ECONOMIC AND FINANCIAL ANALYSIS

A. Demand

1. The population of the Lao People's Democratic Republic (Lao PDR) consumes an average of 20 kilograms (kg) of meat per person annually. This is expected to double in the next 10–20 years.[1] In 2012, domestic production of pork, beef, buffalo meat, and chicken totaled 123,952 tons;[2] while 63,429 tons of beef, pork, and chicken meat and 13,636 tons in meat equivalent of cattle and poultry were imported from Thailand.[3] Adjusting the overall total of 201,017 tons for the small domestic consumption of goat meat, the estimated total domestic demand for meat in 2012 is 211,068 tons. Thus domestic production accounted for some 63% of domestic consumption and imports for 37%.

2. Livestock produced from the Northern Smallholder Livestock Commercialization Project (NSLCP) is destined for local consumption. With average annual meat consumption of 20 kg per person, demand in the project provinces[4] is estimated at 46,200 tons in 2012. By 2028, when the NSLCP livestock production systems (LPS) are at maximum capacity, per capita consumption of meat is expected to reach 30 kg annually, based on the experience of neighboring countries, and with the domestic population of the project provinces increasing from 2.3 to 2.7 million. Thus 81,000 tons of meat would be required to supply the local market, and, at present trends, 25% or 20,250 tons expected to be imported and the balance of 60,750 tons produced domestically. The project's adopters are expected to produce a total of 99,818 fattened animals annually, equivalent to 6,365 tons of meat (Table 1). This level of production represents 8% of expected consumption, 10% of total production, and 31% of estimated imports from the project provinces; the impact on livestock prices is expected to be insignificant.

Table 1: Total Livestock Production of Project Smallholders at Maximum Impact

	Livestock Type			
Item	**Pigs**	**Cattle**	**Goats**	**Total**
Number of smallholders adopting the NSLCP method	3,273	4,909	818	9,000
Production quantity per smallholder per cycle (animal)	9	5	20	
Fattening cycles per year	2	1	1	
Fattened livestock produced per year (animal)	58,909	24,545	16,364	99,818
Average meat yield (kilograms per animal)	40	150	20	
Annual production in meat equivalent (ton)	2,356	3,682	327	6,365

NSLCP = Northern Smallholder Livestock Commercialization Project.
Source: Asian Development Bank.

B. Production System and its Adoption

3. The NSLCP follows on from the recently completed Northern Region Sustainable Livelihoods through Livestock Development Project (LDP). The LDP organized and trained smallholders in smallholder production groups of 5–6 smallholders which in any one village may have 3–4 groups raising different kinds of animals. The NSLCP will consolidate the groups into

[1] W. Stur and P. Phensavanh. 2014. *Lessons Learnt from the Northern Region Sustainable Livelihood through Livestock Development Project and Assessment of Livestock Value Chains in Northern Lao PDR.* Vientiane: International Fund for Agricultural Development.

[2] Food and Agriculture Organization of the United Nations. FAOSTAT. http:// http://faostat.fao.org/ (accessed 3 September 2014).

[3] A. Sendall. 2014. Project preparatory technical assistance 8558. *Working Paper Livestock Value Chain Optimization and Public Private Partnerships for Livestock Processing Facilities*.

[4] Bokeo, Houaphanh, Louangnamtha, Luang Prabang, Oudomxai, Phongsaly, Saignabouly, and Xiangkhouang.

larger smallholder livestock production and marketing groups (SLPMGs), each focusing on one kind of animal, and will provide both technical and business training and support.

4. **Production system**. The LPS will increase the incomes of SLPMGs through the combination of (i) sale of more animals per year (the NSLCP will fatten 9 pigs, 5 cattle, and 20 goats per cycle; the LDP fattened 6 pigs, 3 cattle, and 20 goats per cycle) because of better growth rates leading to a shorter time required to produce a fattened animal, and (ii) heavier animals with a higher sale value.[5] Farmers may keep more animals, meaning greater focus on livestock raising, because of the higher returns found in specialization in livestock raising than alternative livelihood activities. The higher livestock growth rates are achieved by (i) varying the animal feed mix (Tables 2 and 3) towards purchased concentrate with greater protein and other nutritional value (e.g., soybean meal and tapioca chips) than on-farm cultivated feed**;** and (ii) devoting more labor to feeding and management in enclosed surroundings such as pens, which provide great control over the risk and returns in production.[6]

