments including physical contingencies. Taxes and duties were deducted from the financial costs, segregated into tradable and nontradable components, then shadow priced using the following conversion factors: shadow exchange rate factor of 1.11, shadow wage rate factor for unskilled labor of 0.75, and a factor of 1.0 for nontradable components.
3. Economic benefits were identified for each subproject, and sensitivity analyses were undertaken to test the robustness of the subprojects to various changes in assumptions.

A. Wastewater System

4. Three wastewater subprojects are proposed in the corridor towns of Battambang, Bavet, and Poipet. All three subprojects will provide a reticulated sewerage system in the central area and a treatment plant that will use the stabilization ponds process. This treatment process is considered the least-cost solution compared with other wastewater treatment technologies. It is suitable for the three towns where land cost is low and skilled technicians are rare. It has the advantage of requiring low capital and minimum operating skills.
5. The project will directly benefit approximately 187,500 people in the project towns. Battambang has an existing wastewater system with very limited coverage. The construction of the subproject will address the service limitations and enable more households and businesses to be connected to the sanitary facility. Quantifiable economic benefits from the wastewater system include an increase in land value of about 5% from the current valuation.
6. The subproject will generate health benefits for local residents and environmental benefits such as the preservation and conservation of the environment and species.
7. The results of the economic analysis for wastewater subprojects are summarized in Table 1. The evaluated EIRRs range from 13% to 28% for the base case and the sensitivity analyses testing various scenarios.

¹ ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila.

B. Urban Road and Drainage

8. Bavet, located on the south border to Viet Nam, is a recognized industrial gate with many natural advantages. Growth during the past 5 years has been significant with the influx of migrant workers. As an emerging economic corridor town, growth has brought physical development and employment. If this trend continues, the maximum capacity of infrastructure will be reached.

9. The EIRR for the subproject was calculated by comparing the with- and without-project scenarios for the subproject road. In the without-project scenario, the road is assumed to receive only minimal maintenance and to continue to deteriorate. The traffic volume would exceed the capacity of the roads in the near future, resulting in congestion that increases travel time and vehicle operating cost (VOC). The with-project scenario includes international standards for routine and periodic maintenance. Properly maintained roads will reduce travel time and VOC because of the faster and smoother ride on the project road.

10. The EIRR is 17.1%. Sensitivity analyses were undertaken to test the robustness of the analysis and the consequences of changes in variables. All EIRRs remain over 12% and the plausible ranges of variability of the tested parameters and variables are well within the switching values calculated under the sensitivity tests, indicating the economic viability of the subproject.

C. Solid Waste

11. The solid waste management subproject in Poipet includes the development of a sanitary landfill and a materials recovery facility, and procurement of collection equipment to improve the waste collection system.

12. The subproject will directly benefit approximately 80% of the population of Poipet. The existing collection system covers only 20% of the town. Implementation of the proposed improvements will remove the service limitations and enable more households and business establishments to receive efficient waste collection and access to a disposal facility. Willingness-to-pay represents the perceived economic benefits that beneficiaries assume they will get with the subproject. The subproject will generate health and environmental benefits.

13. The evaluated EIRRs range from 17.2% to 21.9% for the base case and the sensitivity analyses testing various scenarios.

D. Flood Protection

14. The subproject in Neak Loeung will construct a flood protection dike with a total length of 5,400 meters covering 363 hectares. The flood protection will directly benefit residents and business establishments over an estimated influence area of 363 hectares. The impact area includes the central area, which experiences yearly flooding due to the inadequate drainage system. Flooding is exacerbated by the low elevation and inordinately heavy rain during certain periods of the year. The floods cause property damage as well as disrupt commercial operations. Other benefits are savings on repair and maintenance of public infrastructure damaged by floods, and health benefits from reduced incidence of water-borne and sanitation-related diseases. The dike will also serve as an access road for local residents and commuters during heavy rains and floods.

15. The economic feasibility of the investments was assessed over for 30 years. Benefits include reduced property damage and avoided revenue losses of commercial establishments as a result of disruptions caused by flooding. Quantifiable economic benefits from the flood control protection include increased land value with the completion of the subproject. This is used as proxy indicator for the benefits attributable to the project. The evaluated EIRRs range from 21.1% to 25.3% for the base case and the sensitivity analyses testing various scenarios.

16. The Battambang flood control subproject will construct embankment protection and flood control structures that will mitigate perennial flooding in the town center, help improve the quality of life of local residents, and contribute to stimulating socioeconomic activities. The evaluated EIRR is about 25.6%.

E. Materials Recovery Facility

17. Three materials recovery facilities are proposed in Bavet, Battambang, and Poipet. These subprojects aim to develop the sustained implementation of the principle of reduce, reuse, and recycle. This is in anticipation of the expected economic growth and the consequent increase in waste generation in these areas. The subproject will translate to improved environmental conditions and provide sources of income to key stakeholders such as waste pickers and the host community.

