

## **ECONOMIC AND FINANCIAL ANALYSIS**

### **A. Introduction**

1. Rapid economic development over the past 3 decades has caused the rapid degeneration of the Yancheng wetlands, with significant loss and fragmentation of wildlife habitats and loss of biodiversity. The main threats are (i) land use changes from conversion to farmland and aquaculture ponds, as well as industrial and urban expansion; (ii) industrial, agricultural, and urban pollution; (iii) the spread of the invasive species *Spartina alterniflora*; (iv) draining; (v) overfishing and other unsustainable resource extraction; and (vi) poaching and poisoning. The importance of the wetlands from the local, national, and global perspectives, and the pressures that affect their ecosystems, have made ecological protection a high priority in national, provincial, and municipal 5-year development plans. These plans also place a high priority on strengthening the ecological protection forest network with reforestation along the coast, rivers, lakes, and transportation routes, as well as in urban centers and villages.

### **B. The Project**

2. The Jiangsu Yancheng Wetlands Protection Project aims to improve the condition of natural resources and the environment in the project area through a number of interventions that are envisioned being implemented under four proposed structural outputs: (i) wetland protection in the Yancheng Rare Birds National Nature Reserve (YRBNNR), in particular wetland restoration and biodiversity conservation; (ii) wetland protection in the Dafeng Milu National Nature Reserve (DMNNR), in particular capacity development; (iii) coastal forest improvement in the Sheyang Forest Farm (SFF), in particular sustainable forestry management; and (iv) coastal forest improvement in the Dafeng Forest Farm (DFF), in particular sustainable forestry management. A fifth proposed output—project management and capacity development—will support facilitating effective project management and the delivery of technical services for efficient implementation. This output includes such non-structural measures as increasing awareness, capacity development, community participation, and environmental protection and monitoring, which are expected to improve institutional and community capacity in water resource and environmental management. These improvements are envisioned (i) improving the utilization, development, and management of water resources and (ii) consequently contributing to environmental health in the project area.

3. The project will be implemented over 5 years. Annual implementation costs have been estimated for each project output and for the overall project. The overall cost, including improved project management, is CNY484.06 million, with an economic value of CNY461.72 million. The estimated costs of the project outputs are as follows: (i) wetlands protection in the YRBNNR CNY324.45 million (CNY309.21 million in economic terms), (ii) wetland protection in the DMNNR CNY39.21 (CNY37.33 million in economic terms), (iii) coastal forest improvement in the SFF CNY78.20 million (CNY74.93 million in economic terms), and (iv) coastal forest improvement in the DFF CNY42.19 million (CNY42.25 million in economic terms). The estimated annual costs during implementation were derived using Costab software. Annual operation and maintenance costs for maintaining project facilities are estimated at 0.5% of total investment costs.

### **C. Economic Analysis**

4. The economic analysis compares with- and without-project scenarios to determine the incremental economic benefits and costs of each of the four outputs. These provide the basis

for calculating economic internal rates of return (EIRRs) by output and for the project. The economic analysis was carried out following Asian Development Bank (ADB) Guidelines for Economic Analysis of Projects.<sup>1</sup> The major assumptions of the analysis are as follows:

- (i) The project life is assumed to be 30 years, including an implementation period of 5 years, after which the salvage value is zero.
- (ii) Financial revenues and costs are expressed in mid-2011 constant terms.
- (iii) All financial costs and benefits are valued using domestic prices and expressed in economic terms using the world price numeraire.
- (iv) All taxes and subsidies are excluded in the evaluation of the economic performance of the outputs and of the project.
- (v) Economic costs, which are assumed to be untradable, are derived by adjusting their values by a standard conversion factor of 0.93, which is consistent with the factor used for recent ADB projects in the People's Republic of China (PRC).<sup>2</sup>
- (vi) The real opportunity cost of capital is assumed to be 12% per year, which is the economic opportunity cost of capital for the PRC.