Table 2: NSLCP versus LDP Pig Fattening (per piglet over 180-day cycle)

Item	Stylo (on farm)	Cassava (on farm)	Soybean Meal	Maize	"Concentrate" Feed	Total
Feed price (KN/kg)	250	250	5,000	1,000	3,000	
NSLCP						
Input (kg)	23.93	33.46	20.54	71.15	0	149.08
Amount (KN)	5,983	8,365	102,699	71,150	0	188,198
Input (kg/piglet)						5 to 8
Output (kg/pig)						55
LDP						
Input (kg)	45.00	0	0	0	13.33	58.33
Amount (KN)	11,250	0	0	0	40,000	51,250
Input (kg/piglet)						5 to 8
Output (kg/pig)						45

kg = kilograms, KN = kip, LDP = Livestock Development Project, NSLCP = Northern Smallholder Livestock Commercialization Project.

Source: Asian Development Bank. Completion Report: Northern Region Sustainable Livelihoods through Livestock Development Project in the Lao People's Democratic Republic. Manila (draft); W. Stur and P. Phensavanh. 2014. Lessons Learnt from the Northern Region Sustainable Livelihood through Livestock Development Project and Assessment of Livestock Value Chains in Northern Lao PDR. Vientiane: International Fund for Agricultural Development.

5. **Adoption**. The LDP experience shows that a many smallholders have strong potential for commercialization; they constitute the target group for the NSLCP. They understand the importance of vaccination and deworming, to reduce mortality and improve health and weight gain. Experienced LDP adopters are expected to form the first-generation LPS adopters. They will have financial literacy and a basic conceptual grasp of carrying out livestock production as part of a livestock value chain (LVC) that sources the animals to be fattened and the high-growth concentrate feed input, and connects them with the livestock market. The prospects of the higher returns from production will be a strong stimulus to adopt. An experience under the LDP of improved production methods of smallholder livestock enterprises gives these smallholders a basic confidence in assessing the risks and grasping management solutions in adopting the market-oriented NSLCP production. Their financial capacity, which was improved under the LDP, is one of the enabling factors for channeling greater capital resources both owned and borrowed to fund the production cycle. The high returns from adopting the LPS is

[5] NSLCP goat management requires 5 hours/day for 5 months while the LDP requires 3 hours/day for 6 months.

[6] Supplementary Document 17 (i) describes the assumptions and parameters used in the livestock models, (ii) presents a least cost assessment, and (iii) gives key references used in the economic and financial analysis (accessible from the list of linked documents in Appendix 2 of the report and recommendation of the President).

likely to mean that access to the NSLCP's rural credit subcomponent, while supportive, will not be a constraining factor, as other rural credit schemes will be incentivized to offer alternative financing solutions.[7] The LDP's successful graduates can be expected to join the second and third generations of adopters of the NSLCP method. Overall, the risks and constraints are manageable in the NSLCP design.[8]

Table 3: NSLCP versus LDP Cattle Fattening (Additional Feed to Forage)
(per cattle over 5–6 month cycle)

Item	Corn Feed	Rice Bran	Tapioca Chips	Total
Feed price (KN/kg)	2,000	1,000	2,000	
NSLCP				
Input (kg)[a]	300	0	300	600
Amount (KN)	600,000	0	600,000	1,200,000
Output (kg/cattle)				75
LDP				
Input (kg) [a]	360	360	0	720
Amount (KN)	720,000	360,000	0	1,080,000
Output (kg/cattle)				50

kg = kilograms, KN = kip, LDP = Livestock Development Project, NSLCP = Northern Smallholder Livestock Commercialization Project

[a] The NSLCP method requires 150 days; the LDP 180 days.

Source: Asian Development Bank. *Completion Report: Northern Region Sustainable Livelihoods through Livestock Development Project in the Lao People's Democratic Republic.* Manila (draft); W. Stur and P. Phensavanh. 2014. Lessons Learnt from the Northern Region Sustainable Livelihood through Livestock Development Project and Assessment of Livestock Value Chains in Northern Lao PDR. Vientiane: International Fund for Agricultural Development.

