

ECONOMIC AND FINANCIAL ANALYSIS

A. Introduction

1. The current Nam Ngum River Basin Development Sector Project was designed with four components: (i) integrated water resources management (IWRM), (ii) reservoir management and modeling, (iii) integrated watershed management including agriculture and forestry development, and (iv) project management. The total cost of the project is \$29 million, one-third of which was spent on capacity building, which will ensure long-term sustainability of land and water resources.

2. The additional financing project is proposed to consolidate and enhance the impact of successful operations documented under the current project. The proposed additional financing project is expected to optimize the use of water resources, especially in the Nam Ngum River Basin (NNRB). The outcome will be integrated watershed management improved in the NNRB. It is expected to produce the following outputs: (i) the Nam Ngum River Basin Committee Secretariat strengthened for sub-basin management, (ii) district land use planning enhanced, (iii) agricultural support services improved, and (iv) institutional and human resource capacity strengthened for project implementation.

3. This linked document presents the project economic reevaluation at project completion (section B) and analyzes the viability of the proposed additional investment (section C).

B. Financial and Economic Reevaluation at Project Completion

1. Methodology in Brief

4. The financial and economic analysis determined incremental benefits attributable to the project interventions. While a number of benefit streams are observed, the analysis only includes benefits attributable to the project interventions that are readily quantifiable. Financial revenue and costs were estimated using constant 2010 prices. Financial farm-gate prices are based on findings and information collected during the project completion review mission in March 2011, together with information made available in the project monitoring reports. The analyses use a world price numeraire, where economic prices for traded crop inputs and outputs have been based on the World Bank commodity price projections. Labor costs have been shadow-priced at 0.8 of the wage rates while other inputs have been adjusted by the standard conversion factor of 0.9 as applicable to the Lao People's Democratic Republic (Lao PDR). The economic viability of the project is evaluated against standard benchmarks, i.e., an economic internal rate of return (EIRR) greater than 12%, a benefit–cost ratio greater than 1.0, and an economic net present value greater than zero.

5. To justify the proposed additional financing, analyses of three scenarios were conducted—the current project reevaluation, the proposed additional financing as an incremental investment, and a combination of the two. The objective of these analyses is to demonstrate (i) whether the current project has been performing well as envisaged at appraisal and has been viable, (ii) whether the investment of the proposed additional financing will be viable if it was an incremental initiative, and (iii) whether the additional financing to further the impact of the current project operations will be sustainable.

6. Detailed assumptions, financial and economic crop budgets, economic price derivations, project costs profiles, and benefit–cost and sensitivity analyses are presented in the spreadsheet models.¹

2. Project Benefits and Economic Reevaluation

7. The benefits of current project interventions have been validated at project completion by the early project completion review mission. At the national level, the project has played a significant role in optimizing the use of water resources by institutionalizing IWRM. Enhanced management of the Nam Ngum 1 reservoir has improved water conservation and mitigated floods. The current project also enabled efficient use of water in agriculture, leading to actual increased crop productivity and household incomes. Adoption of improved land use and land allocation practices, including forest management, has helped maintain the water quality in the long run and added to household incomes. At the community level, integrated agricultural extension activities of the watershed management component has targeted poor areas in the upper NNRB.

8. All the project components implemented capacity building activities. The IWRM component has had significant impact on strengthening the institutional capacity of the Water Resources and Environment Administration. While capacity building has generated significant benefits, direct benefits of these activities are not readily quantifiable. Similarly, the improved watershed planning has enhanced water and land use efficiencies but estimating the intended benefits is not straightforward.

9. The economic reevaluation at completion included only those benefits that are readily quantified. As envisaged at the project appraisal in 2002, the majority of the project benefits were derived from two main sets of activities—improved hydropower generation as a result of improved reservoir management, and enhanced watershed management through integrated agricultural extension. These benefits were quantified and included in the economic reevaluation. It was estimated that the EIRR at completion was 25.8%, compared to the EIRR of 24.7% estimated at project appraisal. The higher reevaluated EIRR was due largely to the reevaluation of benefit streams from hydroelectric power generation. In particular, the analyses validated a net benefit of \$1.5 million per annum from hydroelectric power generation using an additional generation capacity of 50 gigawatt-hours (GWh) per annum, while at appraisal this benefit stream was estimated to be \$600,000 using an additional generation capacity of 20 GWh per annum. Moreover, the reevaluation stated that the higher than expected project benefits have been largely due to the effective implementation of the land use planning and land allocation activities under the project that helped enhance agricultural production and productivity.