5. **Wetlands protection at the Yancheng Rare Birds National Nature Reserve.** The proposed rehabilitation and/or restoration interventions for this output cover 4,005 hectares (ha) of wetlands, mainly in the core and experimental zones. Wetlands provide several important services from which society derives benefits<sup>3</sup> that are valued at CNY56,667.51/ha/year in economic terms.<sup>4</sup> Wetland ecological services and their associated values are observed to have decreased at an average rate of 2.48%/year over 1992–2007. This rate is expected to continue in coming years in the without-project scenario, with no mitigation measures to preserve the wetlands and improve their management. In the with-project scenario—with the proposed interventions including strengthened institutional capacity for water resource and environmental management and increased community participation in environmental monitoring and pollution control—further degradation of the wetlands is averted. Total wetland area without the project is projected to decline from 3,621.6 ha in 2016 to 1,930.8 ha in 2041, and the total value of the wetlands is projected to decline from CNY205.23 million in 2016 to CNY109.41 million in 2041. With the project, the 4,005 ha wetland area is currently valued at CNY226.95 million. These values are projected to remain unchanged over 2016–2041. Total wetland areas saved from degradation are projected to increase from 383.4 ha in 2016 to 2,074.2 ha in 2041. The total value of wetlands saved from degradation is estimated to increase from CNY21.73 million in 2016 to CNY117.54 million in 2041.

6. As the area and quality of wetlands deteriorate, their capacity to sequester carbon likewise deteriorates. The estimated quantity of carbon sequestered over the 30-year project life is carried

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<sup>1</sup> ADB. 1997. *Guidelines for the Economic Analysis of Projects*. Manila.

<sup>2</sup> ADB. 2006. *Report and Recommendation of the President to the Board of Directors on the Proposed Loan to the People's Republic of China for the Inner Mongolia Autonomous Region Environment Improvement Project*. Manila; ADB. 2008. *Report and Recommendation of the President to the Board of Directors on the Proposed Loan to the People's Republic of China for the Integrated Ecosystem and Water Resources Management in the Baiyangdian Basin Project*. Manila; ADB. 2008. *Report and Recommendation of the President to the Board of Directors on the Proposed Loan to the People's Republic of China for the Qingdao Water Resources and Wetland Protection Project*. Manila.

<sup>3</sup> These benefits include food and raw materials, water conservation, erosion control, disturbance regulation, water treatment, biodiversity conservation, nutrient recycling, leisure and recreation, and scientific research and education.

<sup>4</sup> X. B. Bao and H. P. Li. 2008. *Yancheng Wetland Ecosystem Services and Valuation*. A paper presented in the Global Environment Facility-funded Chinese Wetland Biodiversity Protection and Sustainable Utilization Project (English translation).

out by applying data from Polasky and Liu<sup>5</sup> and Neely.<sup>6</sup> Incremental carbon sequestration of 3 tons of carbon (tC)/ha/year (or 11 tons of carbon dioxide equivalent per hectare per year) is applied<sup>7</sup> and multiplied by a trading price of CNY133.02 per certified emission reduction<sup>8</sup> to arrive at a value of CNY1,463 per ton of carbon dioxide equivalent per hectare per year. Without the project and with wetlands not restored, total carbon sequestration of the wetland area will continue to diminish at an average annual rate of 2.48%. As the total wetland area is projected to decline from 3,621.6 ha in 2016 to 1,930.8 ha in 2041, the annual value of carbon sequestered is correspondingly projected to decrease from CNY5.30 million/year in 2016 to CNY2.83 million/year in 2041. With the project, interventions to restore the 4,005 ha wetland area are expected to avert the decline in carbon sequestration capacity. The value of carbon sequestered is estimated at CNY5.86 million/year and projected to remain at this level over 2016–2041. The incremental value of carbon sequestered is estimated to increase from CNY0.56 million/year in 2016 to CNY3.04 million/year in 2041.

7. Wetland improvement is likewise expected to bring about incremental economic benefits from increased numbers of ecotourists and higher entrance fees or visitors' willingness to pay for visiting the natural reserve. Without the project, the number of ecotourists is projected to increase from 93,807 in 2016 to 317,663 in 2041 at an annual rate of 5%/year, with the entrance fee at CNY30/visitor. With the project, the number of visitors is projected to be 50% higher than without the project in 2016 and then increase by 10% annually until 2030, when the maximum capacity of 500,000 visitors per year is reached. The entrance fee is conservatively estimated at CNY50/visitor with the project.

8. The EIRR for the YRBNNR is estimated at 13.92% with an economic net present value (ENPV) of CNY57.57 million and an economic benefit-cost ratio (BCR) of 1.2 (Table 1). The results of the sensitivity analysis indicate that the component's EIRR is not very sensitive to changes in the selected risk variables such as benefits delayed by 1 year, a 10% benefit reduction, or a 10% increase in costs. If benefits are delayed by 2 years, the EIRR drops to 10.5%. If benefits decrease and costs increase by 10% simultaneously, the EIRR falls to 12%.

