ECONOMIC AND FINANCIAL ANALYSIS

I. Introduction

1. The Integrated Participatory Development and Management of Irrigation Program (the program) will support the implementation of Indonesia's Irrigation Improvement Program (IIP) which advances the overarching agenda of food security and rural poverty reduction through increased agricultural water productivity. The IIP aims to: (i) rehabilitate, upgrade, and modernize irrigation schemes that serve 3.2 million hectares (ha); (ii) promote participatory irrigation management; (iii) strengthen water users associations (WUAs) participation; (iv) improve services delivery of river basin organizations and water resources agencies; and (v) improve operations and maintenance (O&M) through asset management and needs-based budgeting.

2. The successful implementation of the IIP will contribute to achieving food security and water security set under the long-term 2005–2025 National Development Plan (RPJPN)[1] and the 2015–2019 National Medium-Term Development Plan (RPJMN).[2] The implementation of the IIP is estimated to cost $9.94 billion from 2015 to 2025. The proposed program will provide $600 million to support selected sub-programs within the IIP in 74 districts across 16 provinces.[3]

3. Between 2006 and 2014, agriculture consistently contributed to between 13.0% and 15.2% of Indonesia's GDP. Although the share of the working population in agriculture has decreased from 42.0% to 34.3% over the same period, this sector still provides employment to some 24 million farm households. The national poverty rate has been reduced from 17.8% in 2006 to 10.7% in 2016, but poverty incidence falls disproportionately on the rural population, which still registers a poverty rate of 14.0%.

4. Poverty reduction is recognized as a development priority in the government's National Medium-Term Development Plan (RPJMN), which targets slashing the national poverty rate to 6–8% by 2019. Food security is another development priority in the RPJMN.[4] The government plans to improve food security through a number of strategies, including increasing rice production and promoting productive irrigation infrastructure and its sustainable management. By supporting the IIP, the program contributes directly to the government's development goals.

II. Economic Analysis

5. This economic and financial analysis assesses the economic viability and financial sustainability of the overall program. The analyses for three core sample subprojects are presented in Annex 1.

A. Major Assumptions and Methodology

6. The economic cost and benefit analysis has been conducted using the Asian Development Bank's (ADB's) *Guidelines for the Economic Analysis of Projects,*[5] and *Key Areas*

[1] Government of Indonesia. 2005. *Long-term Development Plan: RPJPN 2005-2025*. Jakarta.
[2] Government of Indonesia. 2015. *Medium-term Development Plan: RPJMN 2015-2019*. Jakarta.
[3] Conditional on the performance of the Program, an additional $400 million lending is planned for 2019.
[4] Indonesia is one of the biggest importers of cereals in Asia Pacific. Between 2006 and 2013, on average slightly over 1 million ton of rice was imported each year, and the average import value was $486.4 million.
[5] ADB. 1997. *Guidelines for Economic Analysis of Projects*. Manila.

of Economic Analysis of Investment Projects: An Overview.[6] The major assumptions of the analysis are:

(i) economic analysis is carried out over 25 years, including a 5-year implementation period;
(ii) financial costs and revenues used for the financial and economic analyses are based on prevailing prices in 2015 and are expressed in constant 2015 terms;
(iii) imputed labor and land costs are excluded in the financial analysis but are included in the economic analysis;
(iv) economic costs and benefits are valued in Indonesian Rupiah (Rp) using the domestic price level numeraire;
(v) based on analysis of import and export data, the shadow exchange rate factor (SERF) is estimated to be 1.15 using ADB's recommended practice;[7]
(vi) economic price of the main tradable commodities are estimated based on the World Bank's Commodity Price Forecasts of 28 October 2014 after adjusting border prices to farm gate prices. Rice, triple superphosphate (TSP), and potassium chloride (KCl) prices are estimated on the basis of import price parity, and urea prices are estimated based on export price parity. Estimation of economic prices of these commodities for 2015 to 2025 is shown in Annex 2, and the price for 2015, adjusted by the SERF, is used in the economic analysis;
(vii) economic costs and benefits for non-tradable agricultural inputs and agricultural outputs are derived by excluding taxes (namely valued added tax, at 10%). Economic prices of subproject costs are estimated by removing taxes and then adjusting the tradable component by the SERF of 1.15, unskilled labor costs by the shadow wage rate factor (SWRF) of 0.8; and
(viii) the economic opportunity cost of capital is 12%.

B. Economic Costs and Benefits

1. Economic Costs

7. The total program costs consist of two categories: (i) initial capital expenditures and (ii) recurrent O&M costs, as presented in Table 1. Amounting to $1,204 million, capital expenditures include direct investment activities, such as infrastructure rehabilitation and upgrading (Item 1), or irrigation asset management system (Item 2b), that generate quantifiable benefits, as well as others whose benefits are not quantified in the analysis. The financial values of these costs are presented in Table 1. The program's expenditure framework forecasts the annual O&M expenditures to be $38.6 or Rp0.52 million per hectare of rehabilitated farmland. By program completion at year 6, the annual O&M expenditures will reach $44.9 million. In addition, the annual staff and operations budget is $13.3 million. The economic values of these financial expenditures are derived by first decomposing the financial values according to three input sources (tradable, non-tradable, surplus labor) and then converting the financial values of each source using appropriate conversion factors.

[6] ADB. 2014. *Key Areas of Economic Analysis of Investment Projects: An Overview*. Manila.
[7] ADB. 2004. *Shadow Exchange Rates for Project Economic Analysis: Toward Improving Practice at the Asian Development Bank*. ERD Technical Note Series No. 11. Manila.

Table 1: Investment and O&M Costs by Components (million $)

Item	billion Rp	million $
Capital Expenditures		
1. Infrastructure rehabilitation and upgrading		
a. National schemes	8,498	629
b. Sub national schemes	5,258	389
Subtotal	13,755	**1,019**
2. O&M and management services		
a. Irrigation Commissions	40	3
b. Irrigation Asset Management System	704	52
c. Water User Associations/Federations	94	7
Subtotal	838	**62**
3. Planning and Detailed Engineering Design		
a. PSETK	91	7
b Irrigated agriculture management plans	4	0
c. Detailed engineering Design	1,558	115
d. Irrigation Manager Unit (IMU)	6	0
Subtotal	**1,659**	**123**
Total Capital Expenditures	**16,252**	**1,204**
Recurrent Costs		
4. O&M expenditures		
per ha per year	0.52 million Rp	38.6 $
Million $ per year at program maturity	606.5	44.9
5. Staffing and operations		
Million $ per year	180.0	13.3

C. Economic Benefits

8. The program will generate two streams of economic benefits: (i) improved asset management cost savings, and (ii) improved agricultural productivity owing to irrigation infrastructure rehabilitation and agricultural development.

9. **Assets management cost savings**. The irrigation management information system (IAMIS) allows for early detection of repair needs, and this brings multiple benefits. First, by directing routine O&M activities to sections of the irrigation systems where repair is most needed, the IAMIS improves budget allocation efficiency. More can be accomplished with the same amount of funding. Secondly, need-based budgeting is made possible to forecast maintenance expenditures for medium and long term (5 to 10 years) budget planning. The projections on maintenance requirement will help formulate the irrigation development management plans at the provincial and district levels. The program will also support relevant agencies at these levels to secure intra-governmental funding for scheduled maintenance. By 2021, the IAMIS coverage will extend beyond the immediate program area to cover 7.2 million hectares of Indonesia's farmland. For the analysis, the total cost savings is estimated to be 10% of the government's program expenditure allocated to irrigation infrastructure O&M.[8]

[8] Note that the O&M costs in Table 1 only cover the maintenance of irrigation infrastructure in the rehabilitated area, while the government's program O&M expenditure cover broader areas.

10. **Improved agricultural productivity**: Incremental increase in agricultural income is quantified by comparing the with-project farm income against the without-program income. This benefit category consists of two subcomponents: (i) yield improvement and (ii) increased cropping intensity. The program will contribute to the nationwide rehabilitation of irrigation schemes. Without the program, the irrigation schemes will not be otherwise rehabilitated.

11. District-level data on yield and cropping intensity were collected. These are taken as the without-program conditions. Yield and cropping intensity improvement in the program districts are differentiated by their without-program conditions. Table 2 presents the computation and several examples. The yield improvement in districts with low existing yield is greater than ones with high existing yields. For instance, in the Asahan district, with high existing yield greater than 5.0 ton/ha, the per-hectare yield is taken to be 0.2 ton/ha. In contrast, yield in the Maggarai Bara district will improve by 0.5 ton/ha from 3.8 to 4.8 ton/ha.

12. Likewise, the program will increase the cropping intensity to be no less than 180%. In districts such as Aceh Besar and Manggarai Bara, the with-program intensity will increase to 180%. There will be no change to cropping intensity in the Asahan and Bone districts whose existing intensity already exceeds 180%.

Table 2: Derivation of With-Program Yield and Cropping Intensity Estimates[a]

Yield				
Yield category	1	2	3	4
Without-project yield	<3 ton/ha	3-4 ton/ha	4-5 ton/ha	≥5 ton/ha
Improvement[b]	1.2	1.0	0.5	0.2
Cropping Intensity				
Intensity category	1	2		
Without-Proj. intensity	≥180%	<180%		
With-Proj. intensity[b]	no change	180%		

Examples

	Province	District	Yield			Cropping intensity	
			Without-Prog.	Improvement	With-Prog.	Without-Prog.	With-Prog.
1.	Aceh	Aceh Besar	4.29	0.50	4.79	156%	180%
2.	Sumatera Utara	Asahan	5.61	0.20	5.81	184%	184%
3.	Nusa Tenggara Timur	Manggarai Bara	3.75	1.00	4.75	135%	180%
4.	Sulawesi Selatan	Bone	2.21	1.20	3.41	184%	184%

[a] Without-program data are extracted from 2013-2015 district-level agriculture statistics, Central Bureau of Statistics (Badan Pusat Statistik), Indonesia.
[b] Consultant's estimates.

13. The district level estimates are weighted according to their share in the total program area and aggregated to the national level, as presented in Table 3. In the analysis, it is assumed that, during the wet season, all the program farmland will be irrigated with or without rehabilitation. During the dry season, however, the cultivation area will differ owing to a more severe water shortage in the without-rehabilitation (without-program) scenario. The benefit of cultivation area expansion will thus occur only in the dry season. The weighted cropping intensity in the program areas is 177% without the program, but is expected to increase to 195% with the program. The weighted yield is 4.9 ton/ha without the program, but is expected to increase to 5.4 ton/ha with the program.

Table 3: With- and Without-Program Cropping Intensity and Yield Estimates

Province	Program area (approximate)		Without Program[a]		With Program	
	(ha)	(%)	Cropping intensity[b] (%)	Yield[b] (ton/ha)	Cropping intensity[b] (%)	Yield[b] (ton/ha)
1. Aceh	40,874	4.0%	156%	4.54	192%	5.04
2. Sumatera Utara	19,444	1.9%	174%	5.36	194%	5.67
3. Sumatera Barat	54,083	5.2%	184%	4.98	191%	5.48
4. Sumatera Selatan	115,048	11.1%	125%	4.53	180%	5.03
5. Lampung	69,265	6.7%	149%	5.01	184%	5.39
6. Jawa Barat	140,993	13.6%	224%	5.89	209%	6.15
7. Jawa Tengah	119,264	11.5%	197%	5.51	201%	5.74
8. Jawa Timur	117,329	11.4%	201%	5.87	211%	6.07
9. Banten	31,891	3.1%	198%	5.35	199%	5.55
10. Nusa Tenggara Barat	58,737	5.7%	186%	4.88	190%	5.38
11. Nusa Tenggara Timur	36,260	3.5%	135%	3.76	180%	4.76
12. Kalimantan Barat	30,804	3.0%	107%	3.20	180%	4.27
13. Kalimantan Selatan	48,195	4.7%	109%	4.29	180%	4.93
14. Sulawesi Utara	21,272	2.1%	271%	4.39	258%	4.89
15. Sulawesi Tengah	38,704	3.7%	181%	4.49	189%	4.99
16. Sulawesi Selatan	91,141	8.8%	184%	3.57	189%	4.47
Total	1,033,305	100.0%				
Weighted average			177%	4.93	195%	5.39

[a] 2013-2015 district-level agriculture statistics, Central Bureau of Statistics (Badan Pusat Statistik), Indonesia.
[b] The provincial-level estimates are weighted averages of cropping intensity and yield in the program area districts.