10. The benefit of better forest management by the participating farmers was due largely to the joint effort of the project staff and the affected villagers. The demarcation of the forest areas into protection, conservation, and production forest and the signing of a formal agreement stating the rights and responsibilities of the village communities in sustainably managing these forest areas have made significant contributions to reducing soil erosion and improving water retention in the river basin. However, these benefits are not readily quantifiable.

¹ The spreadsheet model is available upon request.

11. The reevaluated results are presented in the subsequent section, and a comparative analysis of the current project scope with additional scope, together with a combined analysis, is in section C.

3. Reevaluated Results

12. The results of the financial and economic analyses for the current project are summarized in Tables 1a and 1b. The base case estimates an EIRR of 25.8% and a financial internal rate of return (FIRR) of 21.7%, well above the benchmark rate of 12%, suggesting that the current project investment is viable. As noted earlier, the EIRR is marginally higher than the appraisal EIRR of 24.7%, suggesting that the benefit streams envisaged have been realistic. While a test of sensitivity indicates all indicators are above the benchmarks, the current project (without additional financing) is still most vulnerable to a reduction of benefits and delays in realization of these benefits. It suggests that practical measures should be taken to ensure the investment made continues to maintain the momentum in benefit realization.

Table 1a: Summary Financial Indicators (KN million)

Cases	FNPV	BCR	FIRR	SI	SV(FNPV)
0. Base case	131,152	1.72	21.7%		
1. Costs + 10%	112,886	1.56	19.8%	1.39	71.8%
2. Benefits decrease - 10%	99,771	1.55	19.6%	2.39	41.8%
3. Benefits decrease - 20%	68,390	1.37	17.4%	2.39	41.8%
4. Benefits delay - 1 year	95,519	1.52	18.4%	2.39	FNPV is 15.2% lower

BCR = benefit–cost ratio, FIRR = financial internal rate of return, FNPV = financial net present value, SI = sensitivity indicator (the ratio that compares percentage change in FNPV with percentage change in a variable), SV = switching value (the percentage change in a variable sufficient to reduce FNPV to zero).

Source: Staff estimates.

Table 1b: Summary Economic Indicators (KN million)

Cases	ENPV	BCR	EIRR	SI	SV(ENPV)
0. Base case	188,893	2.03	25.8%		
1. Capital Costs + 10%	170,627	1.85	23.7%	0.97	103.4%
2. Benefits decrease - 10%	151,737	1.83	23.5%	1.97	50.8%
3. Benefits decrease - 20%	114,582	1.63	21.0%	1.97	50.8%
4. Benefits delay - 1 year	146,735	1.80	21.5%	1.97	ENPV is 16.7% lower

BCR = benefit–cost ratio, EIRR = economic internal rate of return, ENPV = economic net present value, SI = sensitivity indicator (the ratio that compares percentage change in ENPV with percentage change in a variable), SV = switching value (the percentage change in a variable sufficient to reduce ENPV to zero).

Source: Staff estimates.

C. Financial and Economic Analyses of the Proposed Additional Financing

1. The Scope of Additional Investment

13. The additional financing proposed a loan of \$5.0 million to cover the activities associated with improving agricultural support services, strengthening the Nam Ngum River Basin Committee Secretariat in sub-basin management, enhancing district land use planning, and

developing institutional and human resource capacity for project implementation for 2012–2015. Under the proposed additional financing, an additional 3,000 farmers and an estimated additional 2,000 hectares of paddy areas will benefit.