9. **Wetlands protection in the Dafeng Milu National Nature Reserve.** Interventions to rehabilitate milu deer habitat include (i) expanding grazing land by 25 ha, (ii) improving 50 ha of grazing ground, (iii) expanding existing deer resting area by 45.3 ha, (iv) establishing a 45-ha deer forest habitat, and (v) establishing 220 ha of deer fodder ground. Tick control will be implemented, complemented by the relocation of 418 head of milu deer to maintain the deer population within the maximum carrying capacity of the nature reserve. The interventions will be complemented with other activities such as establishing patrol and management facilities; research, monitoring, and rescue facilities; and an education center.

10. Establishing the milu deer forest habitat is expected to improve ecological health and corresponding service values on 45 ha. Improving ecological health is expected to increase the

<sup>5</sup> S. Polasky and Y. Liu. 2006. *The Supply of Terrestrial Carbon Sequestration in Minnesota*. St. Paul: University of Minnesota. <http://wrc.umm.edu/outreach/carbon/>

<sup>6</sup> H. Neely. 2008. *Restoring Farmland to Wetlands: the Potential for Carbon Credits in Eastern North Carolina*. Durham: Duke University, Nicholas School of the Environment and Earth Sciences.

<sup>7</sup> The authors estimated that the average increment of carbon sequestered by healthy wetlands is 2–3 tC/ha/year, or 7.33–11.00 tons of carbon dioxide equivalent per hectare per year. The economic analysis for the Jiangxi Sustainable Forest Ecosystem Development Project in 2010 applied 3 tC/ha/year. ADB. 2010. *Report and Recommendation to the President to the Board of Directors on the Proposed Loan to the People's Republic of China for the Jiangxi Sustainable Forest Ecosystem Development Project*. Manila.

<sup>8</sup> Available at: <http://www.eco2forests.com/carbon-pricing.html>. The price of carbon traded was \$20/tC in 2010, when the average exchange rate was CNY6.65 = \$1.00.

value per hectare of ecological services each year from the current CNY8,531.32/ha/year<sup>9</sup> until the value of healthy coastal protection forests of CNY85,313.16/ha/year (footnote 3) is attained during 2016–2041. Subsequently, the total value of ecological services with the project will increase from CNY0.38 million in 2016 to CNY3.84 million in 2041. Without the project, the value of ecological services is assumed to remain at CNY8,531.32/ha/year throughout the projection period. The incremental value of ecological services is projected to increase from CNY0.04 million in 2016 to CNY3.46 million in 2041.

**Table 1: Estimated Economic Internal Rate of Return of the Yancheng Rare Birds National Nature Reserve (CNY million)**

Year	Project Cost			Project Benefits					
	Investment Cost	Operation and Maintenance	Loss of Income from Aquaculture	Total Costs	Value of Wetland Services Saved from Degradation	Conserved Carbon Sequestration Value	Increased Benefits from Ecotourist Visits	Total Economic Benefits	Net Economic Benefits
2012	90.58		0.93	91.51					(91.51)
2013	82.75		1.86	84.61					(84.61)
2014	89.74		1.86	91.60					(91.60)
2015	35.07		1.86	36.93					(36.93)
2016	11.07	1.55	1.86	14.47	21.73	0.56	4.22	26.51	12.04
2017		1.55	1.86	3.41	26.83	0.69	4.78	32.30	28.90
2018		1.55	1.86	3.41	31.80	0.82	5.41	38.03	34.62
2019		1.55	1.86	3.41	36.65	0.95	6.11	43.70	40.29
2020		1.55	1.86	3.41	41.38	1.07	6.88	49.32	45.92
2021		1.55	1.86	3.41	45.99	1.19	7.74	54.91	51.51
2022		1.55	1.86	3.41	50.48	1.30	8.69	60.48	57.07
2023		1.55	1.86	3.41	54.87	1.42	9.75	66.03	62.63
2024		1.55	1.86	3.41	59.14	1.53	10.92	71.59	68.19
2025		1.55	1.86	3.41	63.31	1.63	12.22	77.17	73.76
2026		1.55	1.86	3.41	67.38	1.74	13.66	82.78	79.38
2027		1.55	1.86	3.41	71.34	1.84	15.26	88.44	85.04
2028		1.55	1.86	3.41	75.21	1.94	17.03	94.18	90.77
2029		1.55	1.86	3.41	78.98	2.04	18.98	100.00	96.59
2030		1.55	1.86	3.41	82.65	2.13	19.43	104.22	100.81
2031		1.55	1.86	3.41	86.24	2.23	19.15	107.62	104.21
2032		1.55	1.86	3.41	89.74	2.32	18.86	110.91	107.50
2033		1.55	1.86	3.41	93.14	2.41	18.55	114.10	110.69
2034		1.55	1.86	3.41	96.47	2.49	18.23	117.19	113.78
2035		1.55	1.86	3.41	99.71	2.57	17.89	120.17	116.77
2036		1.55	1.86	3.41	102.87	2.66	17.53	123.06	119.66
2037		1.55	1.86	3.41	105.96	2.74	17.16	125.85	122.44
2038		1.55	1.86	3.41	108.96	2.81	16.77	128.54	125.14
2039		1.55	1.86	3.41	111.89	2.89	16.36	131.14	127.73
2040		1.55	1.86	3.41	114.75	2.96	15.92	133.64	130.23
2041		1.55	1.86	3.41	117.54	3.04	15.47	136.04	132.64
								<b>EIRR =</b>	<b>13.92%</b>
								<b>NPV @ 12% =</b>	<b>57.75</b>
								<b>BCR =</b>	<b>1.20</b>