18. The results of economic analyses and sensitivity tests are presented in Table 1.

Table 1: Summary Indicators: Base Case and Sensitivity Analysis

Subproject, Scenario	EIRR (%)	NPV (\$ million)	BCR
1. Battambang—Wastewater Treatment			
Base case	28.30	3.80	1.77
10% increase in capital, O&M costs	23.65	2.89	1.61
10% reduction in returns or benefits	23.16	2.51	1.60
10% increase in costs, 10% reduction in benefits	18.63	1.61	1.45
1-year delay in benefits	19.63	2.41	1.77
2. Battambang—Flood Control			
Base case	25.6	16.40	11.57
10% increase in capital, O&M costs	23.6	16.24	10.52
10% reduction in returns or benefits	23.4	14.60	10.41
10% increase in costs, 10% reduction in benefits	21.5	14.45	9.47
1-year delay in benefits			
3. Bavet—Urban Road			
Base case	17.1	41.10	9.16
10% increase in capital, O&M costs	15.7	40.59	8.32
10% reduction in returns or benefits	15.6	36.48	8.24
10% increase in costs, 10% reduction in benefits	14.3	35.98	7.49
1-year delay in benefits			
4. Bavet—Wastewater Treatment			
Base case	23.15	0.77	1.58
10% increase in capital, O&M costs	18.27	0.46	1.44
10% reduction in returns or benefits	17.77	0.39	1.42
10% increase in costs, 10% reduction in benefits	13.16	0.09	1.30
1-year delay in benefits	17.33	0.53	1.58

Subproject, Scenario	EIRR (%)	NPV (\$ million)	BCR
5. Neak Loeung—Flood Control			
Base case	25.3	31.94	7.77
10% increase in capital, O&M costs	23.2	31.47	7.06
10% reduction in returns or benefits	23.0	28.28	6.99
10% increase in costs, 10% reduction in benefits	21.1	27.80	6.35
1-year delay in benefits			
6. Poipet—Wastewater Treatment			
Base case	20.83	0.99	1.69
10% increase in capital, O&M costs	16.92	0.62	1.53
10% reduction in returns or benefits	16.54	0.52	1.52
10% increase in costs, 10% reduction in benefits	13.13	0.15	1.38
1-year delay in benefits	15.15	0.47	1.65
7. Poipet—Solid Waste Management			
Base case	21.85	2.33	2.80
10% increase in capital, O&M costs	19.57	1.92	2.54
10% reduction in returns or benefits	19.34	1.69	2.52
10% increase in costs, 10% reduction in benefits	17.20	1.28	2.29
1-year delay in benefits	17.83	1.54	2.75

BCR = benefit–cost ratio, EIRR = economic internal rate of return, NPV = net present value, O&M = operation and maintenance.

Source: Asian Development Bank estimates.

F. Distributional Analysis

19. The purpose of the distributional analysis is to show how the net benefits of the subprojects are distributed among different groups of stakeholders. In this case the groups include users (both domestic and commercial), the labor sector, and the government.

20. The difference of the discounted economic benefits is distributed among the groups. The amount of net benefits to the poor varies from 31% in the Bavet urban road subproject to 54% in the Poipet solid waste management subproject. Generally, all the subprojects indirectly address local poverty by facilitating economic development in the area, creating more employment opportunities, and improving access to sanitation facilities. The summary result of the benefit distribution and poverty impact analysis is presented Table 2.

Table 2: Benefit Distribution and Poverty Impact Ratio

Subproject	Local Residents	Business Sector	Labor Sector	Government	Total Net Benefits
Battambang Flood Control					
Gains and losses (\$ million)	2.80	1.20	0.13	(0.11)	4.02
Distribution	70%	30%	3%	-3%	
Proportion of poor	47%	20%	47%	0%	
Benefits to poor (\$ million)	1.30	0.24	0.06		1.60
Poverty impact ratio (PIR)					40%
Battambang Wastewater					
Gains and losses	15.76	5.95	1.21	(0.94)	21.98
Distribution	72%	27%	5%	-4%	
Proportion of poor	47%	20%	47%	0%	
Benefits to poor	7.33	1.20	0.56		9.09
Poverty impact ratio					41%
Bavet Urban Road					
Gains and losses (\$ million)	16.67	25.00	0.25	(0.17)	41.75
Distribution	40%	60%	1%	0%	
Proportion of poor	47%	20%	47%	0%	

Benefits to poor (\$ million)	7.75	5.05	0.12		12.92
Poverty impact ratio					31%
Bavet Wastewater					
Gains and losses	3.74	1.22	0.52	(0.24)	5.23
Distribution	71%	23%	10%	-5%	
Proportion of poor	47%	20%	47%	0%	
Benefits to poor	1.74	0.25	0.24		2.22
Poverty impact ratio					43%
Neak Loeung Flood Control					
Gains and losses (\$ million)	5.73	2.46	0.26	(0.21)	8.24
Distribution	70%	30%	3%	-3%	
Proportion of poor	50%	20%	50%	0%	
Benefits to poor (\$ million)	2.87	0.49	0.13		3.49
Poverty impact ratio					42%
Poipet Solid Waste Management					
Gains and losses	7.44		1.00	(0.29)	8.15
Distribution	91%		12%	-4%	
Proportion of poor	52%		52%	0%	
Benefits to poor	3.89		0.52		4.41
Poverty impact ratio					54%
Poipet Wastewater					
Gains and losses	5.40	1.34	0.56	(0.31)	6.99
Distribution	77%	19%	8%	-4%	
Proportion of poor	30%	30%	50%	0%	
Benefits to poor	1.59	0.40	0.28		2.27
Poverty impact ratio					32%

Source: Asian Development Bank estimates.