

Supplementary Document 17:
Detailed Economic and Financial Analysis

DETAILED ECONOMIC AND FINANCIAL ANALYSIS

A. Introduction

1. The proposed Jalalpur Irrigation Project will enhance irrigation water supplies through the right bank of Rasul Barrage on River Jhelum. It is proposed as a non-perennial irrigation system, which will provide irrigation supplies during *kharif* season¹ (i.e., from April to October). The Project will bring areas of Tehsil Pind Dadan Khan of District Jhelum and Tehsil Khushab of District Khushab under the canal command. Two scenarios were compared to determine the economic net benefits of the project. These are the “without-project” and “with-project” scenarios. The “without-project” scenario assumes a continuation of current agricultural practices which are largely *barani* agriculture² and intermittent irrigation of wheat in *rabi* season³ and other crops in *kharif* season in areas along the river belt. The “with-project” scenario assumes increased irrigation intensities mainly during the *kharif* season due to improved water availability from new irrigation infrastructure attributable to the project. It is expected that the project would lead to (i) greater area of irrigated production of *kharif* crops; (ii) higher crop yields of *kharif* crops and wheat (due to availability of adequate soil moisture on some area); and (iii) a “shift” to the production of high-value crops.

B. Macroeconomic Assessments

2. Pakistan’s agriculture sector had modest growth from 1970–2016, where it grew by about 3.4% per annum.⁴ The highest growth rate was achieved in 1985, 1992, and 1996 at 11.0%, 10.0% and 12.0%, respectively. On the other hand, the agriculture sector experienced negative growth of -5% in 1984 and 1993, and -2% in 2001 due to severe droughts that occurred during these periods. Based on the Food and Agriculture Organization of the United Nations (FAO) data,⁵ the pattern of growth in the country’s overall real gross domestic product (GDP) has been closely linked to that of the agriculture sector, despite the declining share of the agriculture sector to the overall GDP. Even with the sector’s modest growth and declining share, it was able to contribute around 27.0% or roughly \$18.3 billion per annum in real terms to the country’s average annual \$73.0 billion real GDP at 2005 constant prices, and was able to employ more than 42.3% of the country’s labor force.

3. Pakistan’s main agricultural products are buffalo’s milk, cow’s milk, wheat, rice, and cotton. These products are mostly grown in the Indus River plain in the provinces of Punjab and Sindh, which as of 2010 accounts for roughly 55% and 19% of the country’s total agriculture production area, respectively.⁶ During 2000–2016, buffalo’s milk had the highest average contribution to the annual agricultural GDP at roughly \$5.5 billion, which is equivalent to about 19.6% of the average annual agricultural GDP of about \$28.4 billion. Over the same period, buffalo’s milk production is closely followed by those of wheat and cow’s milk. On average, these two products contributed \$4.0 billion and \$3.1 billion, which respectively represent 14.1% and 10.8% of the average annual agricultural GDP. Other major agricultural products include rice, cotton lint, sugarcane, maize, and potato.

¹ *Kharif* season refers to the rainy season, often from April to October.

² *Barani* agriculture refers to dry farming practice.

³ *Rabi* season refers to the dry or winter-spring season, often from October or November to May.

⁴ The average annual growth rate for the agricultural sector is 4% from 2000 to 2016.

⁵ Food and Agriculture Organization of the United Nations. 2015. *FAO Statistical Pocketbook*. Rome.

⁶ Government of Pakistan, Pakistan Bureau of Statistics. 2012. *Pakistan Agricultural Census 2010*. Lahore.

4. The widespread poverty in Pakistan has been rooted to the highly differentiated structure of land ownership. As of 2000, the average farm size in Pakistan is 3.1 ha, which has significantly decreased from 1973 when the average farm size is 5.3 ha.⁷ Unfortunately, land reform provisions have been absent in development plans since at least 2000. The last major attempt to redistribute land, which came after Pakistan's green revolution in the 1960s, was largely ineffective due to inefficient implementation, political turbulence, and the power wielded by large landowners who had strong political influence. This land reform policy only resulted in insecure tenancy arrangements, which prohibited long-term farm investments. In the project area, the distribution of farm area by size of farm has been computed based on the latest available data obtained from Agriculture Census Report (2010) with classification into five categories (i.e., very small [less than 2.02 ha], small [2.02-5.05 ha], medium [5.05 to 10.1 ha], large [10.1 to 20.2 ha], and very large [above 20.2 ha]). Of the total 40,033 farms in the project area, the size distribution is as follows: very small 30,178 (60.7%), small 8,143 (29.5%), medium 1,306 (7.5%), large 299 (1.6%), and very large 107 (0.7%). It indicates that about 40,032 farming families would be directly benefited from the project.⁸