14. The per-hectare financial production costs of different agricultural inputs for rice cultivation are taken from a national survey and are presented in Table 4. Major traded commodities are converted to their farm gate economic values using border parity pricing and appropriate conversion factors. The border prices are based on the World Market commodity price forecasts. Family labor is assumed to have the same value as hired labor and all labor is treated as surplus for estimation of its value. The financial values of non-traded inputs and labor are converted to their economic values using appropriate conversion factors.

15. The per-hectare crop budgets are developed for the with- and without-program scenarios. For the without-program, scenario, the revenue is computed by taking the product of expected yield (4.9 ton/ha) and rice price which fluctuates over the years. The farm costs are taken from Table 4. The difference between rice revenue and production represents the per-hectare net income of rice cultivation in the without-program scenario. A similar procedure is followed to compute the with-program income, except that the yield is augmented, and the variable farm costs are scaled upward in proportion to the expected increase in yield. The difference in the without-program and with-program net incomes represents the incremental farm income brought by the program.

Table 4: Rice Cultivation Production Cost Budget by Season (million Rp/ha)

	Without Program		With Program	
	Wet Season	Dry Season	Wet Season	Dry Season
Yield per season (ton/ha)	**4.93**	**4.93**	**5.39**	**5.39**
Yield improvement (%)	-	-	9.3%	9.3%
Cropping intensity (%)	**100%**	**77%**	**100%**	**95%**
Production Costs				
1. Seed	**0.40**	**0.30**	**0.40**	**0.30**
2. Fertilizer[a]	**1.30**	**0.60**	**1.42**	**0.66**
3. Pesticides[a]	**0.20**	**0.10**	**0.22**	**0.11**
4. Wage Workers	**4.60**	**4.60**	**4.72**	**4.72**
a. Land Processing	1.00	1.30	1.00	1.30
b. Planting and replanting	0.90	1.00	0.90	1.00
c. Maintenance	0.80	0.70	0.80	0.70
d. Fertilization	0.30	0.20	0.30	0.20
e. Pest control	0.30	0.10	0.30	0.10
f. Harvesting, threshing and transporation[a]	1.30	1.30	1.42	1.42
5. Agricultural Services	**1.60**	**0.30**	**1.60**	**0.30**
6. Lease Land	**3.80**	**1.40**	**3.80**	**1.40**
7. Rental Tools	**0.30**	**0.20**	**0.30**	**0.20**
8. Fuel[a]	**0.10**	**0.10**	**0.10**	**0.10**
9. Other[a]	**0.40**	**0.30**	**0.40**	**0.30**
Total Production Costs	**12.70**	**7.90**	**12.96**	**8.09**

[a] Marked inputs are variable costs and are adjusted in proportion to yield improvement. Central Bureau of Statistics (Badan Pusat Statistik). Paddy Cultivation Household Survey (*Hasil Pencacahan Survei Rumah Tangga Usaha Tanaman Padi*) Cultivation. https://www.bps.go.id/linkTabelStatis/view/id/1855

16. It can be expected that the full farm benefits will not materialize immediately after construction, as there will be a time lag in farmer's adaptation of better agricultural technologies or practices. To account for such a delay, the analysis includes a benefit ramp-up profile, as presented in Table 5 alongside the scheduled construction progress. The ramp-up profile is consistent with adaptation literature, which advocates a s-curve adoption pattern: 2.5% at Year 1, 13.5% at Year 2, 34% in Years 3 and 4, 16% in Year 5. Particularly, in Year 2, the economic benefit is only 2.5% of its magnitude at program completion. The cumulative benefit ramp-up gradually increases to 100% in Year 6.

Table 5: Construction Progress and Program Benefit Ramp-Up (%)

Project status	**Construction (Implementation) Phase**					**Operation Phase**
Project year	1	2	3	4	5	6-25
Construction progress	23.3%	54%	75%	89%	100%	0%
Benefit build up	2.5%	13.5%	34.0%	34.0%	16.0%	0.0%
Cumulative benefit build up	2.5%	16.0%	50.0%	84.0%	100.0%	100.0%

D. Economic Assessment

17. In present value terms the total investment costs is Rp11,317 billion, consisting of about Rp3,175 billion tradable; Rp3,865 billion non-tradable and hired skilled (scarce) labor; and Rp4,276 billion hired unskilled (surplus) labor. The O&M costs cover the rehabilitated irrigation schemes cover by the program. It amounts to Rp3,011 billion, consisting of Rp515 billion tradable, Rp1,195 billion non-tradable and hired skilled labor, and Rp1,301 billion unskilled labor. In the stakeholder analysis, the program costs are assigned to different stakeholder groups according to the aforementioned input categories.

18. At program completion (Year 6 onward), the combined effect of increased cropping intensity and yield improvement will result in an increase in farm income in the program area in the range of Rp2,800 billion per year.[9] In the initial years, the farm benefits gradually increases from 2.5% in Year 1 to 100% in Year 6. The total farm benefit stream sums to Rp15,590 billion in present value. The O&M costs savings is estimated at Rp286 billion in present value. Overall, the economic internal rate of return (EIRR) is 14.0%, and economic net present value (ENPV) at a 12% discount rate is Rp1,548 billion.

Table 6: Economic Analysis[a] (billion Rp)

Year	Investment Costs	Incremental O&M	Total Costs	Ramp-up (as % of full benefit)	Agricultural Productivity	Asset Mgmt. Cost Savings	Total Benefits	Net Benefit
1	3,245.9	9.5	3,255.4	3%	9.1	0.0	9.1	3,255.0
2	4,297.9	68.1	4,366.0	16%	156.7	1.9	158.6	4,456.5
3	2,806.6	179.4	2,986.0	50%	797.4	10.0	807.4	3,613.9
4	1,981.7	307.5	2,289.2	84%	1,844.6	25.6	1,870.3	3,852.0
5	1,431.0	426.9	1,857.9	100%	2,680.9	42.7	2,723.6	4,154.6
6	0.0	505.3	505.3	100%	2,812.6	50.5	2,863.2	2,863.2
7	0.0	505.3	505.3	100%	2,710.5	50.5	2,761.1	2,761.1
8	0.0	505.3	505.3	100%	2,595.7	50.5	2,646.2	2,646.2
9	0.0	505.3	505.3	100%	2,493.6	50.5	2,544.1	2,544.1
10	0.0	505.3	505.3	100%	2,493.6	50.5	2,544.1	2,544.1
11-25	0.0	505.3	505.3	100%	2,493.6	50.5	2,544.1	2,544.1
NPV =	-11,316.8	-3,011.3	-14,328.1	n/a	15,589.6	286.3	15,875.9	1,547.8
EIRR =								14.0%

[a] The cost and benefit streams were computed and discounted semi-annually.

19. Table 7 presents the sensitivity results, for test on (i) a 10% increase in investment costs; (ii) a 10% decrease in yield improvement; (iii) a 10% decrease in dry-season cultivation area; and (iv) a 10% increase in O&M costs. The result indicates that the economic viability is in general robust against adverse changes.

Table 7: Summary of Sensitivity Analysis of Key Variables

	ENPV	EIRR (%)	SI[a] (%)	SV[b]
Base Case	**1,548**	**14.0%**		
1. +10% investment cost	416	12.5%	-1.1	-0.9
2. -10% yield improvement	164	12.2%	-1.3	-0.8
3. -10% dry-season cultivation area	628	12.8%	-0.8	-1.2
4. -10% point O&M costs savings	1,433	13.8%	-0.1	-9.9

[a] SI = Sensitivity Indicator (ratio of % change in EIRR to % change in a variable)
[b] SV = Switching Value (% change in a variable to reduce the EIRR to the economic discount rate.

[9] The benefit stream fluctuates because of price fluctuations.

III. Financial and Sustainability Analysis

20. The government's overall program to improve irrigated agriculture in the program area is estimated to cost $1,679 million. Investments in the sector have steadily increased since 2011, especially expenditures from the central government for O&M expenditure (Table 8). The trend is likely to continue, as the IIP is a government priority. It is expected that the government will prioritize prioritized funding for this sector.

Table 8: Directorate General of Water Resources Budget Allocation, 2011–2015
(Rp million)

	2011	2012	2013	2014	2015
Irrigation Development	943,419	2,940,000	2,940,000	2,700,000	3,741,080
Irrigation Rehabilitation	1,206,669	1,500,000	1,500,000	1,540,080	3,178,740
Irrigation O&M Budget	336,000	595,000	637,100	1,164,400	1,097,400

O&M = operation and maintenance.
Source: Ministry of Public Works and Housing. 2016.

21. At the subnational level, the provision for O&M expenditure is sourced through the specific allocation funds or *Dana Alokasi Khusus* (DAK). While the DAK has not been predictable, the World Bank's Local Government and Decentralization Project is supporting improvement of subnational governments' accountability and reporting of DAK for basic infrastructure, including irrigation. The program promotes needs-based budgeting as a vehicle to optimize O&M funding allocation. To ensure long-term sustainability of the program, the government has agreed to allocate adequate funds for O&M costs of the irrigation schemes rehabilitated under the program. Overall, the program is affordable and sustainable.

IV. Distribution Analysis

22. A stakeholder analysis was undertaken in accordance with the methodology outlined in the ADB's *Guidelines for the Economic Analysis of Projects* (1997) to measure the economic costs and benefits to different stakeholder groups, which are limited to three in the analysis: (i) the Government of Indonesia, (ii) unskilled (surplus) labor, and (iii) farming households.

23. The first benefit stream, improved agricultural productivity, is estimated to be Rp15,590 billion in present value. As the direct beneficiaries, farming households in program area will earn an incremental net income of Rp12,140 billion. Indonesia is one of the biggest importers of cereals in Asia Pacific. Between 2006 and 2013, on average slightly over one million ton of rice was imported each year, and the average import value was $486.4 million. Increased rice production will reduce Indonesia's reliance on rice import and the drain on foreign exchange reserves. Evaluated at the economic shadow exchange rate, the total import savings amounts to Rp3,450 billion and is assigned to the government.

24. The program will generate a moderate savings in light repairs and rehabilitation, estimated to be Rp286 billion. The amount is split between the government (Rp229 billion) and the farming communities (Rp57 billion).

25. The Government of Indonesia is responsible for the initial investment costs (Rp13,364 billion), plus subsequent O&M costs of Rp3,615 billion. The total program costs sums to Rp17,252 billion. After netting its share of program benefits (Rp3,679 billion), the net cost is

Rp12,044 billion for the government. Hired unskilled (surplus) labor will be paid above their opportunity cost of labor. They will earn a total labor surplus of Rp1,395 billion.

26. As stated, the farming households will experience an increase in net agricultural income of Rp12,140 billion, in addition to a moderate labor savings in O&M of Rp57 billion. The total gross benefits for the farming communities is Rp12,197 billion.