BCR = benefit–cost ratio, EIRR = economic internal rate of return, NPV = net present value.

Note: The economic opportunity cost of capital is at 12%.

Source: Asian Development Bank estimates.

11. Since the introduction of 39 head of milu deer into the DMNRR in 1986, the number of deer increased to 1,618 head in 2010 at an average annual rate of increase of 2.5%/year. Project interventions are expected to halve the annual mortality rate, from 4% to 2%. The loss of

<sup>9</sup> C. F. Tong et al. 2006. *Ecosystem Service Value and Restoration in the Urban Sanyang Wetland of Wenzhou, China*. [www.elsevier.com/locate/ecoleng](http://www.elsevier.com/locate/ecoleng). This base value is 10% of the value of mature ecosystems. The 10% base value is consistent with the estimate provided in the publication cited in this footnote. The authors indicated that the potential value of restored wetland ecosystems is 10 times their base value. Discussions with the DMNRR and forest farm staff during field visits confirmed this, as well as that restored wetland and coastal protection forests will attain the full value after at least 30–40 years.

one milu deer is estimated at about CNY63,886.<sup>10</sup> The total value of carbon sequestration with the project is estimated at CNY0.07 million/year over 2016–2041. Carbon sequestration benefits which were derived from rehabilitating the 45-ha milu deer forest habitat are assumed to be incremental.<sup>11</sup> The current number of ecotourists visiting the DMNNR was estimated in 2010 at 300,000/year. This is projected to increase to 400,000/year by 2016 without the project and be kept at that maximum capacity until 2041. With the project, it is assumed that the maximum capacity will be maintained while the entrance fee is increased from CNY35/visitor to CNY50/visitor. Incremental economic benefits from ecotourists are derived mainly from higher entrance fees or willingness to pay and estimated at CNY6.00 million/year.

12. The EIRR for the DMNNR is estimated at 16.17%, with an ENPV of CNY11.643 million and a BCR of 1.4 (Table 2). The results of the sensitivity analysis indicate that the EIRR is not sensitive to changes in selected risk variables such as benefit reduction and cost increase by 10% together or benefits delayed by 2 years.