2. Incremental Benefits

14. The project is expected to yield major benefits, as follows:

- (i) Increased agricultural support activities will provide (a) knowledge and skills in farming and forestry, (b) access to rural credits for livelihood improvement, and (c) small-scale rural infrastructure. Improved access of farmers to technologies for farming and forestry practices will increase yields and/or labor efficiencies. Introducing high-yielding varieties and integrated pest management will increase rice yields. Better forage production and access to vaccination programs together with improved access to credits to initiate and expand improved practices will increase animal productivity and population. Small-scale inland fish farming with hatchery techniques will supplement the diets and incomes of farmers. Improved forest management techniques will facilitate the sustainable use of nontimber forest products, which will also be an income source. The project support in consolidating decentralized agricultural extension service delivery will help enhance sustainability of agricultural production in crops and livestock.
- (ii) Supplementary support in strengthening rural revolving fund institutions will provide farmers access to micro-loans for purchasing farm inputs such as seeds, fertilizers, and livestock. Some 3,000 households will benefit from this assistance. About 60% of the total loan amount is expected to be utilized for livestock purchases, 20% for the purchase of farm inputs, and the balance for trading and small enterprises.
- (iii) Provision of more small-scale rural infrastructure and village common assets will be developed through the capacity building and infrastructure fund. These assets will include rehabilitating and constructing irrigation schemes, village access roads and small bridges, village water supply, village social infrastructure including primary schools and health clinics, and rice processing mills and storage. About \$0.5 million will be provided for the fund.
- (iv) Strengthening the Nam Ngum River Basin Committee Secretariat, enhancing district land use planning, and further developing institutional and human resources will have significant impact on (a) sustainability of water- and land-based natural resources through better management; (b) improved water and food security, and ecosystem services; (c) reduced incidence of floods and droughts; and (d) greater resilience of communities to climate and other changes.

3. Summary of Estimated Results

15. While a number of benefit streams are expected from the additional financing interventions, the financial and economic analyses include only those that are readily quantified. Major quantifiable benefits are derived from improved agricultural activities including rice cultivation, livestock rearing, and forest rehabilitation.

16. The summary results of the analyses for the additional financing as an incremental investment are in Table 3a, and for a combination of the current project and additional financing in Table 3b. In the case of additional financing as an incremental investment, the analysis indicates an EIRR of 28.7% and an FIRR of 24.1%, and the combined case shows an EIRR of 27.4% and an FIRR of 22.6%. These analyses suggest that the additional investment is viable

due largely to prudent selection of high-yielding activities based on the current project evaluation. It further suggests that the additional investment will add significant value to further the benefits documented in the current project and will enable maximization of synergy with actual investment, particularly in capacity building and institutional development from the current project. This is evidenced in observing that the estimated EIRR and FIRR of the combined case are somewhat higher than those of the current project (27.4% versus 25.8% for the EIRR and 22.6% versus 21.7% for the FIRR), providing a solid justification for the proposed additional financing. The economic and financial performance of the current and additional financing projects is summarized in Table 4.

17. Sensitivity tests were undertaken to test the robustness of the analyses and examine the consequences of changes in a range of variables including an increase in costs, reduction in benefit, as well as delay of benefit realization. The tests were undertaken with the following variables: (i) cost increase by 10%, (ii) benefit decrease by 10%, (iii) benefit decrease by 20%, and (iv) benefit delay by 1 year. It is indicated that in both cases the project is sensitive to reduced benefit and delays in project implementation and hence realization of benefits. It suggests that if the additional financing is approved by the Board of Directors, the project administration team need to closely monitor the timely implementation of proposed activities in coordination with the government's executing and implementing agencies to ensure the project is viable. Furthermore, incorporating and disseminating lessons learnt from the current project will help further enhance the benefits of the additional investment.

**Table 2a: Additional Financing as an Incremental Investment
Summary Financial Indicators (KN million)**

Cases	FNPV	BCR	FIRR	SI	SV(FNPV)
0. Base case	40,364	1.87	24.1%		
1. Costs + 10%	35,719	1.70	22.1%	1.15	86.9%
2. Benefits decrease - 10%	31,682	1.68	21.9%	2.15	46.5%
3. Benefits decrease - 20%	23,000	1.50	19.5%	2.15	46.5%
4. Benefits delay - 1 year	28,905	1.62	20.0%	2.15	FNPV is 17.1% lower

BCR = benefit-cost ratio, FIRR = financial internal rate of return, FNPV = financial net present value, SI = sensitivity indicator (the ratio that compares percentage change in FNPV with percentage change in a variable), SV = switching value (the percentage change in a variable sufficient to reduce FNPV to zero).