C. Demand Analysis

5. On average, around 51.5% of the country's dietary energy is derived from cereals.⁹ However, the sluggish growth in the production of cereals such as rice, wheat, and maize underscores the critical need to address food insecurity issues, especially since the contribution of cereals has been declining by an annual average of 0.5%. During 1990–2015, the average annual per-capita food production value is about \$179.3, increasing at an average annual rate of 0.5%. Despite the annual increase in food production value, FAO reports that the average annual food deficit in the country is about 171.3 kcal/capita/day from 1990 to 2015. Prevalence of undernourishment has remained critical since at least 1990s with 20.0% incidence.

6. It is imperative that the productivity of the agriculture sector be improved in view of the declining per capita food supply faced by the country. During 1990–2015, the per-capita food supply decreased by an average rate of 1.1% per annum. This average decline in per capita food supply was accompanied by the volatility of domestic food prices, which is roughly 10.0% above the normal price level. The volatile domestic food prices have distorted the production decisions of farmers and hence translated into productivity losses (footnote 8).

7. Although the share of the agriculture sector to the national GDP has been on the decline, this does not necessarily suggest that the sector is less economically significant since the country's real GDP relies heavily on the performance of agriculture and its related subsectors. The imminent plateau in the sector's growth may be attributed to the obsolescence of existing agricultural technologies, inefficiency of the farm tenure system, and most especially the inadequacy of basic infrastructures such as irrigation.

8. The project area is water scarce and there is a strong demand by farmers for sustainable supply of irrigation water to increase the efficiency by which farm resources are used. Having a

⁷ Sial, M.H., Iqbal, S., and Sheikh, A.D. 2012. *Farm Size-Productivity Relationship*. Pakistan Economic and Social Review. Vol. 50, No. 2 (Winter 2012), pp. 139–162 (as reported by FAO [2001]).

⁸ ADB. 2013. *Jalalpur Irrigation Project*. Consultant's final report. Manila (TA 8404-PAK). The population of primary beneficiaries of the project is estimated at about 384,000 which includes the population of households whose major source of income is farming in target 80 villages.

⁹ FAOSTAT. 2016. *food supply-livestock and fish primary equivalent, Food and Agriculture Organization of the United Nations*. <http://faostat3.fao.org/download/FB/CL/E>

sustainable supply of irrigation water could raise the cropping intensities and crop yields, and may incentivize farmers to venture into the production of high-value crops. These changes in the agricultural production landscape could result to better and more sustainable rural incomes.

9. The favorable climate and cheap labor for growing high value crops, will help to increase the farm income in the project area. The project area is suitable for shifting towards and growing of high value crops like maize, rice, and vegetables. Net profit against the investment is much higher for these crops compared with existing low value crops. The products are in high demand all over Pakistan and could be marketed easily in the project area as well as in the nearby urban centers like Jhelum, Khushab, and Sargodah. Places such as Jhelum and the nearby vicinities of the project area have been considered important markets after shifting to production and marketing these crops.

10. At present, the only crops the project area are wheat, sorghum/millet, *kharif* oilseeds, and smaller proportion of maize, cotton, and rice. The annual production is about 25,943 ton of wheat, 1,230 ton of Bajra (millet), 86 ton of *Kharif* oilseeds, 6,478 ton of maize, 183 ton of cotton, and 608 ton of rice, which are expected to be increased to 67,767 tons; 1,741 tons; 478 tons; 194,842 tons; 14,335 tons; and 12,646 tons, respectively in “with-project” scenario at full development. In addition, the annual production of about 78,502 tons of fodders and 66,556 tons of vegetables are also expected at full project development. These increases are small proportion for Punjab province which currently contributes a very significant proportion to the national production of wheat, maize, cotton, rice, millets, and oilseeds etc. As such, incremental produces can be marketed easily even within the project area without substantial risk of saturation since these increases are not sizable from both the national and provincial scales (Table 1).