**Table 2: Estimated Economic Internal Rate of Return of the Dafeng Milu National Nature Reserve (CNY million)**

Year	Economic Cost			Economic Benefits					Net Economic Benefits
	Investment Cost	Operation and Maintenance	Total Costs	Reduced Losses due to Milu Deer Mortality	Increased Value of Wetland Forest Services	Increased Carbon Sequestration Value	Increased Revenue from Ecotourist Visits	Total Economic Benefits	
2012	8.50		8.50						(8.50)
2013	15.08		15.08						(15.08)
2014	11.00		11.00						(11.00)
2015	1.59		1.59						(1.59)
2016	1.15	0.19	1.34	2.28		0.07	6.00	8.35	7.01
2017		0.19	0.19	2.20	0.04	0.07	6.00	8.30	8.11
2018		0.19	0.19	2.12	0.08	0.07	6.00	8.26	8.07
2019		0.19	0.19	2.04	0.12	0.07	6.00	8.22	8.04
2020		0.19	0.19	1.96	0.17	0.07	6.00	8.19	8.01
2021		0.19	0.19	1.88	0.22	0.07	6.00	8.17	7.98
2022		0.19	0.19	1.80	0.28	0.07	6.00	8.15	7.96
2023		0.19	0.19	1.72	0.35	0.07	6.00	8.14	7.95
2024		0.19	0.19	1.65	0.42	0.07	6.00	8.13	7.94
2025		0.19	0.19	1.57	0.50	0.07	6.00	8.13	7.95
2026		0.19	0.19	1.50	0.58	0.07	6.00	8.14	7.96
2027		0.19	0.19	1.43	0.67	0.07	6.00	8.16	7.98
2028		0.19	0.19	1.35	0.78	0.07	6.00	8.19	8.01
2029		0.19	0.19	1.28	0.89	0.07	6.00	8.24	8.05
2030		0.19	0.19	1.21	1.01	0.07	6.00	8.29	8.10
2031		0.19	0.19	1.14	1.14	0.07	6.00	8.35	8.17
2032		0.19	0.19	1.07	1.29	0.07	6.00	8.43	8.24
2033		0.19	0.19	1.01	1.45	0.07	6.00	8.53	8.34
2034		0.19	0.19	0.94	1.63	0.07	6.00	8.64	8.45
2035		0.19	0.19	0.88	1.83	0.07	6.00	8.77	8.58
2036		0.19	0.19	0.81	2.04	0.07	6.00	8.91	8.73
2037		0.19	0.19	0.75	2.27	0.07	6.00	9.08	8.90
2038		0.19	0.19	0.68	2.53	0.07	6.00	9.28	9.09
2039		0.19	0.19	0.62	2.81	0.07	6.00	9.50	9.31
2040		0.19	0.19	0.56	3.12	0.07	6.00	9.74	9.55
2041		0.19	0.19	0.50	3.46	0.07	6.00	10.02	9.83
								<b>EIRR =</b>	<b>16.17%</b>
								<b>NPV @ 12% =</b>	<b>11.64</b>
								<b>BCR =</b>	<b>1.39</b>

BCR = benefit–cost ratio, EIRR = economic internal rate of return, NPV = net present value.

Note: The economic opportunity cost of capital is at 12%.

Source: Asian Development Bank estimates.

13. **Coastal forest improvement in the Sheyang Forest Farm.** The restoration of the SFF will cover 493.3 ha. The expected benefits are (i) the increased value of ecological services of

<sup>10</sup> The calculated value may be considered as the minimum estimate of the government's willingness to protect milu deer, considering their global importance. For the economic analysis, the calculated average value of one milu deer is the sum of the NPV of the (i) DMNNR investment cost/head/year, (ii) cost of medical treatment/head/year, (iii) cost of supplemental feed/head/year, and (iv) DMNNR cost of operation and maintenance/head/year. These NPVs are projected over 30 years and discounted at 12%.

<sup>11</sup> Projections of benefits from enhanced carbon sequestration for the DMNNR follow those applied for the YRBNNR.

coastal protection forests on 493.3 ha, with incremental economic benefits increasing from CNY4.60 million/year in 2016 to CNY42.09/year in 2041;<sup>12</sup> (ii) enhanced carbon sequestration capacity of the restored and/or rehabilitated forest farm area and ecological habitat on 493.3 ha, with incremental benefits from enhanced carbon sequestration of CNY0.72 million/year over 2016–2041;<sup>13</sup> and (iii) increased revenues from ecotourists as the number of visits is projected to be higher by 2016 and to increase at 10% annually with the project but at only 5% without the project, subject to a maximum capacity of 200,000 ecotourist visits per year, and the entrance fee with the project at CNY25/visitor, 25% higher than without the project.

14. The EIRR for the SFF is estimated at 13.61%, with an ENPV of CNY9.451 million and a BCR of 1.2 (Table 3). The results of the sensitivity analysis indicate that the EIRR is not sensitive to changes in the selected risk variables in general. In the sensitivity tests, only when benefits are delayed by 2 years or benefits decrease and costs increase by 10% simultaneously does the EIRR fall between 11.0% and 11.7%.