Table 9: Stakeholder Analysis and Poverty Impact Analysis (Rp billion)

	Fin.	Econ.	Externality	Allocation of Externality			Total
				GoI	Labour	Farming HHs	
Project Benefits							
Improved Agricultural Productivity	-	15,590	15,590	3,450	0	12,140	15,590
Assets Management	-	286	286	229	0	57	286
Total Benefits	**-**	**15,876**	**15,876**	**3,679**	**0**	**12,197**	**15,876**
Project Costs							
Investment Costs							
Tradable	3,341	3,175	-166	3,175	0	0	3,175
Non-tradable	4,677	3,865	-812	3,865	0	0	3,865
Labour	5,346	4,276	-1,069	5,346	-1,069	0	4,276
Subtotal	13,364	11,317	-2,047	12,386	-1,069	0	11,317
O&M Costs							
Tradable	542	515	-27	515	0	0	515
Non-tradable	1,446	1,195	-251	1,195	0	0	1,195
Labour	1,627	1,301	-325	1,627	-325	0	1,301
Subtotal	3,615	3,011	-603	3,337	-325	0	3,011
Total Project Costs	**16,978**	**14,328**	**-2,650**	**15,723**	**-1,395**	**0**	**14,328**
Net Benefits	**-16,978**	**1,548**	**18,526**	**-12,044**	**1,395**	**12,197**	**1,548**

ANNEXES

Annex 1: Supplementary Economic and Financial Analyses for Three Subprojects
Annex 2: Derivation of Economic Prices for Major Traded Outputs and Inputs

Supplementary Economic and Financial Analyses for Three Subprojects

I. Introduction

1. This economic and financial analysis assesses the economic viability and financial sustainability of three sample subprojects. The methodology uses financial analyses designed to verify the sustainability of the subproject from the perspective of farming households, and standard economic cost benefit analysis for the economic assessment. Since there is no implementing institution intending to recover all or a portion of costs through increased revenues, it is not necessary to assess financial viability. However, a financial assessment is still necessary from the perspective of individual farm households who will be expected to make incremental investments in time and purchased inputs in order to obtain the expected subproject benefits. In addition the households might also be required to make incremental contributions to operation and maintenance (O&M) of the system. An analysis is required of a range of farm sizes in differing locations of the system to ensure that the proposed changes are financially sustainable and to assess how the benefits will be distributed between small, medium, and large farms.

2. The economic analysis is based on assessment of the without- and with-intervention scenarios, the former based on farming household surveys conducted in the subproject areas on October/November 2014 and the latter based on the consultant team's assessment of the benefits that are likely to be achieved following implementation of the program activities. Following assessment of these two scenarios in financial terms, the economic costs and benefits are assessed by applying standard conversion methodologies. Sensitivity tests are conducted to investigate the robustness of the subproject's economic viability. Distribution analysis are conducted to determine the allocation of project benefits to different stakeholder groups.

II. Economic Rationale

A. Karowa Subproject

3. DI Karowa is a small district irrigation scheme typical of schemes in Eastern Indonesia. While its area is 258 ha, only 200 ha are expected to benefit from the program activities. The scheme was also selected for the following reasons: (i) it is a sub-scheme which has received little or no other remedial attention; (ii) it is urgently in need of sustainable irrigation off-take control; and (iii) it is in a state of disrepair, with obvious possibilities for seasonal improvements in cropping intensity and possibly crop diversification.

4. Karowa is a typical village irrigation scheme, originally diverting flow from temporary structures in the river until sufficient support was acquired to construct the existing gabion weir and main canal. However, periodic floods exacerbated by disturbance of natural vegetation on the upper slopes have stripped the galvanized protection from gabion cages, weakening them until they fail. Consequently the weir is currently in need of reconstruction, preferably in a more permanent form than previously used. However, it is beyond the financial and technical capacity of local farmers to undertake the required work and assistance is required from the district, and possibly higher level, authorities. Investment in this subproject will increase the incomes of the farming community, which are currently extremely low; provide employment opportunities for the younger members of the community and potentially reduce population drift away from the villages; provide the opportunity for crop diversification; and improve the dietary intake of the farm households. Without project support it is highly unlikely that any of these benefits will be

achieved.

B. Mon Sukon Subproject

5. The Jambo Aye Irrigation scheme covers an existing area of 19,360 ha, according to the Draft Management Plan 2014 from the Office of the Sumatra 1 River Basin Authority of Aceh Province. A further 3,000 ha feeds the Simpang Ulim irrigation system at the lower end of the Jambo Aye main system. Apart from the 17 km of main canal, there are approximately 237 km of secondary canals under operational control of the Irrigation Service. Mon Sukon is a part of the Jambo Aye scheme with an estimated area of 1,040 ha and was selected for inclusion in the project on the basis of the following criteria: (i) it is the sub-scheme which has received least remedial attention; (ii) it is urgently in need of assistance to deal with the drainage and siltation problems. (iii) it has the least well developed farm road system and a high level of poverty, and (iv) it has a high proportion of rice paddy, as opposed to oil palm development (unlike some adjacent sub-schemes) and good potential to grow other crops, including palawija.

6. Mon Sukon is a part of a national irrigation scheme. Drainage and control of sedimentation are the foremost issues requiring attention, with additional upgrade, repair and new construction of secondary/tertiary canals, bridges and farm access roads. Since the overall scheme is still under construction, it is unlikely that the required improvements in the Mon Sukon area would qualify for additional funding without external support.

C. Lembor Subproject

7. DI Lembor scheme was identified as having dry area characteristics, in contrast to the aforementioned subprojects. In the event it was found to be only marginally drier than these schemes. The scheme has benefited from some external assistance, but insufficient to construct the necessary infrastructure required to cope with seasonal water shortages. Although some 2 m wide at take-off from WaeSele weir, most irrigation canals in the scheme are relatively narrow; their construction and repair requires manual labor, materials and light equipment only. Roads within the scheme are mostly built of cut but uneven rock which makes vehicle access slow and challenging. Water availability is the dominant constraint. In an average year the lower-most third of the irrigated area receives little or no water during the third growing season, and is sometimes water stressed even in the second growing season.

8. Significant investments are required to achieve the potential yields of the scheme and to maintain them at these levels. Such investment is beyond the capacity of the local government and community, and while the irrigation system is a national system it has not received the necessary investment from the central government. Including it in the project will ensure that the required investments are made and that the system becomes sustainable.

III. Least Cost Analysis

9. Least cost economic analysis is required to select between two or more technically feasible alternatives for achieving a specific objective and avoiding the unnecessary use of resources in project design and analysis. Given a preliminary estimate of likely investment and O&M costs for each of the alternatives, and assuming that the benefits from each approach are the same,[1] the alternative with the least economic cost over the project life, and implicitly the highest economic return can be selected for more detailed study and full economic assessment.

[1] Where benefits differ, an adjustment should be made to reflect the differences.

10. For the DI Karowa core subproject, a least cost analysis is required to determine the appropriate option for weir construction with a choice between (i) a traditional gabion weir with an expected life of 3-5 years and very low O&M costs; (ii) a capped gabion weir with an expected life of 10-15 years with higher O&M costs but an investment cost about 34% less than a new masonry weir; and (iii) a new masonry weir with the highest costs but the longest expected life. The least cost analysis was based on an investment cost of Rp4,500 million for a gabion weir, Rp6,100 for a capped gabion weir and Rp8,700 million for the concrete weir with annual operation and management (O&M) costs of 3%, 0.67% and 0.13% respectively. For the purpose of the analysis, the expected life of the weirs was assumed to be 4 years, 12 years and 25 years, respectively, with replacement at those intervals. The net present value at a 12% discount rate of the alternatives was estimated Rp11,507 million for the gabion weir, Rp7,488 million for the capped gabion weir, and Rp7,859 million for the concrete weir. The capped gabion weir was therefore selected as the least cost structure.

11. Based on the work of the team's technical specialists, no issues were identified for the DI Mon Sukon core subproject that required least cost analysis. For the DI Lembor core subproject, a least cost analysis should be conducted to determine the appropriate approach for improving irrigation to the tail of the system, which currently suffers from water shortage in the dry season. Based on the initial investigations two options were identified: (i) construction of a new weir and distribution canal in the lower part of the system; and (ii) improvements to water management in the head and middle of the system so that more water can be made available to the tail without the need for investment in relatively expensive infrastructure. From technical considerations the construction of a new weir was considered most appropriate and no least cost analysis was conducted.

IV. Subproject Costs and Benefits

A. Subproject Costs

1. Investment Costs

12. Subproject investment costs included (i) improved agricultural production and market access; (ii) improved irrigation, drainage and agricultural infrastructure; (iii) improved irrigation systems management; and (iv) improved asset management. The investment in improved irrigation system management included investments in the scheme, investments in district improvement and investments in provincial improvement. One hundred percent of the district and provincial improvements were included as subproject costs, which is consistent with the principles of a sector project since at the stage of project preparation there are no other subprojects in the district or province currently identified for inclusion in the program. Consequently, the one subproject must justify expenditures at a higher level. Investment in improved asset management was estimated on a per hectare basis based on the total anticipated investment of $95.29 million and a benefitting area of 453,000 ha, implying a cost of $210/ha.

13. The financial costs of the three subprojects are in constant 2015 values.[2] Table A1.1 presents the three subprojects' investment costs by components and subcomponents. The investment cost for the Karowa subproject was estimated at Rp15.93 billion, including Rp12.28 billion to be spent directly on the irrigation system area, Rp1.65 billion for capacity building at district level, Rp1.36 billion for capacity building at provincial level, and Rp0.64 billion for

[2] Constant values include physical contingencies but exclude price contingencies.

sustainable irrigation management through implementation of asset management. The Rp12.28 billion direct investment in the irrigation area comprises of Rp2.61 billion for agriculture development, Rp7.99 for irrigation and farm infrastructure, and Rp1.68 billion for institutional capacity building. For the Mon Sukon and Lembor subprojects, the investment costs were estimated at Rp30.68 billion and Rp43.94 billion respectively. Since the Karowa subproject requires a reconstruction of its weir, its investment cost is substantially higher than the others on a per-hectare basis, resulting in significant impact on the economic viability.

2. Operation and Maintenance Costs

14. Since there was no specific data available on O&M costs without- and with-project, the incremental cost was estimated at 5% of the proposed agricultural and infrastructure investments. This is consistent with general experience in Indonesia. The sensitivity tests included an analysis of the impact of increased O&M costs to ensure that the subproject is robust to such changes.

Table A1.1: Investment Cost by Components (Rp billion)

Subproject	**Karowa**	**Mon Sukon**	**Lembor**
Project Area	**200 ha**	**1,040 ha**	**2,365 ha**
Investment Costs[a]			
1. Direct investment	**12.28**	**24.06**	**38.22**
a. Agriculture development	2.61	6.72	12.89
b. Irrigation and farm infrastructure	7.99	14.91	18.02
c. Institutional capacity building	1.68	2.44	7.32
2. Capacity building	**3.01**	**3.30**	**3.35**
a. Kabupaten level	1.65	1.65	1.65
b. Provincial level	1.36	1.65	1.70
3. Sustainable irrigation management	**0.64**	**3.31**	**2.37**
Total Investment Costs (subproject)			
Subproject	**15.93**	**30.68**	**43.94**
Per hectare (million IDR)	**79.66**	**29.50**	**18.58**
With-project O&M Costs[b]			
As % of irrigation and farm infrastructure investment (1.b)	5%	5%	5%
With-project annual O&M	0.40	0.75	0.90

[a] Inputs composition: 25% tradable, 35% non-tradable and hire skilled (scarce) labor, and 40% hired unskilled (surplus) labor

[b] Inputs composition: 50% tradable, 10% non-tradable, and 40% unskilled (surplus) labor provided by farming households.

Source: Consultants' estimates.

B. Subproject Benefits

1. Introduction

15. Subproject benefits were estimated based on comparison of the without- and expected with-project scenarios. The without-intervention scenario was derived from household surveys of small, medium, and large farmers in the head, middle and tail of the system conducted in October/November 2014. Given its small size, the Karowa irrigation scheme is divided into two sections. The head of the Karowa irrigation system was defined as the area well served with irrigation water, while the tail was defined as the remainder of the system. For the Mon Sukon

and Lembor subprojects, the head irrigation area was defined as the 30% of the area closest to its head, the middle as the next 40%, and the tail as the bottom 30%. To facilitate on-the-ground definition of these area key features were identified that could be used as boundaries. The number and average irrigated area of different categories of survey respondents are presented in Table A1.2.