C. Financial Returns to Smallholders Livestock Production

6. **Production models**. Livestock fattening is practiced using methods adapted by to market demand. The practice is expected to be common among members of the livestock production groups using the LDP production method and those adopting the market-oriented LPS. Thus this particular form of livestock production is selected to represent the differences in the production costs and returns of LDP and NSLCP adopters (Table 4). In the NSLCP system, (i) more animals are fattened per cycle and greater use is made of nutrient-rich concentrate feed for pigs and cattle; and (ii) the use of livestock management labor for goats is more intensive.

7. **Financial viability**. Each of the three NSLCP production models, for the fattening of pigs, cattle, and goats is financially viable. However, goats, accounting for just 9% of livestock production in the project area, showed exceptionally high returns and were excluded in the analysis for conservatism (Table 4). The net annual returns to smallholders adopting the models are sufficient to service production loans at an opportunity cost interest rate of 24%. Based on the draft LDP completion report assessment of the financial viability of LDP production models (para 41) and Table 4, the returns to the NSLCP adopter equity are expected to be well above the equivalent returns of LDP livestock producers. The LDP producers' returns on equity can be considered to represent the opportunity cost of equity for the NSLCP adopters, implying the

[7] ADB. *Completion Report: Northern Region Sustainable Livelihoods through Livestock Development Project in the Lao People's Democratic Republic.* Draft. Manila.

[8] The NSLCP reduces risk by (i) providing technical extension training to improve animal health; (ii) providing business training so that the SLPMGs can better understand financial planning and cost management; (iii) organizing the SLPMGs so they are in a better position to negotiate more favorable terms in the LVC; (iv) providing access to credit to address financial capacity constraints; (v) improving the overall enabling business environment within the LVC and the predictability of investments and outcomes; and (vi) providing SLPMGs with equipment and materials to build pens, fences, and troughs to improve animal productivity.

NSLCP adopters' equity returns are above the opportunity cost of equity. The NSLCP livestock production models are all financially viable.

Table 4: Representative Annual Returns by Livestock Type and Production Model

(KN)

	Pigs		Cattle	
Item	**LDP**	**NSLCP**	**LDP**	**NSLCP**
Fattening cycle per year	2	2	1	1
Mortality rate	10%	10%	0%	0%
Investment costs[a]				
Pens, fences, troughs	1,650,000	1,650,000	3,000,000	5,000,000
Pasture (labor)	0	0	1,400,000	2,345,000
Seasonal costs per cycle[a]				
Livestock purchase	3,000,000	4,500,000	18,000,000	30,000,000
Vaccine, medicine	90,000	150,000	30,000	100,000
Feed	307,500	1,618,455	3,240,000	6,000,000
Livestock care, management	787,500	787,500	2,362,500	2,625,000
Seed	0	0	25,000	42,500
Forage production (labor)	350,000	350,000	700,000	1,190,000
Maintain fences, pens	0	0	0	0
Periodic maintenance[a]				
Pens, fences, troughs renewal	310,000	310,000	625,000	1,041,667
Resow pasture	0	0	425,000	708,333
Credit costs				
Principal	3,000,000	4,500,000	8,000,000	12,000,000
Interest (24% per annum)	720,000	1,080,000	960,000	1,440,000
Gross annual returns				
Livestock sales[a]	10,692,000	19,602,000	30,000,000	53,000,000
Value of manure as fertilizer	200,000	200,000	200,000	250,000
Average Net Annual Return	1,460,500	4,592,589	4,496,500	11,197,917
Equity IRR (20 years)	49%	300%	45%	107%

IRR = internal rate of return, KN = kip.

[a] Asian Development Bank. Completion Report: Northern Region Sustainable Livelihoods through Livestock Development Project in the Lao People's Democratic Republic. Manila (draft).

Source: Asian Development Bank estimates.

8. **Sensitivity analysis.** Sensitivity tests (Table 5) assessed the effect on smallholders' equity returns from livestock production by varying the (i) market price of fattened livestock, and (ii) the mortality rate for pigs**.** The tests shows that the smallholder's return on equity capital input into production is highly sensitive to a fall in livestock price and much less so to a rise in livestock mortality. The tests show the superior returns achieved with the NSLCP production system enable NSLCP adopters can better withstand adverse changes than LDP smallholders.