Source: Staff estimates.

**Table 2b: Additional Financing as an Incremental Investment
Summary Economic Indicators (KN million)**

Cases	ENPV	BCR	EIRR	SI	SV(ENPV)
0. Base case	72,717	2.38	28.7%		
1. Capital Costs + 10%	67,464	2.17	26.6%	0.72	138.4%
2. Benefits decrease - 10%	60,192	2.15	26.4%	1.72	58.1%
3. Benefits decrease - 20%	47,667	1.91	23.9%	1.72	58.1%
4. Benefits delay - 1 year	56,299	2.07	23.9%	1.72	ENPV is 16.6% lower

BCR = benefit-cost ratio, EIRR = economic internal rate of return, ENPV = economic net present value, SI = sensitivity indicator (the ratio that compares percentage change in ENPV with percentage change in a variable), SV = switching value (the percentage change in a variable sufficient to reduce ENPV to zero).

Source: Staff estimates.

**Table 3a: Combined Current Project and Additional Financing
Summary Financial Indicators (KN million)**

Cases	FNPV	BCR	FIRR	SI	SV(FNPV)
0. Base case	162,571	1.81	22.6%		
1. Costs + 10%	142,429	1.64	20.8%	1.24	80.7%
2. Benefits decrease - 10%	126,172	1.63	20.6%	2.24	44.7%
3. Benefits decrease - 20%	89,772	1.45	18.4%	2.24	44.7%
4. Benefits delay - 1 year	121,561	1.60	19.2%	2.24	FNPV is 25.2% lower

BCR = benefit–cost ratio, FIRR = financial internal rate of return, FNPV = financial net present value, SI = sensitivity indicator (the ratio that compares percentage change in FNPV with percentage change in a variable), SV = switching value (the percentage change in a variable sufficient to reduce FNPV to zero).

Source: Staff estimates.

**Table 3b: Combined Current Project and Additional Financing
Summary Economic Indicators (KN million)**

Cases	ENPV	BCR	EIRR	SI	SV(ENPV)
0. Base case	225,518	2.15	27.4%		
1. Capital Costs + 10%	205,975	1.96	25.6%	0.87	115.4%
2. Benefits decrease - 10%	183,423	1.94	25.4%	1.87	53.6%
3. Benefits decrease - 20%	141,328	1.72	22.6%	1.87	53.6%
4. Benefits delay - 1 year	178,068	1.91	23.0%	1.87	ENPV is 21.0% lower

BCR = benefit–cost ratio, EIRR = economic internal rate of return, ENPV = economic net present value, SI = sensitivity indicator (the ratio that compares percentage change in ENPV with percentage change in a variable), SV = switching value (the percentage change in a variable sufficient to reduce ENPV to zero).

Source: Staff estimates.

Table 4: Economic and Financial Performance of the Current and Additional Financing Projects