Table A1.2: Number and Irrigated Area of Survey Respondents by Farm Location and Size

Farm Location	Farm Size	Karowa (200 ha)		Mon Sukon (1,040 ha)		Lembor (2,365 ha)	
		Number of Respondents	Average irrigated area	Number of Respondents	Average irrigated area	Number of Respondents	Average irrigated area
Head	Large	22	1.43	7	1.04	5	0.75
	Medium	1	1	4	0.81	10	0.65
	Small	0	0	22	0.44	24	0.31
Middle	Large	n/a	n/a	11	1.23	1	1.00
	Medium	n/a	n/a	20	0.71	18	0.48
	Small	n/a	n/a	36	0.41	24	0.28
Tail	Large	38.00	1.51	1	2.00	4	1.00
	Medium	11.00	0.83	9	0.71	28	0.51
	Small	3.00	0.50	25	0.50	21	0.29

2. Expanded Irrigated Area

16. Without-intervention for the irrigated area of Karowa was estimated at 100 ha, with about 158 ha of the potential irrigation area currently not receiving any water. With the program, the irrigated area is expected to increase to 200 ha. About 58 ha, in the tail of the scheme might not fully benefit from the improved irrigation. The main beneficiaries of the improved water availability will be the farmers located in the tail of the system. As for the Mon Sukon and Lembor subprojects, their irrigated areas are not expected to change following subproject implementation - they will remain at 1,040 ha and 2,365 ha, respectively. The project benefits will come exclusively from improved irrigation and agriculture systems.

3. Incremental Cropping Intensity

17. Expected cropping intensities before, without and with interventions are shown in Table A1.3. For all three subprojects, the overall average cropping intensity in the without-intervention scenario is expected to remain constant as the before-project scenario. With project, the overall average cropping intensity in Karowa is expected to increase from 199% to 254%. In the head of the system, the cropping intensity is expected to remain unchanged at around 284% for large farms and 300% for medium farms. The 300% for medium farms is considered to represent the maximum potential for the cropping system. In the tail, the average cropping intensity is expected to increase from 120% to 225%. Small farmers, who are currently limited to growing a single rice crop, are expected to be able to grow at least a second rice crop, and potentially a third rice crop or a palawija crop.

18. In Mon Sukon, with intervention the overall average cropping intensity is expected to increase from 163% to 225. The cropping intensity in the head of the system is expected to increase from 165% to 225%, in the middle from 122% to 225%, and in the tail from 163% to 225%. This apparently inconsistent data most likely results from the drainage issues that have been identified in the system.

19. In Lembor, with intervention the overall average cropping intensity is expected to increase from 176% to 230%. The cropping intensity in the head of the system is expected to

increase from 199% to 231%, in the middle from 192% to 230%, and in the tail from 139% to 230%. Overall the large farms currently have a lower cropping intensity (167%) than medium farms (183%) or small farms (190%), suggesting that smaller farms are more intensively cropped, which is as expected.

Table A1.3: Subproject Impact on Cropping Intensities by Farm Location and Size (%)

Farm Location	Farm Size	Karowa (200 ha)			Mon Sukon (1,040 ha)			Lembor (2,365 ha)		
		Before Subproject	Without Subproject	With Subproject	Before Subproje	Without Subproje	With Subproje	Before Subproje	Without Subproje	With Subproje
Head	Large	283	283	284	181	181	225	180	180	230
	Medium	300	300	300	162	162	225	208	208	230
	Small	0	0	0	133	133	225	227	227	233
	Average	**288**	**288**	**288**	**165**	**165**	**225**	**199**	**199**	**231**
Middle	Large	n/a	n/a	n/a	115	115	225	200	200	230
	Medium	n/a	n/a	n/a	129	129	224	178	178	230
	Small	n/a	n/a	n/a	132	132	225	185	185	230
	Average	**n/a**	**n/a**	**n/a**	**122**	**122**	**225**	**192**	**192**	**230**
Tail	Large	127	127	225	200	200	225	125	125	230
	Medium	120	120	225	178	178	225	158	158	230
	Small	100	100	225	181	181	225	154	154	230
	Average	**120**	**120**	**225**	**192**	**192**	**225**	**139**	**139**	**230**
Overall	Large	216	216	258	171	171	225	167	167	230
	Medium	195	195	256	156	156	225	183	183	230
	Small	100	100	225	151	151	225	190	190	231
	Average	**199**	**199**	**254**	**163**	**163**	**225**	**176**	**176**	**230**

Source: Consultants estimates based on survey data.

4. Incremental Crop Yields

20. Expected rice and palawija yields before-, without-, and with- intervention by farm size and location are shown in Tables A1.4.1 to A1.4.3. Yield estimates for the before- and without-intervention scenarios are based on the summary statistics of households surveys. In the surveys, several respondents reported high rice yield exceeding 6.5 ton/ha. These influential observations overstate the average yield given the relatively small sample sizes. To be conservative, in the analysis the average yields are capped at 6.0 ton/ha per rice crop for all scenarios – in the event that the survey's averages exceed this threshold, the without-intervention yield is taken to be 6.0 ton/ha, and there is no incremental yield increase in the with- intervention scenario.

Table A1.4.1: Subproject Impact on Dry Season Rice Income by Farm Location and Size in Karowa (Rp '000)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	24,424	3,973	24,424	3,973	33,168	5,395
	Medium	27,690	1,538	27,690	1,538	36,440	2,024
	Small	0	0	0	0	0	0
	Average	**26,057**	**2,755**	**26,057**	**2,755**	**34,804**	**3,710**
Tail	Large	7,263	1,362	7,263	1,362	14,993	2,811
	Medium	46,721	2,920	46,721	2,920	46,721	2,920
	Small	0	0	0	0	27,634	2,126
	Average	**26,992**	**2,141**	**26,992**	**2,141**	**29,783**	**2,619**
Overall	Large	15,844	2,667	15,844	2,667	24,080	4,103
	Medium	37,205	2,229	37,205	2,229	41,580	2,472
	Small	0	0	0	0	27,634	2,126
	Average	**26,525**	**2,448**	**26,525**	**2,448**	**32,293**	**3,164**

Source: Consultants estimates based on survey data.

Table A1.4.2: Subproject Impact on Dry Season Rice Income by Farm Location and Size in Mun Sukon (Rp '000)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	10,823	332	11,123	341	13,073	401
	Medium	9,252	730	9,520	752	11,259	889
	Small	17,063	439	17,500	450	20,343	523
	Average	**12,379**	**500**	**12,714**	**514**	**14,892**	**604**
Middle	Large	4,725	148	4,960	155	6,489	203
	Medium	13,747	636	14,105	653	16,434	760
	Small	10,930	273	11,252	281	13,348	334
	Average	**9,801**	**352**	**10,106**	**363**	**12,090**	**432**
Tail	Large	22,040	1,075	22,040	1,075	22,040	1,075
	Medium	9,192	394	9,471	406	11,282	484
	Small	7,087	249	7,313	256	8,780	308
	Average	**12,773**	**573**	**12,941**	**579**	**14,034**	**622**
Overall	Large	12,529	518	12,708	524	13,867	560
	Medium	10,730	587	11,032	603	12,992	711
	Small	11,693	320	12,022	329	14,157	388
	Average	**11,651**	**475**	**11,921**	**486**	**13,672**	**553**

Source: Consultants estimates based on survey data.

Table A1.4.3: Subproject Impact on Dry Season Rice Income by Farm Location and Size in Lembor (Rp '000)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	26,109	2,117	26,731	2,167	29,998	2,432
	Medium	19,658	1,872	20,182	1,922	23,594	2,247
	Small	18,222	569	18,793	587	22,137	691
	Average	**21,330**	**1,519**	**21,902**	**1,559**	**25,243**	**1,790**
Middle	Large	11,000	2,750	11,320	2,830	13,400	3,350
	Medium	15,832	887	16,354	916	19,748	1,106
	Small	12,149	387	12,696	405	16,254	518
	Average	**12,994**	**1,341**	**13,457**	**1,384**	**16,467**	**1,658**
Tail	Large	18,900	2,700	19,380	2,769	22,500	3,214
	Medium	15,219	902	15,697	930	18,802	1,114
	Small	21,088	857	21,088	857	21,088	857
	Average	**18,402**	**1,486**	**18,721**	**1,518**	**20,797**	**1,728**
Overall	Large	18,670	2,522	19,144	2,589	21,966	2,999
	Medium	16,903	1,220	17,411	1,256	20,715	1,489
	Small	17,153	604	17,526	616	19,826	689
	Average	**17,575**	**1,449**	**18,027**	**1,487**	**20,836**	**1,726**

Source: Consultants estimates based on survey data.

a. Karowa Subproject

21. Rice yields in the Karowa subproject are not expected to increase under the without-intervention scenario and there is even potential for yield decline as the system is further neglected. In the with- intervention scenario, yields are expected to increase by 25%, owing to a combination of improved water availability and provision of agricultural extension services. The rate of increase in yields is expected to be rapid since farmers are experienced in producing with good water availability and will be effectively recovering to a level that was previously achievable, before the weir failed.

22. There are no palawija crops currently grown in the Karowa irrigated area. However, some maize is observed in upland areas and other palawija are grown in home plots for

household consumption. Given the relatively isolated situation of the scheme, the closest market being at the subdistrict-level township is about half an hour away. There seem to be limited potential for palawija crops without substantial marketing interventions. However, the analysis included the adoption of palawija in 25% of the irrigated area, which is considered to be the maximum achievable area. While it is likely that a range of crops will be grown, maize was selected as the single example for the analysis. For all subprojects, maize yields are proposed to be about 6.0 ton/ha, a yield that should be readily achievable.

V. Financial Analysis

A. Crop Budgets

1. Rice

23. Financial incomes from wet season rice before, without, and with interventions are shown in Table A1.5.1. The financial gross margins exclude the cost of family labor since farmers do not pay themselves or family members a wage for working on the farm. Similarly, the rental value of land is excluded from the costs even where farmers rent the land, although this is relatively rare in the subproject area. A standardized measure of income from rice is shown as the return to land and family labor, where the unit is expressed as income per day of family labor used for rice production.

a. Karowa Subproject

24. Household survey in the Karowa subproject indicates substantial differences between farm location. Without- interventions, average income from rice for farms at the head of the system is Rp19.3 million/ha, which is substantially higher than for those at the tail of the system, at Rp6.8 million. Similarly, imputed returns to land and family labor are Rp2.3 million/person-day for farms in the head of the system and Rp0.6 million/person-day for those in the tail. With the project, the gross margin is expected to increase to about Rp27.0 million in the head and to Rp27.3 million in the tail.

Table A1.5.1: Wet Season Rice Income by Farm Location and Size in Karowa (Rp '000)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	21,270	3,335	21,270	3,335	29,485	4,623
	Medium	17,405	1,243	17,405	1,243	24,483	1,749
	Small	0	0	0	0	0	0
	Average	**19,337**	**2,289**	**19,337**	**2,289**	**26,984**	**3,186**
Tail	Large	12,240	1,262	12,240	1,262	30,682	3,164
	Medium	5,685	227	5,685	227	28,662	1,146
	Small	2,466	190	2,466	190	23,702	1,823
	Average	**6,797**	**560**	**6,797**	**560**	**27,682**	**2,044**
Overall	Large	16,755	2,299	16,755	2,299	30,083	3,894
	Medium	11,545	735	11,545	735	26,573	1,447
	Small	1,233	95	1,233	95	11,851	912
	Average	**13,067**	**1,424**	**13,067**	**1,424**	**27,333**	**2,615**

Source: Consultants estimates based on survey data.

b. Mon Sukon Subproject

25. Overall, gross margins/ha from rice appear to be largely as expected – highest in the head of the system and declining towards the tail, but when considered by farm size, they are highest in the head of the system but lowest in the middle and tail. This might be due to the sample size or could reflect the actual situation. Average gross margin without interventions from rice for farms at the head of the system (Rp14.88 million/ha) is substantially more than for those in the middle of the system (Rp7.51 million/ha) or in the tail (Rp7.72 million/ha). With project, the gross margin is expected to increase to about Rp17.44 million/ha in the head, Rp9.54 million/ha in the middle, and Rp8.77 million/ha in the tail. Returns to land and labor are expected to increase to an average of Rp0.6 million/person-day in the head, Rp0.46 million/person-day in the middle and Rp0.5 million/person-day in the tail.