Table 5. Sensitivity Tests on Smallholder Returns from Livestock Production

Test	**Return on Equity with LDP System** (%)	**Return on Equity with NSLCP System** (%)
Pigs base case	49	300
Pig price 10% lower	13	83
Pig mortality 10% higher	44	246
Cattle base case	45	107
Cattle price 10% lower	13	36

LDP = Livestock Development Project, NSLCP = Northern Smallholder Livestock Commercialization Project

Source: Asian Development Bank.

D. Economic Analysis

9. **Assumptions and methodology**. The economic analysis is conducted in constant 2014 prices, with the kip as the unit of account and with inputs and outputs of livestock production including livestock valued at world prices. Tradable inputs and outputs are valued at border

equivalent prices. Nontradable items are valued at their domestic market prices adjusted by the standard conversion factor (SCF). Table 6 summarizes the prices of livestock, the adjustment factors used to estimate border parity prices of tradable inputs and outputs, the SCF, and the wage adjustment factor, used to estimate economic values of production inputs and outputs. With the single exception of the adjustment factor for nontradable nonlivestock input, the analysis adopts the livestock prices and adjustment factors used in the LDP completion report. The cost of credit of 24%, reflects the opportunity cost of a sustainable rural credit[9] and used in estimating the financial returns to equity of livestock producers was not used in estimating the economic value of those returns as it is considered a transfer payment.

Table 6. Production Input and Output Economic Price Adjustment

Item	District Market Price (KN)	Adjustment Factor
Livestock output		**Border parity**
Pigs, 6–7 months (LW 45–60 kg per animal)	1,155,000	0.96
Cattle, 5–6 years (LW 200 kg per animal)	9,800,000	0.98
Livestock input		**Border parity**
Piglets, 6 weeks (LW 5–8 kg per animal)	500,000	0.96
Cattle, 4–5 years (LW 150 kg per animal)	6,000,000	0.98
Nonlivestock input, tradable		**Border parity**
Seed; vaccine, medicine; concentrate feed such as corn, soybean, tapioca chips; drinking and feeding troughs for pigs		0.99
Nontradable input		**SCF**
Pens and fencing constructed and repaired; pasture sown and resown; on-farm feed		0.90
	Market Rate	**Shadow Wage**
Production labor, per day	35,000	0.80

kg = kilogram, LW = live weight, SCF = standard conversion factor.
Sources: Asian Development Bank. *Completion Report: Northern Region Sustainable Livelihoods through Livestock Development Project in the Lao People's Democratic Republic*. Manila (draft); ADB 2014 fact-finding mission field survey for livestock production inputs and outputs prices; for border parity adjustment factor for livestock, inputs and outputs, the SCF and wage adjustment factor; fact-finding mission assumption for tradable non livestock inputs.

10. Cattle fattening is the only LPS requiring land for pasture in addition to the producer's holding. Most of the land available is degraded scrub land, not cropped, thus a zero opportunity cost is assumed. The phase-in of SLPMGs adopting the LPS is consistent with an assumed benefit stream starting in 2017, 2 years after the project starts. The effective starting adoption rate of 10% in 2017, increasing by an addition of 10% annually until 2028, means that 14 years after project starts, 1.2 times the number of smallholders in the 300 targeted SLPMGs will have adopted this LPS. Project costs are valued after removing transfers including financial charges during implementation of the kip equivalent to $0.83 million and the kip equivalent of $4.5 million in rural credit. In addition the kip equivalent of $1.0 million in price contingencies were removed, as the analysis is conducted in 2014 constant prices; in all a total of $6.33 million equivalent from the total project costs were removed. Valuation is at border equivalent prices for tradable items with the SCF applied to the domestic market prices of nontradable items in the local currency components of project costs. With the exception of these identified transfers, all project costs are included in the economic analysis. The analysis was conducted for project implementation and a 20-year benefit period starting 2 years following project start-up.

11. **Quantified benefits**. The benefits quantified for the economic viability assessment are the gain in combined value added to livestock, excluding goat, by the target SLPMGs plus other

[9] R. Hickson and B. Khanthaphat. 2011. *Northern Region Sustainable Livelihoods through Livestock Development Project Evaluation of Village Livelihood Fund Microfinance Program.* Vientiane: Ministry of Agriculture and Forestry.

smallholders, totaling 9,000, who are expected to adopt the LPS, when compared with the value added to livestock that would be obtained if the same smallholders retained the LDP system.