Summary of Project Scope and Activities		Economic and Financial Performance			Data Sources and Remarks
Current Project	Additional Financing	Current Project	Additional Financing	Overall Project	
Outcome: Integrated watershed management improved in NNRB		Average household farm income increased by 54% (12,000 households) (baseline: 60%-80%, 10,000 households)	Average farm income will increase by 60% (3,000 households in additional 50 villages by 2015)	Average farm income will increase by 60% (total 15,000 households by 2015)	Project benefit monitoring report (November 2010) of NNRBDSP
		Coordination mechanism for IWRM strengthened at the central and provincial levels	District development plans updated in accordance with sub-basin plans	IWRM better implemented	Further income increase is expected in ongoing villages due to continuous support
		FIRR: 21.7% EIRR: 25.8% (baseline ^a : EIRR 24.7%)	FIRR: 24.1% EIRR: 28.7%	FIRR: 22.6% EIRR: 27.4%	
Outputs					
Integrated Water Resources Management Component					
MoNRE ^b strengthened for IWRM coordination among central and provincial agencies	(completed)	26 training programs organized for IWRM (baseline: 24) 446 staff trained			WREA was established in 2007 and strengthened
NNRBC strengthened to support WRCC	Output 1: NNRBCS strengthened for sub-basin management	NNRBCS was established in 2010	Five sub-basin plans will be prepared for effective IWRM	Institutional and human resource capacity of NNRBCS improved for operationalizing IWRM	Decree for the establishment of river basin committees approved in 2010
NNRB management plan adopted and implemented	(completed)	National water resources profile prepared in 2008			
Hydro-meteorological data management improved	(completed)	NNRB plan prepared in 2009 (baseline: 1)			
	(completed)	Hydro-meteorological equipment and data collection improved.			ADB's PCR mission for NNRBDSP
Reservoir Management and River Basin Modeling Component					
The Ministry of Industry and Handcrafts (MIH) strengthened for effective reservoir management	(completed)	Two models introduced for surface runoff and day-to-day operation of Nam Ngum 1 reservoir			Additional turbine for Nam Ngum 1 station under consideration
Watershed Management Component					
IWMU in the MAF	Output 2: District land	17 subwatershed profiles	10 district land use plans	Environmentally	ADB's PCR

Summary of Project Scope and Activities		Economic and Financial Performance			Data Sources and Remarks
Current Project	Additional Financing	Current Project	Additional Financing	Overall Project	
strengthened	use planning enhanced	and initial plans prepared (baseline: 16) Three consolidated subwatershed development plans prepared	developed and/or revised in accordance with the consolidated subwatershed development plans	sustainable land use plans will promote sustainable farm and forestry management	mission for NNRBDSP
Output 3: Agricultural support services improved		Land use planning and land allocation conducted in 90 villages 29 <i>khet</i> (village cluster) extension service centers (KESCs) established 16 district financial management teams (DFMTs) established for village revolving funds Rice yield increased by 0.5 t/ha in 12,719 ha (baseline: from 1.5 t/ha to 2.0 t/ha, 10,000 ha) The number of poultry, pigs, cattle, and buffalo increased by 20%–60% in 158 surveyed villages	Land use planning and land allocation will be conducted in 30 villages 16 KESCs will operate in a sustainable manner 16 DFMTs will be savings and credit unions registered with the Bank of Lao PDR Rice yield will increase by 0.5 t/ha in 2,000 ha The number of livestock will increase by 20%–60% in additional 50 villages	Land use planning and land allocation will be conducted in 140 villages KESCs institutionalized in NNRB 16 DFMTs will be sustainable Rice yield will increase by 0.5 t/ha in 14,719 ha The number of livestock will increase by 20%–60% in 208 villages	ADB's PCR mission for NNRBDSP Further improvements in farm and forestry productivity are expected in ongoing 230 villages
Capacity Development Component					
Project management	Output 4: Institutional and human resources strengthened for project implementation	Effective project management	Inter-sector agency coordination will be facilitated Participation and ownership of districts and communities will be strengthened		

DFMT = district financial management team, EIRR = economic internal rate of return, FIRR = financial internal rate of return, IWMU = Integrated Watershed Management Unit, IWRM = integrated water resources management, KESC = *khet* (village cluster) extension service center, MAF = Ministry of Agriculture and Forestry, MIH = Ministry of Industry and Handicraft, MoNRE = Ministry of Natural Resources and Environment, NNRB = Nam Ngum River Basin, NNRBC = Nam Ngum River Basin Committee, NNRBCS = Nam Ngum River Basin Committee Secretariat, NNRBDSP = Nam Ngum River Basin Development Sector Project, PCR = project completion review, WREA = Water Resources and Environment Administration.

^a Baseline means a target value at the appraisal stage of the NNRBDSP (described in the Report and Recommendation of the President).

^b Water Resources Coordination Committee was superseded by the Water Resources and Environment Administration in 2007, which was again superseded by the Ministry of Natural Resources and Environment in June 2011.