**Table 3: Estimated Economic Internal Rate of Return for the Sheyang Forest Farm**  
(CNY million)

Year	Economic Cost			Economic Benefits				Net Economic Benefits
	Investment Cost	Operation and Maintenance	Total Costs	Increased Value of Coastal Protection Forest Services	Increased Value of Carbon Sequestration	Increased Revenue from Ecotourism	Total Economic Benefits	
2012	3.54		3.54					(3.54)
2013	20.26		20.26					(20.26)
2014	21.71		21.71					(21.71)
2015	12.60		12.60					(12.60)
2016	16.84	0.38	17.21	4.60	0.72	1.88	7.20	(10.02)
2017		0.38	0.38	5.02	0.72	2.17	7.92	7.54
2018		0.38	0.38	5.49	0.72	2.50	8.71	8.34
2019		0.38	0.38	6.00	0.72	2.52	9.24	8.86
2020		0.38	0.38	6.55	0.72	2.39	9.67	9.29
2021		0.38	0.38	7.16	0.72	2.26	10.15	9.77
2022		0.38	0.38	7.82	0.72	2.13	10.67	10.30
2023		0.38	0.38	8.55	0.72	1.98	11.25	10.88
2024		0.38	0.38	9.34	0.72	1.83	11.89	11.52
2025		0.38	0.38	10.20	0.72	1.67	12.60	12.22
2026		0.38	0.38	11.15	0.72	1.51	13.38	13.00
2027		0.38	0.38	12.18	0.72	1.33	14.24	13.86
2028		0.38	0.38	13.31	0.72	1.15	15.18	14.80
2029		0.38	0.38	14.54	0.72	1.00	16.26	15.89
2030		0.38	0.38	15.89	0.72	1.00	17.61	17.23
2031		0.38	0.38	17.36	0.72	1.00	19.08	18.71
2032		0.38	0.38	18.97	0.72	1.00	20.69	20.31
2033		0.38	0.38	20.72	0.72	1.00	22.44	22.07
2034		0.38	0.38	22.64	0.72	1.00	24.36	23.99
2035		0.38	0.38	24.74	0.72	1.00	26.46	26.09
2036		0.38	0.38	27.03	0.72	1.00	28.75	28.38
2037		0.38	0.38	29.53	0.72	1.00	31.25	30.88
2038		0.38	0.38	32.27	0.72	1.00	33.99	33.61
2039		0.38	0.38	35.25	0.72	1.00	36.98	36.60
2040		0.38	0.38	38.52	0.72	1.00	40.24	39.87
2041		0.38	0.38	42.09	0.72	1.00	43.81	43.43
							<b>EIRR =</b>	<b>13.61%</b>
							<b>NPV @ 12% =</b>	<b>9.45</b>
							<b>BCR =</b>	<b>1.17</b>

BCR = benefit–cost ratio, EIRR = economic internal rate of return, NPV = net present value.

Note: The economic opportunity cost of capital is at 12%.

Source: Asian Development Bank estimates.

15. **Coastal forest improvement in the Dafeng Forest Farm.** The proposed interventions for the DFF include (i) rehabilitating existing forests by replanting indigenous plant species on 900 ha; (ii) rehabilitating 133.8 ha of coastal wetlands;<sup>14</sup> and (iii) other activities such as constructing a water supply and drainage system, wetland boardwalks, and patrol stations, as well as improving forest and wetland protection services. The expected benefits are (i) the

<sup>12</sup> Projections of benefits from improved ecological services in the SFF follow those applied for the DMNRR.

<sup>13</sup> Projections of benefits from enhanced carbon sequestration in the SFF follow those applied for the YRBNRR.

<sup>14</sup> This includes 122.7 ha of coastal wildlife habitat restoration and 11.1 ha of wetland rehabilitation.

increased in value of ecological services on 1,033.8 ha, with incremental benefits increasing from CNY0.85 million in 2017 to CNY79.34million in 2041;<sup>15</sup> (ii) improved biodiversity in wetlands and coastal protection forests increasing the carbon sequestration capacity of these ecosystems, with incremental benefits from enhanced carbon sequestration estimated at CNY1.51 million/year over 2016–2041;<sup>16</sup> and (iii) increased revenues from ecotourists as the number of visits is projected to be higher by 2016 and to increase 10% with the project, versus 5% without the project, subject to a maximum capacity of 250,000 ecotourist visits per year, and the entrance fee with the project at CNY30/visitor, 20% higher than without the project.

16. The EIRR for the DFF is 21.67%, the ENPV CNY48.65 million, and the BCR 2.7 (Table 4). The EIRR is not sensitive to changes in the selected risk variables, as their corresponding sensitivity indicators are all less than one. For instance, when the benefits decrease and costs increase by 10% simultaneously, the EIRR is estimated at 19.4%.