12. **Unquantified benefits.** The project slaughterhouses and wet market interventions will bring sector benefits in improved food safety, public health, and urban environment, through the associated development of institutional capacity for regulatory enforcement and through the proposed action to address a market failure to supply meat processed from livestock in accordance with hazard analysis and critical control points standards. A long-term impact will be the general availability of market-supplied butcher's meat processed according to food safety, public health, and environmental standards**.** Another unquantified benefit is strengthened sector institutional capacity for management of livestock development projects.

13. **Project economic viability.** The project's internal economic rate of return (EIRR) is 15%, which is above the benchmark of 12%. The net present value discounted at 12% is KN24.027 billion. The project economic viability is (i) highly sensitive to the price of fattened cattle, where a relatively small permanent drop of about 8% will send the economic yield below the 12% benchmark; (ii) is less sensitive to pig price variations; but (iii) is reasonably robust with respect to the NSLCP system adoption rate and project costs (Table 7).

Table 7. Sensitivity Tests on Project Economic Viability

Test	EIRR	Switching Value
Base Case	15.0%	
Pig price 10% lower	14.0%	31.0%
Cattle price 10% lower	10.9%	7.4%
Pig mortality 20% higher	14.8%	282.8%
Adoption 15% lower	12.5%	17.7%
Project costs 15% higher	12.8%	20.5%

Source: Asian Development Bank.

14. **Distribution analysis**. The benefits and costs of the project are shared among different groups. An assessment of the distribution of benefits and costs is presented in Table 8. The analysis indicates that the overall share of the poor to project net benefits is about 11%.

Table 8. Distribution of Benefits and Costs (in KN million)

Item	NPV (12%)	Government / Economy	Labor	Farmers	Total
Project Benefits	136,482			136,482	136,482
Project Costs					
Traded	19,550	19,550			19,550
Unskilled labor	37,162		37,162		37,162
Non-traded	55,743	55,743			55,743
Subtotal	112,455	75,293	37,162		112,455
Net benefits	24,027	(75,293)	(37,162)	136,482	24,027
Proportion of poor (%)		27%	30%	25%	
Benefits of poor		(20,329)	(11,149)	34,120	2,643
Share of poor to net benefits (%)				*11%*	

NPV = net present value
Source: Asian Development Bank estimates.

E. Construction of New Slaughterhouses

15. **Economic justification.** In 2009, Luang Prabang's sole slaughterhouse closed following a provincial government decision to put the slaughterhouse site to another use. To accommodate the processing of live cattle into meat, the provincial government allowed slaughter slabs to operate. The enforcement of food safety, health, and environmental

regulations for slaughter slab operations is lacking. Most of the traders carry out the slaughter of livestock at these slabs. Thus failure of governance has led to a market failure to supply, at full recovery of cost from the price paid by the consumer, butcher's meat that has been processed according to food safety and public health standards. Uncertainty has been created for private sector investment in slaughterhouses, where the perceived risk is of competition from a cheaper alternative that is able to avoid regulatory enforcement. The proposed intervention in Luang Prabang and Xiengkhuang will address the market failure and restore confidence among private investors in the market for slaughterhouse and butchery products meeting the proper standards.

F. Financial Sustainability Analysis

16. While some design parameters remain open for the upgrading of 2 provincial capital and 12 district wet markets, the criteria for selecting alternatives at the detailed design stage and the methodology for decisions on economic and financial aspects are included in the Project Administration Manual. The project will conduct feasibility studies with support from the loan implementation consultants. The indicative financial sustainability analysis is limited in purpose and scope to assessing if and what stakeholder resources will be available to fund ongoing costs of the facilities to allow reasonable expectation of these investments.[10]

17. **Representative slaughterhouses.** Assuming a slaughter fee comparable to the traders' current slaughter cost, the proposed slaughterhouse should recover operating costs from service fees, including a provision for meeting food safety and sanitary standards for processing butcher's meat from livestock, depreciation, and periodic maintenance. Based on the operating cost assumptions, the financial projections show a working ratio of 0.85; the operation and maintenance (O&M) cost recovery index is 1.18. When due in 2031, the first periodic maintenance carries a cost to cash balance ratio of 0.13; the cash balance is 20% of total assets. These results support a reasonable expectation of operating cost recovery. The demand for safe food products will lead to an opportunity to raise fees and create a profitable environment. Projected financial statements show that the wet market upgrades can be expected to recover all operating costs, depreciation, and periodic maintenance from incremental market rent income, with a working ratio of 0.67 and a period maintenance to cash deposit ratio of less than 0.5, which support a reasonable anticipation of financial sustainable.