Table 1: Production Profile

Major Crops	Production 2014–2015			Project Area in 2014–2015		Project Area in 2025–2026	
	Pakistan (‘000 tons)	Punjab Province (‘000 tons)	Punjab as % of Pakistan Production	Production (‘000 tons)	% of Punjab Production	Production (‘000 tons)	% of Punjab Production
(1)	(2)	(3)	(4) = (3)/(2)*100	(5)	(6) = (5)/(3)*100	(7)	(8) = (7)/(3)*100
Maize	4,937	4,020.0	81.43%	6.48	0.16%	194.84	4.85%
Cotton	2,374	1,747.0	73.59%	0.18	0.01%	14.34	0.82%
Rice	7,003	3,648.0	52.09%	0.61	0.02%	12.65	0.35%
Bajra	295	267.4	90.64%	1.23	0.46%	1.74	0.65%
Kharif oilseeds (Sesamum)	34	25.8	75.22%	0.09	0.33%	0.48	1.86%
Wheat	25,086	19,282.0	76.86%	25.94	0.13%	67.77	0.35%

Source: Agriculture Statistics of Pakistan, 2014–2015; and consultant’s estimates.

D. Rationale for the Proposed Project Investment

11. The present condition of low yields and traditional crops in the project area is due to non-availability of adequate and quality irrigation water. The increase in cultivated area, crop intensities, and yields in the command area is not possible without developing the facilities for canal irrigation water.

12. The project area is endowed with productive fertile land and a climate that is conducive to the production of many types of food and non-food crops. In order to develop the irrigated agricultural production in the area and improve the socio-economic conditions, the government has focused on developing the canal irrigation infrastructure. Towards this end, it is planned that a new canal irrigation system (main canal and distribution) will be developed to turn the rain-fed area into full irrigation for crop cultivation.

13. An intervention such as this project is necessary because farmers, in their own private capacity, are not incentivized to invest on canal irrigation water development because of the prohibitively high financial costs. Moreover, such an investment would not generate sufficient direct financial returns for private sector investors. Since irrigation water is a “public” good, investments on irrigation development could only take off if undertaken by the government.

E. Project Scenarios

14. **“Without-Project” Scenario.** The “without project” scenario involves no intervention for the provision of irrigation water supply. Under this scenario, the area will remain dependent on sporadic rainfall and limited quantity of groundwater and there would be no change in the present level of agricultural practices, input usage, and cropped area.

15. Analysis of primary and secondary data indicates that the existing agriculture situation in the command area, cropping pattern, and intensities would remain unchanged under the rain-fed conditions without provision of regulated irrigation. This scenario is further described as follows: (i) existing cropping intensity in project command area is estimated at only 42.56% (13% in *kharif* and 29.42% in *rabi* and annuals), (ii) the principal *kharif* crops are Millet (*Bajra*) and Sorghum, (the existing farming in the command area is below the subsistence level and is unsustainable), and (iii) yield level is low due to erratic and inadequate rainfall resulting in shortage of required moisture.

16. **“With-Project” Scenario.** With provision of irrigation water supply to the existing un-irrigated command area, there would be improvement in the cropping pattern, cropping intensity, and crop yields. In this scenario, an area of 68,263 hectares, where rain-fed agriculture is being practiced will be brought under canal irrigation during *kharif* season. Timely and adequate volume of water availability for *kharif* crops will be ensured. The present level of cropping intensity will increase from 42.56% to 132.6% (90% in *kharif* and 42.5% in *rabi* and annuals). Furthermore, high value crops including cotton, maize, and vegetables will be grown alongside traditional crops such as rice, millet, and fodder, which will result in good land use practices and increased farm incomes. The available soil moisture will also improve the wheat crop production to a certain extent. In effect, this will contribute to improved environmental conditions particularly in the primary impact area and enhanced living standards in the project area. Domestic water supply would also contribute to improved environmental health of households in the beneficiary villages.