Table A1.5.2: Wet Season Rice Income by Farm Location and Size in Mon Sukon ('000 Rp)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	14,763	362	15,146	371	17,638	432
	Medium	12,354	882	12,722	909	15,111	1,079
	Small	16,337	267	16,769	274	19,579	320
	Average	**14,484**	**504**	**14,879**	**518**	**17,442**	**610**
Middle	Large	6,834	312	7,125	326	9,014	412
	Medium	9,015	399	9,320	412	11,306	500
	Small	5,751	148	6,091	157	8,301	213
	Average	**7,200**	**286**	**7,512**	**298**	**9,540**	**375**
Tail	Large	8,995	439	9,238	451	9,238	451
	Medium	6,732	333	6,984	345	8,620	426
	Small	6,717	234	6,948	242	8,451	295
	Average	**7,481**	**335**	**7,723**	**346**	**8,770**	**391**
Overall	Large	10,197	371	10,503	383	11,963	432
	Medium	9,367	538	9,675	555	11,679	669
	Small	9,601	216	9,936	224	12,110	276
	Average	**9,722**	**375**	**10,038**	**387**	**11,917**	**459**

Source: Consultants estimates based on survey data

c. Lembor Subproject

26. In Lembor, the average gross margin without interventions from rice for farms at the head of the system (Rp21.79 million/ha) is substantially more than for those in the middle of the system (Rp14.57 million/ha) or in the tail (Rp15.58 million/ha). Returns to land and family labor are Rp1.50 million/person-day for farms in the head of the system, Rp1.33 million/person-day for the middle of the system, and Rp0.88 million/person-day for the tail. With subproject, the gross margin is expected to increase to about Rp24.78 million/ha in the head, Rp17.56 million/ha in the middle, and Rp17.13 million/ha in the tail. Returns to land and labor are expected to increase to an average of Rp1.68 million/person-day in the head, Rp1.62 million/ person-day in the middle and Rp1.00 million/person-day in the tail.

Table A1.5.3: Wet Season Rice Income by Farm Location and Size in Lembor ('000 Rp)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	24,084	1,745	24,661	1,787	28,413	2,059
	Medium	22,066	2,102	22,654	2,157	24,220	2,307
	Small	17,488	535	18,050	552	21,702	664
	Average	**21,213**	**1,461**	**21,788**	**1,499**	**24,778**	**1,676**
Middle	Large	8,875	2,219	9,195	2,299	11,275	2,819
	Medium	18,119	1,142	18,638	1,175	22,012	1,388
	Small	15,348	509	15,887	527	19,390	643
	Average	**14,114**	**1,290**	**14,573**	**1,333**	**17,559**	**1,616**
Tail	Large	5,546	693	5,774	722	7,254	907
	Medium	16,833	1,007	17,324	1,036	20,511	1,227
	Small	23,628	892	23,628	892	23,628	892
	Average	**15,336**	**864**	**15,575**	**884**	**17,131**	**1,009**
Overall	Large	12,835	1,552	13,210	1,603	15,647	1,928
	Medium	19,006	1,417	19,538	1,456	22,248	1,641
	Small	18,822	645	19,188	657	21,573	733
	Average	**16,888**	**1,205**	**17,312**	**1,239**	**19,823**	**1,434**

Source: Consultants estimates based on survey data.

27. Tables A1.6.1 to A1.6.3 present a similar analysis of the impact of the project on dry season rice production. Where dry season rice is currently produced, the gross margin per ha and returns to land and labor are acceptable. With the improved irrigation system they will both increase.

Table A1.6.1: Dry Season Rice Income by Farm Location and Size in Karowa (Rp '000)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	24,424	3,973	24,424	3,973	33,168	5,395
	Medium	27,690	1,538	27,690	1,538	36,440	2,024
	Small	0	0	0	0	0	0
	Average	**26,057**	**2,755**	**26,057**	**2,755**	**34,804**	**3,710**
Tail	Large	7,263	1,362	7,263	1,362	14,993	2,811
	Medium	46,721	2,920	46,721	2,920	46,721	2,920
	Small	0	0	0	0	27,634	2,126
	Average	**26,992**	**2,141**	**26,992**	**2,141**	**29,783**	**2,619**
Overall	Large	15,844	2,667	15,844	2,667	24,080	4,103
	Medium	37,205	2,229	37,205	2,229	41,580	2,472
	Small	0	0	0	0	27,634	2,126
	Average	**26,525**	**2,448**	**26,525**	**2,448**	**32,293**	**3,164**

Source: Consultants estimates based on survey data.

Table A1.6.2: Dry Season Rice Income by Farm Location and Size in Mon Sukon ('000 Rp)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	10,823	332	11,123	341	13,073	401
	Medium	9,252	730	9,520	752	11,259	889
	Small	17,063	439	17,500	450	20,343	523
	Average	**12,379**	**500**	**12,714**	**514**	**14,892**	**604**
Middle	Large	4,725	148	4,960	155	6,489	203
	Medium	13,747	636	14,105	653	16,434	760
	Small	10,930	273	11,252	281	13,348	334
	Average	**9,801**	**352**	**10,106**	**363**	**12,090**	**432**
Tail	Large	22,040	1,075	22,040	1,075	22,040	1,075
	Medium	9,192	394	9,471	406	11,282	484
	Small	7,087	249	7,313	256	8,780	308
	Average	**12,773**	**573**	**12,941**	**579**	**14,034**	**622**
Overall	Large	12,529	518	12,708	524	13,867	560
	Medium	10,730	587	11,032	603	12,992	711
	Small	11,693	320	12,022	329	14,157	388
	Average	**11,651**	**475**	**11,921**	**486**	**13,672**	**553**

Source: Consultants estimates based on survey data.

Table A1.6.3: Dry Season Rice Income by Farm Location and Size in Lembor ('000 Rp)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	26,109	2,117	26,731	2,167	29,998	2,432
	Medium	19,658	1,872	20,182	1,922	23,594	2,247
	Small	18,222	569	18,793	587	22,137	691
	Average	**21,330**	**1,519**	**21,902**	**1,559**	**25,243**	**1,790**
Middle	Large	11,000	2,750	11,320	2,830	13,400	3,350
	Medium	15,832	887	16,354	916	19,748	1,106
	Small	12,149	387	12,696	405	16,254	518
	Average	**12,994**	**1,341**	**13,457**	**1,384**	**16,467**	**1,658**
Tail	Large	18,900	2,700	19,380	2,769	22,500	3,214
	Medium	15,219	902	15,697	930	18,802	1,114
	Small	21,088	857	21,088	857	21,088	857
	Average	**18,402**	**1,486**	**18,721**	**1,518**	**20,797**	**1,728**
Overall	Large	18,670	2,522	19,144	2,589	21,966	2,999
	Medium	16,903	1,220	17,411	1,256	20,715	1,489
	Small	17,153	604	17,526	616	19,826	689
	Average	**17,575**	**1,449**	**18,027**	**1,487**	**20,836**	**1,726**

Source: Consultants estimates based on survey data.

2. Secondary Crops

28. Gross margins and returns to labor for maize are shown in Tables Table A1.7.1 to A1.7.3. Since no palawija crops are currently grown, they are shown only for the with-interventions scenario, and based on the lack of data these estimates are generic.

Table A1.7.1: Subproject Impact on Main Secondary Crop Income by Farm Location and Size in Karowa ('000 Rp)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	0	0	0	0	16,393	205
	Medium	0	0	0	0	16,393	205
	Small	0	0	0	0	17,133	214
	Average	**0**	**0**	**0**	**0**	**16,639**	**208**
Tail	Large	0	0	0	0	16,393	205
	Medium	0	0	0	0	16,393	205
	Small	0	0	0	0	16,393	205
	Average	**0**	**0**	**0**	**0**	**16,393**	**205**
Overall	Large	0	0	0	0	16,393	205
	Medium	0	0	0	0	16,393	205
	Small	0	0	0	0	16,763	210
	Average	**0**	**0**	**0**	**0**	**16,516**	**206**

Source: Consultants estimates based on survey data.

Table A1.7.2: Subproject Impact on Main Secondary Crop Income by Farm Location and Size in Mon Sukon ('000 Rp)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	0	0	0	0	16,278	203
	Medium	0	0	0	0	16,373	205
	Small	0	0	0	0	16,287	204
	Average	**0**	**0**	**0**	**0**	**16,313**	**204**
Middle	Large	0	0	0	0	16,319	204
	Medium	0	0	0	0	16,311	204
	Small	0	0	0	0	16,272	203
	Average	**0**	**0**	**0**	**0**	**16,301**	**204**
Tail	Large	0	0	0	0	16,283	204
	Medium	0	0	0	0	16,290	204
	Small	0	0	0	0	16,323	204
	Average	**0**	**0**	**0**	**0**	**16,298**	**204**
Overall	Large	0	0	0	0	16,293	204
	Medium	0	0	0	0	16,293	204
	Small	0	0	0	0	16,322	204
	Average	**0**	**0**	**0**	**0**	**16,304**	**204**

Source: Consultants estimates based on survey data.

Table A1.7.3: Subproject Impact on Main Secondary Crop Income by Farm Location and Size in Lembor ('000 Rp)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	0	0	0	0	16,468	206
	Medium	0	0	0	0	16,463	206
	Small	0	0	0	0	16,455	206
	Average	**0**	**0**	**0**	**0**	**16,462**	**206**
Middle	Large	0	0	0	0	16,493	206
	Medium	0	0	0	0	16,459	206
	Small	0	0	0	0	16,461	206
	Average	**0**	**0**	**0**	**0**	**16,471**	**206**
Tail	Large	0	0	0	0	16,467	206
	Medium	0	0	0	0	16,450	206
	Small	0	0	0	0	16,447	206
	Average	**0**	**0**	**0**	**0**	**16,454**	**206**
Overall	Large	0	0	0	0	16,476	206
	Medium	0	0	0	0	16,459	206
	Small	0	0	0	0	16,457	206
	Average	**0**	**0**	**0**	**0**	**16,462**	**206**

Source: Consultants estimates based on survey data.

B. Irrigated Farm Budgets

29. Individual crop budgets and cropping intensities have been combined to generate farm budgets. The farm gross margins and returns to land and labor are summarized in Tables A1.8.1 to A1.8.3. Although there is considerable variation between the different farm categories, these seem to be consistent with expectations. The overall average gross margin is Rp35.23 million before subproject, increasing to Rp35.23 million without subproject and Rp54.62 million with subproject. Return to land and labor increases from Rp1.9 million/person-day to Rp3.2 million/person-day. Tables A1.8.2 and A1.8.3 report the expected farm incomes for Mon Sukon and Lembor.

Table A1.8.1: Subproject Impact on Irrigated Farm Incomes by Farm Location and Size in Karowa ('000 Rp)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	77,937	3,877	77,937	3,877	106,168	5,282
	Medium	30,362	1,214	30,362	1,214	42,652	1,706
	Small	0	0	0	0	0	0
	Average	**63,982**	**3,096**	**63,982**	**3,096**	**87,537**	**4,233**
Tail	Large	12,993	1,275	12,993	1,275	31,765	3,118
	Medium	10,299	529	10,299	529	26,174	1,345
	Small	822	190	822	190	7,901	1,823
	Average	**9,938**	**822**	**9,938**	**822**	**25,665**	**2,263**
Overall	Large	49,933	2,755	49,933	2,755	74,086	4,349
	Medium	18,722	817	18,722	817	33,092	1,496
	Small	822	190	822	190	7,901	1,823
	Average	**35,232**	**1,887**	**35,232**	**1,887**	**54,623**	**3,185**

Source: Consultants estimates based on survey data.