18. **The meat processing training facility and laboratory.** The project will assist the Ministry of Agriculture and Forestry's (MAF) Northern Agricultural and Forestry College in Luang Prabang to develop training courses for butchering and meat processing. Demonstration facilities are needed for this new training program. The project will provide the college with a small meat processing training facility at an estimated cost of $234,900. The O&M cost is estimated at 1.5% of the total investment cost, which is roughly $3,523/year. The project will provide $71,000 worth of laboratory equipment with an estimated O&M cost of $1,065/year. MAF confirmed that it can support this through its regular budget.

19. **Other Items.** Included are equipment and materials for SLPMGS, project management vehicles and equipment, and project steering committees. The O&M costs are financially sustainable or upon project completion will not affect project sustainability (footnote 10).

[10] Supplementary Document 14, Indicative Financial Sustainability Analysis (accessible from the list of linked documents in Appendix 2 of the report and recommendation of the President).

Table 7: Analysis of Project Economic Viability

(KN 10,000)

Year	Project Benefits						Total Project Benefits	Project Costs	Net Benefit Stream
	1st Generation		2nd Generation		3rd Generation				
	Pigs	Cattle	Pigs	Cattle	Pigs	Cattle			
2014									
2015	0	0	0	0	0	0	0	22,649	(22,649)
2016	0	0	0	0	0	0	0	1,569,630	(1,569,630)
2017	9,619	(75,241)	0	0	0	0	(65,621)	2,190,404	(2,256,026)
2018	77,750	425,419	0	0	0	0	503,169	4,703,287	(4,200,118)
2019	174,938	1,498,419	0	0	0	0	1,673,357	4,362,097	(2,688,740)
2020	311,001	1,161,130	0	0	0	0	1,472,130	3,365,464	(1,893,334)
2021	311,001	1,161,130	9,619	(75,241)	0	0	1,406,509	2,068,273	(661,764)
2022	311,001	1,161,130	77,750	425,419	0	0	1,975,299	79,236	1,896,063
2023	311,001	1,161,130	174,938	1,498,419	0	0	3,145,487	79,236	3,066,252
2024	311,001	1,161,130	311,001	1,161,130	0	0	2,944,260	79,236	2,865,025
2025	311,001	1,161,130	311,001	1,161,130	9,619	(75,241)	2,878,639	79,236	2,799,403
2026	311,001	1,161,130	311,001	1,161,130	77,750	425,419	3,447,429	79,236	3,368,194
2027	311,001	1,161,130	311,001	1,161,130	174,938	1,498,419	4,617,618	79,236	4,538,382
2028	311,001	1,161,130	311,001	1,161,130	311,001	1,161,130	4,416,391	79,236	4,337,155
2029	311,001	1,161,130	311,001	1,161,130	311,001	1,161,130	4,416,391	79,236	4,337,155
2030	311,001	1,161,130	311,001	1,161,130	311,001	1,161,130	4,416,391	79,236	4,337,155
2031	311,001	1,161,130	311,001	1,161,130	311,001	1,161,130	4,416,391	79,236	4,337,155
2032	311,001	1,161,130	311,001	1,161,130	311,001	1,161,130	4,416,391	79,236	4,337,155
2033	311,001	1,161,130	311,001	1,161,130	311,001	1,161,130	4,416,391	79,236	4,337,155
2034	311,001	1,161,130	311,001	1,161,130	311,001	1,161,130	4,416,391	475,572	3,940,819
2035	311,001	1,161,130	311,001	1,161,130	311,001	1,161,130	4,416,391	79,236	4,337,155
2036	311,001	1,161,130	311,001	1,161,130	311,001	1,161,130	4,416,391	379,652	4,036,739
								EIRR	15.0%
								NPV (12%)	2,402,716

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