F. Major Assumptions

17. General Assumptions

- (i) Gravity irrigation by developing Jalalpur Canal Irrigation System will improve cropping intensity and crop yields;
- (ii) Estimated cropping intensity, cropped area, yields, and production for each crop under the “without-project” scenario are shown in Auxiliary Tables 1 to 4. Whereas, those for the “with-project” scenario, the same are shown in Auxiliary Tables 5 to

8. The estimates in these tables are based on the Jalalpur irrigation Project Design Advance (PDA) Consultants' agronomic studies and calculations in 2017;
- (iii) Net project benefits were calculated as the sum of the incremental net agricultural benefits obtained for all crops. The project benefits start to accrue in year 5; and
 - (iv) The economic quantification of project benefits and project costs has been carried out at the constant July 2017 price level.

18. Project Investment

- (i) The project cost includes: (a) civil works; (b) acquisition of mechanical equipment; (c) survey, study, and design; (d) command area development and allied works; (e) conduct of training and workshops; (f) contracting of consulting services; and (g) land resettlement and acquisition. Other costs include those of (a) project management office and project implementation office salaries, (b) office accommodation, (c) operations and maintenance equipment, and (d) office/vehicle for operation and maintenance activities. Detailed estimate of the project cost was based on the PDA work conducted in 2017; and
- (ii) The total investment cost was assumed to phase over six years, starting year 1. The phasing of investment cost follows the schedule below (Table 2).

Table 2: Phasing of Investment Cost (%)

	Year						Total
	1	2	3	4	5	6	
Share of total investment (%)	29	23	24	14	6	4	100

19. For operation and maintenance costs, (i) operation and maintenance (O&M) costs of the project arise from the operations of the gravity irrigation system; (ii) the estimated (O&M) cost in financial terms is Rs.370 million per year—an equivalent of Rs. 336 million in economic terms. These unit values were based on the PDA estimates in 2017; O&M cost initially will be nominal and will comprise operating cost plus fraction of estimated maintenance cost; (iii) annual real increase in maintenance costs has been computed at 10% per annum; and (iv) the O&M is assumed after hiring the operational staff and would be started from Year 5 of the Project.

20. Assumptions Used in Converting Financial into Economic Values, Estimating Economic Parameters

- (i) The world price numeraire was used to derive the export and import parity prices and the standard conversion factor (SCF);
- (ii) An SCF of 0.908 was used to convert a financial price into its economic price for non-tradable goods (see Annex Table 1 for the derivation). Data used in the derivation of the SCF were obtained from the various local sources;
- (iii) A shadow wage rate factor (SWRF) of 0.76 was used for unskilled labor (see Annex Table 2 for the derivation). Data used in the derivation of the SWRF were obtained from the Economic Survey of Pakistan and Pakistan Bureau of Statistics;
- (iv) Specific conversion factors for cement, steel, petroleum products, and insecticides have also been derived for converting the values in economic terms (see Annex Table 3 for derivation);
- (v) Export parity prices have been derived for rice and cotton, which are the major export commodities of Pakistan;
- (vi) Import parity prices have been derived for wheat, sugarcane, and fertilizer inputs (i.e. urea, di-ammonium phosphate, potassium chloride). Data used in the derivation of export and import parity prices were obtained from the latest available

World Bank Commodity Prices (June 2017), various issues of economic survey and PDA estimates. Necessary adjustments have been made to account for transport and handling between port and market as well as quality differences. (See Annex Tables 4 to 10 for detailed derivations of parity prices);

- (vii) For domestic prices, wholesale prices (crop outputs and seed prices) prevailing in major commodity markets of project area (Khushab, Pind Dadan Kahn) during respective harvesting periods has been collected and adjusted to the farm gate by deducting marketing costs between the farm and the market (see Table 3 for detailed prices of crop outputs and inputs used for deriving the economic crop budgets);
- (viii) A discount rate of 9% was considered as the opportunity cost of capital; and
- (ix) The cash flows have been drawn in the local currency: Rupees (Rs). The Rs-\$ exchange rate of \$1.0 = Rs105 was used in the economic analysis.