Table A1.8.2: Subproject Impact on Irrigated Farm Incomes by Farm Location and Size in Mon Sukon ('000 Rp)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	24,518	350	25,170	360	29,412	420
	Medium	14,664	828	15,096	852	17,907	1,011
	Small	9,671	296	9,925	304	11,575	355
	Average	**18,180**	**509**	**18,678**	**523**	**21,916**	**617**
Middle	Large	9,281	283	9,836	295	12,288	375
	Medium	9,536	450	9,836	464	11,788	557
	Small	3,840	179	4,023	188	5,217	244
	Average	**8,414**	**317**	**8,827**	**329**	**10,906**	**408**
Tail	Large	62,070	757	62,556	763	62,556	763
	Medium	9,875	362	10,208	374	12,374	453
	Small	6,538	250	6,755	259	8,164	313
	Average	**41,868**	**591**	**42,278**	**598**	**42,976**	**624**
Overall	Large	37,693	521	38,240	530	39,982	567
	Medium	11,490	559	11,849	576	14,177	688
	Small	6,735	244	6,954	252	8,375	305
	Average	**24,877**	**484**	**25,314**	**495**	**27,168**	**557**

Source: Consultants estimates based on survey data.

Table A1.8.3: Subproject Impact on Irrigated Farm Incomes by Farm Location and Size in Lembor ('000 Rp)

Farm Location	Farm Size	Before Subproject		Without Subproject		With Subproject	
		Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)	Gross margin (per ha)	Return to land & labor (per day)
Head	Large	33,729	1,900	34,535	1,946	39,308	2,215
	Medium	27,792	1,937	28,539	1,989	31,930	2,225
	Small	12,010	518	12,402	535	14,846	640
	Average	**27,512**	**1,662**	**28,220**	**1,705**	**32,044**	**1,931**
Middle	Large	19,875	2,484	14,895	2,564	24,675	3,084
	Medium	14,456	1,023	14,895	1,054	17,752	1,256
	Small	7,165	426	7,444	443	9,257	551
	Average	**16,374**	**1,760**	**13,702**	**1,816**	**20,333**	**2,184**
Tail	Large	10,271	1,053	10,619	1,089	12,879	1,321
	Medium	13,051	968	13,441	997	15,979	1,185
	Small	10,015	880	10,015	880	10,015	880
	Average	**11,019**	**1,002**	**11,323**	**1,030**	**13,302**	**1,212**
Overall	Large	20,161	1,805	18,696	1,859	24,377	2,206
	Medium	19,323	1,369	19,870	1,408	22,840	1,620
	Small	9,812	606	10,041	618	11,489	690
	Average	**18,172**	**1,469**	**17,614**	**1,512**	**21,746**	**1,771**

Source: Consultants estimates based on survey data.

C. Affordability and Sustainability

30. Overall, the financial analysis indicates that farming household's income will increase substantially, regardless of their farm size or location in the irrigation system. They will be able to afford any additional contributions to O&M so that the system can be sustainable in the long term.

VI. Economic Analysis

A. Major Assumptions and Methodology

31. The economic cost and benefit analysis has been conducted using the Asian Development Bank's (ADB's) *Guidelines for the Economic Analysis of Projects,*[3] and *Key Areas of Economic Analysis of Investment Projects: An Overview*.[4] The major assumptions of the analysis are:

(i) economic analysis is carried out over 25 years, including a 5-year program implementation period;
(ii) financial costs and revenues used for the financial and economic analyses are based on prevailing prices in 2015 and are expressed in constant 2015 terms;
(iii) economic costs and benefits are valued in Indonesian Rupiah (Rp) using the domestic price level numeraire;
(iv) based on analysis of import and export data, the shadow exchange rate factor (SERF) is estimated to be 1.15 using ADB's recommended practice;[5]
(v) economic price of the main tradable commodities are estimated based on the World Bank's Commodity Price Forecasts of 28 October 2014 after adjusting border prices to farm gate prices. Rice, maize, soybeans, groundnuts, triple superphosphate (TSP), and potassium chloride (KCl) prices are estimated on the basis of import price parity, and urea prices are estimated based on export price parity. Estimation of economic prices of these commodities for 2015 to 2025 is shown in Annex 1, and the price for 2015, adjusted by the SERF, is used in the economic analysis;
(vi) economic costs and benefits for non-tradable inputs and outputs are derived by excluding taxes and duties, and economic prices of subproject costs are estimated by removing taxes and then adjusting the foreign exchange component by the SERF of 1.15, unskilled labor costs by the opportunity cost of surplus labor (OCSL) of 0.8 and the skilled labor cost by the opportunity costs of scarce labor (OCSCL) of 1.0; and
(vii) the economic opportunity cost of capital is 12%.

B. Economic Costs and Benefits

1. Economic Costs

32. The total program costs consist of two categories: (i) initial investment costs and (ii) recurring O&M costs. Investment costs include direct investment activities, such as agriculture development and irrigation and farm infrastructure rehabilitation, that generate quantifiable benefits, as well as others such as capacity building whose benefits are not quantified in the analysis. While the Government of Indonesia will defray most of these costs, the farming communities are expected to provide labor for the irrigation scheme's O&M. The financial values of these costs are presented in Table 1. Their economic values are derived by first decomposing the financial values according to three input sources (tradable, non-tradable, surplus labor) and then converting the financial values of each source using appropriate

[3] ADB. 1997. *Guidelines for Economic Analysis of Projects*. Manila.
[4] ADB. 2014 *Key Areas of Economic Analysis of Investment Projects: An Overview.* Manila.
[5] ADB. 2004. *Shadow Exchange Rates for Project Economic Analysis: Toward Improving Practice at the Asian Development Bank*. ERD Technical Note Series No. 11. Manila.

conversion factors.

2. Economic Benefits

33. The program will generate two streams of economic benefits: and (i) O&M cost savings of the irrigation system and (ii) an increase in agricultural income (hereafter referred to as crop benefits) owing to irrigation infrastructure rehabilitation and agricultural development. The economic value of the asset management benefits were assessed based on the expected savings in light repairs and moderate rehabilitation. For Karowa system the financial cost savings were estimated at Rp0.6 million/ha/year, which was converted to its economic value based on the assessed material, skilled labor and unskilled labor content. The economic value was estimated at Rp0.587 million/ha/year. For both Mon Sukon and Lembor, the economic cost savings were estimated at Rp0.995 million/ha/year.

34. Crop benefit estimation is based on a comparison of the without- and the with-interventions financial crop budgets to determine the incremental increase in agricultural income. The without- interventions scenario was defined as a continuation of the current situation with double cropping of rice in the areas that receive water irrespective of the offtake and no cropping in a large area that can only be serviced if the weir is functioning. In the with-interventions scenario, the reconstruction of the weir, rehabilitation of the irrigation system, strengthening of institutional arrangements, and support for agricultural development, as described in the subproject outputs, will result in an increase in the area that is double cropped and yield increases as farmers adopt improved technologies. Potentially farmers will also grow a limited area of palawija crops, which for the purpose of analysis is taken to be maize, but farmers likely will diversity to other crops.[6]

35. Major traded commodities such as rice, maize, urea, superphosphate and potassium chloride were converted to their farm gate economics values using border parity pricing. The border prices are based on the World Market commodity price forecasts. Family labor was assumed to have the same value are hired labor and all labor was treated as surplus for estimation of its value. The financial values of non-traded inputs and labor are converted to their economic values using appropriate conversion factors.

36. It can be expected that the foreseen project benefits will not materialize immediately after construction, as there will be a time lag in farmer's adaptation of better agricultural technologies or practices. To account for such a delay, the analysis includes a benefit ramp-up profile, as presented in Table A1.9 alongside the scheduled project construction progress. The ramp-up profile is advocates a s-curve adoption pattern: 2.5% at Year 1, 13.5% at Year 2, 34% in Years 3 and 4, 16% in Year 5. Particularly, in Year 2, the economic benefit is only 2.5% of its full magnitude at program completion. The cumulative benefit ramp-up gradually increases to 100% in Year 6 – three years after the de facto construction completion.

[6] Maize was chosen since its cultivation is less water intensive, and there is a ready output market.

Table A1.9: Project Construction Progress and Benefit Ramp-Up (%)

Project status	Construction (Implementation) Phase					Operation Phase
Project year	1	2	3	4	5	6-25
Construction progress						
Karowa	59.7%	69.1%	97.8%	99.8%	100.0%	100.0%
Mun Sukon	62.3%	77.5%	98.8%	99.9%	100.0%	100.0%
Lembor	57.3%	76.9%	99.1%	99.9%	100.0%	100.0%
Benefit ramp-up						
Annual	0.0%	2.5%	13.5%	34.0%	34.0%	16.0%
Cumulative	0.0%	2.5%	16.0%	50.0%	84.0%	100.0%

C. Economic Assessment of Base Case

37. For the Karowa subproject, in present value terms the total investment costs is Rp11.63 billion, consisting of 25% tradable (Rp2.91 billion); 35% non-tradable and hired skilled (scarce) labor (Rp4.07 billion); and 40% hired unskilled (surplus) labor (Rp4.65 billion). Also in present value terms, O&M costs sums to Rp2.00 billion, consisting of 50% tradable (Rp1.00 billion); 10% non-tradable (Rp0.20 billion); and 50% unskilled labor (Rp0.80 billion) to be provided by farming households. In the stakeholder analysis, the project costs are assigned to different stakeholder groups according to the aforementioned input compositions ratios.

38. At program completion, the farming households in Karowa are expected to experience an increase in agricultural income by Rp2.65 billion per year. However, this level of benefit is not immediately achievable owing to a time lag in farmers' adaptation of better agricultural technology and services. As stated, the benefit stream will gradually increasing from 2.5% in Year 2 to 100% in Year 6. The total crop benefit stream sums to Rp14.31 billion. The O&M costs savings is estimated to be Rp590 million in present value.

39. Overall, the economic internal rate of return (EIRR) for the Karowa subproject is 13.3%, and the economic net present value (ENPV) at a 12% discount rate is Rp1.27 billon (Table A1.10.1). The computation for the EIRRs for the Mon Sukon and Lembor subprojects are reported in Tables A1.10.2 and A1.10.3. Compared to Karowa, these subproject yields substantially higher EIRRs at 26.3% and 23.8% respectively. Due to the high investment costs required for weir reconstruction, Karowa's EIRR is substantially lower than Mon Sukon or Lembor's. The finding highlights the importance of a running irrigation asset management system for any irrigation scheme, to which the project will contribute through capacity building and the upgrading of the irrigation asset management information system (IAMIS).

Table A1.10.1: Economic Analysis for Karowa (Rp million)

Project Year	Investment Cost[a]	Incremental O&M[b]	Total Cost	Ramp-up (as % of full benefit)	Total Crop Benefits	Asset Man. Benefits	Total Benefits	Net Cash Flow
1	-8,400	0	-8,400	0.0%	0	0	0	8,400
2	-1,324	0	-1,324	2.5%	-69	-69	-138	1,186
3	-4,038	0	-4,038	16.0%	-443	-443	-886	3,152
4	-282	-199	-481	50.0%	-1,385	-1,326	-2,711	-2,230
5	-32	-334	-366	84.0%	-2,326	-2,228	-4,554	-4,189
6	0	-398	-398	100.0%	-2,770	-2,652	-5,422	-5,024
7	0	-398	-398	100.0%	-2,770	-2,652	-5,422	-5,024
8-25	0	-398	-398	100.0%	-2,770	-2,652	-5,422	-5,024
ENPV =	**-11,627**	**-2,001**	**-13,629**	**n/a**	**14,309**	**590**	**14,899**	**1,271**
EIRR =								**13.3%**

[a] Inputs composition: 25% tradable, 35% non-tradable and hire skilled (scarce) labor, and 40% hired unskilled (surplus) labor.

[b] Inputs composition: 50% tradable, 10% non-tradable, and 40% unskilled (surplus) labor provided by farming

households.
Source: Consultants estimates.