**Table 4: Estimated Economic Internal Rate of Return for the Dafeng Forest Farm**  
(CNY million)

Year	Economic Cost			Project Benefits			Total Economic Benefits	Net Economic Benefits
	Investment Cost	Operation and Maintenance	Total Costs	Increase in Value of Ecological Services	Increased Carbon Sequestration Value	Increased Revenue from Ecotourism		
2012	3.08		3.08					(3.08)
2013	7.88		7.88					(7.88)
2014	10.31		10.31					(10.31)
2015	10.96		10.96					(10.96)
2016	8.03	0.20	8.23		1.51	2.68	4.19	(4.04)
2017		0.20	0.20	0.85	1.51	3.12	5.48	5.28
2018		0.20	0.20	1.78	1.51	3.60	6.90	6.70
2019		0.20	0.20	2.81	1.51	3.62	7.94	7.74
2020		0.20	0.20	3.93	1.51	3.43	8.87	8.67
2021		0.20	0.20	5.16	1.51	3.22	9.90	9.69
2022		0.20	0.20	6.51	1.51	3.01	11.03	10.83
2023		0.20	0.20	7.99	1.51	2.79	12.28	12.08
2024		0.20	0.20	9.61	1.51	2.55	13.67	13.47
2025		0.20	0.20	11.39	1.51	2.30	15.20	15.00
2026		0.20	0.20	13.33	1.51	2.04	16.89	16.69
2027		0.20	0.20	15.47	1.51	1.77	18.75	18.55
2028		0.20	0.20	17.82	1.51	1.48	20.81	20.61
2029		0.20	0.20	20.39	1.51	1.25	23.15	22.95
2030		0.20	0.20	23.20	1.51	1.25	25.97	25.76
2031		0.20	0.20	26.29	1.51	1.25	29.05	28.85
2032		0.20	0.20	29.68	1.51	1.25	32.44	32.24
2033		0.20	0.20	33.39	1.51	1.25	36.16	35.96
2034		0.20	0.20	37.47	1.51	1.25	40.23	40.03
2035		0.20	0.20	41.93	1.51	1.25	44.70	44.49
2036		0.20	0.20	46.83	1.51	1.25	49.59	49.39
2037		0.20	0.20	52.20	1.51	1.25	54.96	54.76
2038		0.20	0.20	58.08	1.51	1.25	60.85	60.65
2039		0.20	0.20	64.54	1.51	1.25	67.30	67.10
2040		0.20	0.20	71.62	1.51	1.25	74.38	74.18
2041		0.20	0.20	79.38	1.51	1.25	82.14	81.94
							<b>EIRR =</b>	<b>21.67%</b>
							<b>NPV @ 12% =</b>	<b>48.65</b>
							<b>BCR =</b>	<b>2.68</b>

BCR = benefit–cost ratio, EIRR = economic internal rate of return, NPV = net present value.

Note: The economic opportunity cost of capital is at 12%.

Source: Asian Development Bank estimates.

17. **Whole project.** Based on the calculated incremental cost and benefit streams projected under each component, the EIRR for the whole project is estimated at 14.87% (Table 5). The ENPV of the whole project is calculated at CNY127.50 million, and the BCR is 1.3.

<sup>15</sup> Projections of benefits from improved ecological services in the DFF follow those applied for the DMNRR.

<sup>16</sup> Projections of benefits from enhanced carbon sequestration in the DFF follow those applied for the YRBNNR.