Table A1.10.2: Economic Analysis for Mon Sukon (Rp million)

Project Year	Investment Cost[a]	Incremental O&M[b]	Total Cost	Ramp-up (as % of full benefit)	Total Crop Benefits	Asset Man. Benefits	Total Benefits	Net Cash Flow
1	-16,809	0	-16,809	0.0%	0	0	0	16,809
2	-4,104	0	-4,104	2.5%	-290	0	-290	3,814
3	-5,750	0	-5,750	16.0%	-1,859	0	-1,859	3,891
4	-305	-881	-1,186	50.0%	-5,810	-517	-6,327	-5,141
5	-32	-1,481	-1,512	84.0%	-9,761	-869	-10,630	-9,118
6	0	-1,763	-1,763	100.0%	-11,620	-1,035	-12,655	-10,892
7	0	-1,763	-1,763	100.0%	-11,620	-1,035	-12,655	-10,892
8-25	0	-1,763	-1,763	100.0%	-11,620	-1,035	-12,655	-10,892
ENPV =	**-22,585**	**-8,870**	**-31,456**	**n/a**	**60,035**	**5,208**	**65,243**	**33,788**
EIRR =								**26.3%**

[a] Inputs composition: 25% tradable, 35% non-tradable and skilled (scarce) labor, and 40% hired unskilled (surplus) labor
[b] Inputs composition: 50% tradable, 10% non-tradable, and 40% unskilled (surplus) labor provided by farming households.
Source: Consultants estimates

Table A1.10.3: Economic Analysis for Lembor (Rp million)

Project Year	Investment Cost[a]	Incremental O&M[b]	Total Cost	Ramp-up (as % of full benefit)	Total Crop Benefits	Asset Man. Benefits	Total Benefits	Net Cash Flow
1	-24,705	0	-24,705	0.0%	0	0	0	24,705
2	-8,475	0	-8,475	2.5%	-399	0	-399	8,076
3	-9,567	0	-9,567	16.0%	-2,553	0	-2,553	7,013
4	-367	-1,611	-1,977	50.0%	-7,979	-1,177	-9,156	-7,178
5	-32	-2,706	-2,738	84.0%	-13,405	-1,977	-15,381	-12,644
6	0	-3,222	-3,222	100.0%	-15,958	-2,353	-18,311	-15,090
7	0	-3,222	-3,222	100.0%	-15,958	-2,353	-18,311	-15,090
8-25	0	-3,222	-3,222	100.0%	-15,958	-2,353	-18,311	-15,090
ENPV =	**-35,874**	**-16,213**	**-52,087**	**n/a**	**82,449**	**11,843**	**94,292**	**42,204**
EIRR =								**23.8%**

[a] Inputs composition: 25% tradable, 35% non-tradable and skilled (scarce) labor, and 40% hired unskilled (surplus) labor.
[b] Inputs composition: 50% tradable, 10% non-tradable, and 40% unskilled (surplus) labor provided by farming households.
Source: Consultants estimates.

D. Sensitivity Analysis

40. Sensitivity analyses are conducted including (i) a 10% increase in investment costs; (ii) a 10% decrease in crop benefits; (iii) a 10% increase in O&M costs; (iv) a 10% investment cost increase combined with a 10% benefit decrease; and (v) a one year lag in benefits. Switching values and sensitivity indexes are estimated for the investment cost increase, benefit decrease, and O&M cost increase. The results of the sensitivity analyses are summarized in Table A1.11.

41. For the Karowa subproject, a 10% investment costs increase would reduce the EIRR to 11.5%, while a 10% benefit decrease would reduce the EIRR to 12.0%. The combined effect of changes in investment costs and benefit stream would further reduce the EIRR to 10.1%. A 10% increase in O&M would reduce the EIRR to 12.5%, and a one-year project delay would reduce the EIRR to 11.2%. As for the Mon Sukon and Lembor subprojects, their EIRRs well exceed the required 12% thresholds for all scenarios. Findings from the sensitivity analysis indicate that the Karowa subproject needs to be monitored more closely to ensure its economic viability.

Table A1.11: Summary of Sensitivity Analysis of Key Variables

	ENPV (IDR millions)	EIRR (%)	SI (%)	SV (%)
Karowa (200 ha)				
Base Case	**1,271**	**13.3%**		
1. 10% increase in investment costs	-482	11.5%	13.79	7%
2. 10% decrease in benefits	-35	12.0%	-10.27	-10%
3. 10% increase in O&M costs	481	12.5%	6.22	16%
4.10% increase in investment costs + 10% decrease in benefits	-1,913	10.1%	n/a	n/a
5.1 year benefit lag	-803	11.2%	n/a	n/a
Mon Sukon (1,040 ha)				
Base Case	**33,788**	**26.3%**		
1. 10% increase in investment costs	31,106	24.3%	0.79	126%
2. 10% decrease in benefits	27,361	24.0%	-1.90	-53%
3. 10% increase in O&M costs	32,956	26.0%	0.25	406%
4.10% increase in investment costs + 10% decrease in benefits	25,102	22.3%	n/a	n/a
5.1 year benefit lag	26,720	22.3%	n/a	n/a
Lembor (2,365 ha)				
Base Case	**42,204**	**23.8%**		
1. 10% increase in investment costs	38,050	21.9%	0.98	102%
2. 10% decrease in benefits	33,392	21.7%	-2.09	-48%
3. 10% increase in O&M costs	41,144	23.5%	0.25	398%
4.10% increase in investment costs + 10% decrease in benefits	29,805	20.0%	n/a	n/a
5.1 year benefit lag	32,446	20.3%	n/a	n/a

SI = sensitivity index; SV = switching value.
Source: Consultant's estimates.

E. Stakeholder Analysis

42. A stakeholder analysis was undertaken in accordance with the methodology outlined in the ADB's *Guidelines for the Economic Analysis of Projects* (1997) to measure the allocate the economic costs and benefits to different stakeholder groups, which are limited to three in the analysis: (i) the Government of Indonesia, (ii) unskilled (surplus) labor, and (iii) farming households.

43. Table A1.12.1 presents the stakeholder analysis results for the Karowa subproject. The Government of Indonesia is responsible for the initial investment costs (Rp14.43 billion), plus around 60.0% of the subsequent O&M costs (Rp1.36 billion). The total project costs sums to Rp15.79 billion for the government. The porgram will also generate a moderate savings in light repairs and rehabilitation, estimated to be Rp0.35 billion. The net project cost for the government is thus Rp15.43 billion. Unskilled (surplus) labor will be hired during program implementation and paid above their opportunity cost of labor. They will earn an economic surplus of Rp2.80 billion. Lastly, the farming households will experience a significant increase in net agricultural income of Rp14.31 billion, in addition to a moderate labor savings in O&M of Rp0.24 billion. However, they are also expected to contribute labor inputs to the irrigation scheme's O&M, estimated to be about Rp0.64 billion. The total benefit accrued to farmers is thus Rp13.90a billion. Analysis results for the Mon Sukon and Lembor subprojects are presented in Tables A1.12.2 and A1.12.3.

Table A1.12.1: Stakeholder Analysis and Poverty Impact Analysis for Karowa (Rp million)

	FNPV	ENPV	Externality	Distribution of Externlaity			Total
				Government	Labour	Farmers	
Project Benefits							
Crop benefits	-	14,309	14,309	-	-	14,309	14,309
Asset management benefits	-	590	590	354	-	236	590
Total Incremental Benefits	-	14,899	14,899	354	-	14,545	14,899
Project Costs							
Investment Costs[a]							
Tradable	(4,179)	(3,491)	688	(3,491)	-	-	(3,491)
Non-tradable	(5,851)	(4,250)	1,601	(4,250)	-	-	(4,250)
Labour	(6,687)	(3,886)	2,801	(6,687)	2,801	-	(3,886)
Total Costs	(16,716)	(11,627)	5,089	(14,428)	2,801	-	(11,627)
O&M Costs[b]							
Tradable	(1,006)	(1,157)	(151)	(1,157)	-	-	(1,157)
Non-tradable	(201)	(201)	-	(201)	-	-	(201)
Labour	(805)	(644)	161	-	-	(644)	(644)
Total O&M Costs	(2,011)	(2,001)	10	(1,358)	-	(644)	(2,001)
Project Net Benefits	**(18,728)**	**1,271**	**19,999**	**(15,432)**	**2,801**	**13,902**	**1,271**
Poverty Impact Analysis							
Proportion of Poor				20.0%	22.3%	20.0%	
Net Benefits to the Poor			319	(3,086)	625	2,780	
Poverty Impact Ratio			**25%**				

[a] Inputs composition: 25% tradable, 35% non-tradable and hire skilled (scarce) labor, and 40% hired unskilled (surplus) labor.

[b] Inputs composition: 50% tradable, 10% non-tradable, and 40% unskilled (surplus) labor provided by farming households.

Source: Consultants estimates.

Table A1.12.2: Stakeholder Analysis and Poverty Impact Analysis for Mon Sukon (Rp million)

	FNPV	ENPV	Externality	Distribution of Externlaity			Total
				Government	Labour	Farmers	
Project Benefits							
Crop benefits	-	60,035	60,035	-	-	60,035	60,035
Asset management benefits	-	5,208	5,208	3,125	-	2,083	5,208
Total Incremental Benefits	-	65,243	65,243	3,125	-	62,119	65,243
Project Costs							
Investment Costs[a]							
Tradable	8,233	(6,781)	(15,015)	(6,781)	-	-	(6,781)
Non-tradable	11,527	(8,256)	(19,782)	(8,256)	-	-	(8,256)
Labour	13,173	(7,548)	(20,721)	13,173	(20,721)	-	(7,548)
Total Costs	32,933	(22,585)	(55,518)	(1,864)	(20,721)	-	(22,585)
O&M Costs[b]							
Tradable	(4,458)	(5,126)	(669)	(5,126)	-	-	(5,126)
Non-tradable	(892)	(892)	-	(892)	-	-	(892)
Labour	(3,566)	(2,853)	713	-	-	(2,853)	(2,853)
Total O&M Costs	(8,915)	(8,870)	45	(6,018)	-	(2,853)	(8,870)
Project Net Benefits	**24,018**	**33,788**	**9,770**	**(4,757)**	**(20,721)**	**59,266**	**33,788**
Poverty Impact Analysis							
Proportion of Poor				18.0%	20.1%	18.0%	
Net Benefits to the Poor			5,638	(856)	(4,173)	10,668	
Poverty Impact Ratio			**17%**				

[a] Inputs composition: 25% tradable, 35% non-tradable and hire skilled (scarce) labor, and 40% hired unskilled (surplus) labor.

[b] Inputs composition: 50% tradable, 10% non-tradable, and 40% unskilled (surplus) labor provided by farming households.

Source: Consultants estimates.

Table A1.12.3: Stakeholder Analysis and Poverty Impact Analysis for Lembor (Rp million)

	FNPV	ENPV	Externality	Distribution of Externlaity			Total
				Government	Labour	Farmers	
Project Benefits							
Crop benefits	-	82,449	82,449	-	-	82,449	82,449
Asset management benefits	-	11,843	11,843	7,106	-	4,737	11,843
Total Incremental Benefits	-	94,292	94,292	7,106	-	87,186	94,292
Project Costs							
Investment Costs[a]							
Tradable	12,786	(10,772)	(23,557)	(10,772)	-	-	(10,772)
Non-tradable	17,900	(13,113)	(31,013)	(13,113)	-	-	(13,113)
Labour	20,457	(11,989)	(32,447)	20,457	(32,447)	-	(11,989)
Total Costs	51,143	(35,874)	(87,017)	(3,428)	(32,447)	-	(35,874)
O&M Costs[b]							
Tradable	(948)	(9,369)	(8,421)	(9,369)	-	-	(9,369)
Non-tradable	(190)	(1,629)	(1,440)	(1,629)	-	-	(1,629)
Labour	(758)	(5,214)	(4,456)	-	-	(5,214)	(5,214)
Total O&M Costs	(1,896)	(16,213)	(14,317)	(10,999)	-	(5,214)	(16,213)
Project Net Benefits	**49,247**	**42,204**	**(7,043)**	**(7,321)**	**(32,447)**	**81,972**	**42,204**
Poverty Impact Analysis							
Proportion of Poor				17.0%	22.7%	17.0%	
Net Benefits to the Poor			5,329	(1,245)	(7,362)	13,935	
Poverty Impact Ratio			**13%**				

[a] Inputs composition: 25% tradable, 35% non-tradable and hire skilled (scarce) labor, and 40% hired unskilled (surplus) labor.

[b] Inputs composition: 50% tradable, 10% non-tradable, and 40% unskilled (surplus) labor provided by farming households.

Source: Consultants estimates.

Annex 2: Derivation of Economic Prices for Major Traded Outputs and Inputs

Table A2.1: Derivation of Input Parity Price for Rice

Item	Unit	Adjust-ment	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
World market price, constant 2014 $: Thai 5% broken [a]	$/t		413	404	395	386	377	368	359	350	342	333	325
Quality differential		-10%	41	40	40	39	38	37	36	35	34	33	33
Equivalent value of Indonesian Product	$/t		372	364	356	347	339	331	323	315	308	300	293
Freight and Insurance Cost to Indonesian port	$/t		35	35	35	35	35	35	35	35	35	35	35
C.i.f value at Indonesian Port			407	399	391	382	374	366	358	350	343	335	328
Conversion to IDR b	IDR:$	12,200											
Value at Indonesian Port	IDR/kg		4,962	4,863	4,764	4,665	4,566	4,468	4,369	4,270	4,182	4,083	3,996
Port handling charges, storage & loss		5%	248	243	238	233	228	223	218	214	209	204	200
Internal handling/transport charges	IDR/kg		25	25	25	25	25	25	25	25	25	25	25
Value at wholesale market	IDR/kg		5,235	5,131	5,027	4,924	4,820	4,716	4,612	4,509	4,416	4,313	4,220
Transport costs: miller to wholesale market	IDR/kg		30	30	30	30	30	30	30	30	30	30	30
Dealer handling & processing costs	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Value at local market/mill	IDR/kg		5,155	5,051	4,947	4,844	4,740	4,636	4,532	4,429	4,336	4,233	4,140
Conversion to unmilled rice		62%	3,196	3,132	3,067	3,003	2,939	2,874	2,810	2,746	2,688	2,624	2,567
Milling cost	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Transport cost: farmgate to local miller	IDR/kg		10	10	10	10	10	10	10	10	10	10	10
Economic value at farmgate	IDR/kg		3,136	3,072	3,007	2,943	2,879	2,814	2,750	2,686	2,628	2,564	2,507

[a] Price data derived from World Bank Commodity Price Forecast, 7 July 2014.

[b] Prevailing exchange rate October 2014.

Source: Consultant's estimates

Table A2.2: Derivation of Input Parity Price for Maize

Item	Unit	Adjust-ment	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
World market price, constant 2014 $: No. 2 Yellow, FOB US Gulf port [a]	$/t		179	180	182	183	183	184	185	186	187	187	188
Quality differential		0%	0	0	0	0	0	0	0	0	0	0	0
Equivalent value of Indonesian Product	$/t		179	180	182	183	183	184	185	186	187	187	188
Freight and Insurance Cost to Indonesian port	$/t		45	45	45	45	45	45	45	45	45	45	45
C.i.f. value at Indonesian Port			224	225	227	228	228	229	230	231	232	232	233
Conversion to IDR b	IDR:$	12,200											
Value at Indonesian Port	IDR/kg		2,733	2,745	2,769	2,782	2,782	2,794	2,806	2,818	2,830	2,830	2,843
Port handling charges, storage & loss		5%	137	137	138	139	139	140	140	141	142	142	142
Internal handling, transport costs	IDR/kg		20	20	20	20	20	20	20	20	20	20	20
Value at wholesale market	IDR/kg		2,889	2,902	2,928	2,941	2,941	2,953	2,966	2,979	2,992	2,992	3,005
Transport costs local to wholesale market	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Dealer handling & processing costs	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Value at local market	IDR/kg		2,789	2,802	2,828	2,841	2,841	2,853	2,866	2,879	2,892	2,892	2,905
Transport costs: farmgate to local market	IDR/kg		10	10	10	10	10	10	10	10	10	10	10
Economic farmgate price	IDR/kg		2,779	2,792	2,818	2,831	2,831	2,843	2,856	2,869	2,882	2,882	2,895

[a] Price data derived from World Bank Commodity Price Forecast, 7 July 2014.

[b] Prevailing exchange rate October 2014.

Source: Consultant's estimates

Table A2.3: Derivation of Input Parity Price for Soybeans

Item	Unit	Adjust-ment	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
World market price, constant 2014 $: US soybeans, c.i.f Rotterdam [a]	$/t		448	449	449	449	449	448	448	447	446	446	445
Quality differential		0%	0	0	0	0	0	0	0	0	0	0	0
Equivalent value of Indonesian Product	$/t		448	449	449	449	449	448	448	447	446	446	445
Freight and Insurance Cost to Indonesian port	$/t		42	43	44	45	46	47	48	49	50	51	52
Value at Indonesian Port			490	492	493	494	495	495	496	496	496	497	497
Conversion to IDR b	IDR:$	12,200											
Value at Indonesian Port	IDR/kg		5,978	6,002	6,015	6,027	6,039	6,039	6,051	6,051	6,051	6,063	6,063
Port handling charges, storage & loss		5%	299	300	301	301	302	302	303	303	303	303	303
Internal handling, transport costs	IDR/kg		20	20	20	20	20	20	20	20	20	20	20
Value at wholesale market	IDR/kg		6,297	6,323	6,335	6,348	6,361	6,361	6,374	6,374	6,374	6,387	6,387
Transport costs local to wholesale market	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Dealer handling & processing costs	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Value at local market	IDR/kg		6,197	6,223	6,235	6,248	6,261	6,261	6,274	6,274	6,274	6,287	6,287
Transport costs: farmgate to local market	IDR/kg		10	10	10	10	10	10	10	10	10	10	10
Economic farmgate price	IDR/kg		6,187	6,213	6,225	6,238	6,251	6,251	6,264	6,264	6,264	6,277	6,277

[a] Price data derived from World Bank Commodity Price Forecast, 7 July 2014.

[b] Prevailing exchange rate October 2014.

Source: Consultant's estimates

Table A2.4: Derivation of Input Parity Price for Groundnuts

Item	Unit	Adjust-ment	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
World market price, constant 2014 $: c.i.f. Argentina [a]	$/t		2,713	2,666	2,648	2,591	2,545	2,488	2,442	2,390	2,344	2,292	2,246
Quality differential		0%	0	0	0	0	0	0	0	0	0	0	0
Equivalent value of Indonesian Product	$/t		2,713	2,666	2,648	2,591	2,545	2,488	2,442	2,390	2,344	2,292	2,246
Freight and Insurance Cost to Indonesian port	$/t		45	45	45	45	45	45	45	45	45	45	45
Value at Indonesian Port			2,758	2,711	2,693	2,636	2,590	2,533	2,487	2,435	2,389	2,337	2,291
Conversion to IDR b	IDR:$	12,200											
Value at Indonesian Port	IDR/kg		33,648	33,074	32,855	32,159	31,598	30,903	30,341	29,707	29,146	28,511	27,950
Port handling charges, storage & loss		5%	1,682	1,654	1,643	1,608	1,580	1,545	1,517	1,485	1,457	1,426	1,398
Internal handling, transport costs	IDR/kg		20	20	20	20	20	20	20	20	20	20	20
Value at wholesale market	IDR/kg		35,350	34,748	34,517	33,787	33,198	32,468	31,878	31,212	30,623	29,957	29,368
Transport costs local to wholesale market	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Dealer handling & processing costs	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Value at local market	IDR/kg		35,250	34,648	34,417	33,687	33,098	32,368	31,778	31,112	30,523	29,857	29,268
Transport costs: farmgate to local market	IDR/kg		10	10	10	10	10	10	10	10	10	10	10
Economic farmgate price	IDR/kg		35,240	34,638	34,407	33,677	33,088	32,358	31,768	31,102	30,513	29,847	29,258

[a] Price data derived from World Bank Commodity Price Forecast, 7 July 2014 and International Monetary Fund data.

[b] Prevailing exchange rate October 2014.

Source: Consultant's estimates

Table A2.5: Derivation of Export Parity Price for Urea

Item	Unit	Adjust-ment	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
World market price, constant 2014 $: E. European bulk, c.i.f. Palembang	$/t		299	293	287	281	274	268	262	257	251	245	239
Quality/Price Differential		10%	30	29	29	28	27	27	26	26	25	25	24
Equivalent value of Indonesian product	$/t		329	322	316	309	301	295	288	283	276	270	263
Freight and Insurance Cost	$/t		40	40	40	40	40	40	40	40	40	40	40
Value at Indonesian Port ex Palembang	$/t		369	362	356	349	341	335	328	323	316	310	303
Conversion to IDR b	IDR:$	12,200											
Value at Indonesian Port	IDR/kg		4,501	4,420	4,340	4,259	4,165	4,085	4,004	3,937	3,856	3,776	3,695
Port charges/internal handling	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Value at wholesale market	IDR/kg		4,551	4,470	4,390	4,309	4,215	4,135	4,054	3,987	3,906	3,826	3,745
Transport cost-wholesale to farmgate	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Economic value of fertilizer at farmgate	IDR/kg		4,601	4,520	4,440	4,359	4,265	4,185	4,104	4,037	3,956	3,876	3,795

[a] Price data derived from World Bank Commodity Price Forecast, 7 July 2014.

[b] Prevailing exchange rate October 2014.

Source: Consultant's estimates

Table A2.6: Derivation of Import Parity Price for Triple Superphosphate (TSP)

Item	Unit	Adjust-ment	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
World market price, constant 2014 $: 47% P, N. Europe/Florida [a]	$/t		389	379	370	361	351	342	333	325	316	308	299
Freight and Insurance Cost	$/t		30	30	30	30	30	30	30	30	30	30	30
Value at Indonesian Port	$/t		419	409	400	391	381	372	363	355	346	338	329
Conversion to IDR b	IDR:$	12,200											
Value at Indonesian Port	IDR/kg		5,112	4,990	4,880	4,770	4,648	4,538	4,429	4,331	4,221	4,124	4,014
Port charges	IDR/kg	5%	256	249	244	239	232	227	221	217	211	206	201
Internal handling/transport costs	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Value at wholesale market	IDR/kg		5,417	5,289	5,174	5,059	4,931	4,815	4,700	4,598	4,482	4,380	4,264
Transport cost-wholesale market to farmgate	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Economic farmgate price	IDR/kg		5,467	5,339	5,224	5,109	4,981	4,865	4,750	4,648	4,532	4,430	4,314

[a] Price data derived from World Bank Commodity Price Forecast, 7 July 2014.

[b] Prevailing exchange rate October 2014.

Source: Consultant's estimates

Table A2.7: Derivation of Import Parity Price for Potassium Chloride (KCl)

Item	Unit	Adjust-ment	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
World market price, constant 2014 $: 60% K,													
North Europe/Canada [a]	$/t		299	296	293	289	286	282	279	276	272	269	265
Freight and Insurance Cost	$/t		30	30	30	30	30	30	30	30	30	30	30
Value at Indonesian Port	$/t		329	326	323	319	316	312	309	306	302	299	295
Conversion to IDR b	IDR:$	12,200											
Value at Indonesian Port	IDR/kg		4,014	3,977	3,941	3,892	3,855	3,806	3,770	3,733	3,684	3,648	3,599
Port charges	IDR/kg	5%	201	199	197	195	193	190	188	187	184	182	180
Internal handling/transport costs	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Value at wholesale market	IDR/kg		4,264	4,226	4,188	4,136	4,098	4,047	4,008	3,970	3,919	3,880	3,829
Transport cost-wholesale market to farmgate	IDR/kg		50	50	50	50	50	50	50	50	50	50	50
Economic farmgate price	IDR/kg		4,314	4,276	4,238	4,186	4,148	4,097	4,058	4,020	3,969	3,930	3,879

[a] Price data derived from World Bank Commodity Price Forecast, 7 July 2014.

[b] Prevailing exchange rate October 2014.

Source: Consultant's estimates