**Table A5: Estimated Economic Internal Rate of Return for the Whole Project (CNY million)**

Year	Subproject Costs			Subproject Benefits					Incremental Benefits	
	Investment Cost	O&M Cost	Aqua-culture Income Loss	Total	Increased Value of Ecological Services	Increased Value of Carbon Sequestered	Increased Benefits from Ecotourism	Reduced Milu Deer Mortality		Total
2012	105.70		0.93	106.63						(106.63)
2013	125.97		1.86	127.83						(127.83)
2014	132.76		1.86	134.62						(134.62)
2015	60.22		1.86	62.08						(62.08)
2016	37.09	2.31	1.86	41.25	26.33	2.86	14.78	2.28	46.25	4.99
2017		2.31	1.86	4.17	32.74	2.99	16.07	2.20	54.00	49.83
2018		2.31	1.86	4.17	39.15	3.12	17.51	2.12	61.90	57.73
2019		2.31	1.86	4.17	45.57	3.25	18.25	2.04	69.10	64.93
2020		2.31	1.86	4.17	52.03	3.37	18.70	1.96	76.05	71.89
2021		2.31	1.86	4.17	58.53	3.49	19.23	1.88	83.12	78.95
2022		2.31	1.86	4.17	65.10	3.60	19.83	1.80	90.33	86.16
2023		2.31	1.86	4.17	71.75	3.72	20.52	1.72	97.71	93.54
2024		2.31	1.86	4.17	78.51	3.83	21.31	1.65	105.29	101.12
2025		2.31	1.86	4.17	85.40	3.94	22.20	1.57	113.10	108.93
2026		2.31	1.86	4.17	92.44	4.04	23.21	1.50	121.19	117.02
2027		2.31	1.86	4.17	99.67	4.14	24.36	1.43	129.60	125.43
2028		2.31	1.86	4.17	107.11	4.24	25.66	1.35	138.36	134.19
2029		2.31	1.86	4.17	114.79	4.34	27.23	1.28	147.64	143.48
2030		2.31	1.86	4.17	122.75	4.43	27.68	1.21	156.08	151.91
2031		2.31	1.86	4.17	131.03	4.53	27.40	1.14	164.10	159.94
2032		2.31	1.86	4.17	139.67	4.62	27.11	1.07	172.47	168.30
2033		2.31	1.86	4.17	148.71	4.71	26.80	1.01	181.23	177.06
2034		2.31	1.86	4.17	158.21	4.79	26.48	0.94	190.42	186.25
2035		2.31	1.86	4.17	168.21	4.88	26.14	0.88	200.09	195.93
2036		2.31	1.86	4.17	178.77	4.96	25.78	0.81	210.32	206.15
2037		2.31	1.86	4.17	189.96	5.04	25.41	0.75	221.15	216.98
2038		2.31	1.86	4.17	201.84	5.11	25.02	0.68	232.65	228.49
2039		2.31	1.86	4.17	214.50	5.19	24.61	0.62	244.91	240.74
2040		2.31	1.86	4.17	228.00	5.26	24.17	0.56	258.00	253.83
2041		2.31	1.86	4.17	242.46	5.34	23.72	0.50	272.01	267.84
									<b>EIRR =</b>	<b>14.87%</b>
									<b>NPV @ 12% =</b>	<b>127.50</b>
									<b>BCR =</b>	<b>1.34</b>

BCR = benefit-cost ration, EIRR = economic internal rate of return, NPV = net present value, O&M = operation and maintenance.  
 Note: The economic opportunity cost of capital is at 12%.  
 Source: Asian Development Bank estimates.

18. The sensitivity analysis indicates that the economic viability of the project is not sensitive to changes in benefits and costs. When the overall benefits (e.g., wetland values, carbon price, and tourism revenues) decrease by 10% and the costs (e.g., investment and operation and maintenance) decrease by 10%, the EIRR is estimated at 12.9%.

**Table A6: Results of Sensitivity Analysis for the Whole Project**

Change Variables	Base	Recalculated		Switching
	EIRR <sup>a</sup>	EIRR <sup>a</sup>	Sensitivity Indicator	Value <sup>b</sup>
	14.9%	(%)		(%)
Delay in benefits by 1 year		13.4		
Delay in benefits by 2 years		12.2		
Lower benefits from ecological services by 10%		14.1	0.52	34
Price of carbon traded lower by 10%		14.8	0.03	>100
Lower benefits from ecotourist visits by 10%		14.6	0.15	>100
Lower benefits generated by the project as a whole by 10%		13.8	0.72	26
Increase in project investment and O&M costs by 10%		13.9	0.65	34
Decrease in project benefits and increase in project costs by 10%		12.9	1.34	14

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

<sup>a</sup> At 12% discount rate.

<sup>b</sup> The switching value is the percentage increase or decrease in costs or benefits to maintain an EIRR equal the economic opportunity cost of capital of 12%.

Source: Asian Development Bank estimates.

## D. Financial Analysis

19. The financial analysis of the project mainly evaluated the capacity of the governments of Dafeng city, Jiangsu Province, and Tinghu District to cover annual counterpart financing and annual debt service. The annual counterpart financing requirement during project implementation, as a ratio of the projected annual government revenues, falls significantly below 1% for all governments. Likewise, estimated annual debt service is considerably less than 1% of annual government revenues. These low ratios indicate acceptable fiscal risk.