Table 3: Financial and Economic Prices

Crop Inputs	Description	Unit	Financial Price	Conversion Factor	Economic Price
Seeds	Cotton (Seed -Cotton)	Rs./Kg	135	0.908	122.61
	Rice (Paddy)	Rs./Kg	130	0.908	118.07
	Bajra	Rs./Kg	35	0.908	31.79
	Sorghum	Rs./Kg	40	0.908	36.33
	Maiz	Rs./Kg	450	0.908	408.69
	KH Oilseed (sesamum)	Rs./Kg	150	0.908	136.23
	Kh. Pulses (moong)	Rs./Kg	120	0.908	108.98
	Kh. Vegetables(Tinda)	Rs./Kg	1,500	0.908	1,362.29
	Kh. Fodder	Rs./Kg	40	0.908	36.33
	Gowara	Rs./Kg	40	0.908	36.33
	Wheat	Rs./Kg	50	0.908	45.41
	Rabi Oilseeds	Rs./Kg	55	0.908	49.95
	Rb. Pulses (Gram)	Rs./Kg	55	0.908	49.95
	Potato	Rs./Kg	20	0.908	18.16
	Rb. Vegetables (Turnip)	Rs./Kg	2,000	0.908	1,816.39
	Condiments (Onion)	Rs./Kg	5,000	0.908	4,540.97
	Rb.Fodder (Barseem)	Rs./Kg	200	0.908	181.64
	Sugarcane	Rs./Kg	2	0.908	1.82
	Orchards(Citrus)	Rs/Plant	75.0	0.908	68.11
	Ploughing Charges	Ploughing Charges	Rs/Plough/ha	1,977	0.760
Planking Charges	Planking Charges	Rs/Plough/ha	988	0.760	752.52
Ridging	Ridging	Rs/Ridging/ha	3,954	0.760	3,010.09
Pesticides	Spray Charges	Rs/Spray/ha	1,350	0.950	1,285.71
Fertilizer	N-Urea	Rs/Kg	62	**	55.00
	P-DAP	Rs/Kg	85	**	86.29
	K-Potash	Rs/Kg	93	**	58.89
	Zink-Zn	Rs/Kg	0		0.00
Manure	F Yard Manure	Rs/Kg	1	0.908	0.91

Crop Inputs	Description	Unit	Financial Price	Conversion Factor	Economic Price
Labor	Hired Labor	Rs/M.days	500	0.760	379.17
	Family Labor	Rs/M.days	500	0.760	379.17

Crop Outputs	Description	Unit	Financial Price	Conversion Factor	Economic Price
	Cotton (Seed -Cotton)	Rs./Kg	72.72	**	69.80
	Rice (Paddy)	Rs./Kg	35.75	**	44.57
	Bajra	Rs./Kg	25.54	0.908	23.19
	Sorghum	Rs./Kg	30.98	0.908	28.14
	Maiz	Rs./Kg	23.53	0.908	21.37
	KH Oilseed (sesamum)	Rs./Kg	123.60	0.908	112.25
	Kh. Pulses (moong)	Rs./Kg	75.07	0.908	68.18
	Kh. Vegetables(Tinda)	Rs./Kg	26.38	0.908	23.96
	Kh. Fodder	Rs./Kg	3.82	0.908	3.47
	Gowara	Rs./Kg	29.40	0.908	26.70
	Wheat	Rs./Kg	29.04	**	27.24
	Rabi Oilseeds	Rs./Kg	74.34	0.908	67.51
	Rb. Pulses (Gram)	Rs./Kg	65.83	0.908	59.78
	Potato	Rs./Kg	12.82	0.908	11.64
	Rb. Vegetables (Turnip)	Rs./Kg	7.79	0.908	7.07
	Condiments (Onion)	Rs./Kg	14.97	0.908	13.59
	Rb.Fodder (Barseem)	Rs./Kg	3.62	0.908	3.29
	Sugarcane	Rs./Kg	3.80	**	4.61
	Orchards(Citrus)	Rs./Kg	27.20	0.908	24.70

Crop By-Products	Description	Unit	Financial Price	Conversion Factor	Economic Price
	Cotton Sticks	Rs./Kg	3.00	0.908	2.72
	Maize stalks	Rs./Kg	2.00	0.908	1.82
	Wheat Straw	Rs./Kg	8.50	0.908	7.72
	Rice Straw	Rs./Kg	4.00	0.908	3.63
	Jawar / Bajra	Rs./Kg	3.00	0.908	2.72
	Jawar / Bajra	Rs./Kg	3.00	0.908	2.72

** Border/Parity Prices Used

Source: Local prices were based on consultant's survey of project area markets.

21. Assumptions Used in Calculating the Opportunity Cost of Land to be acquired for the Project. The Project is to resettle residents and commercial entities from lands that would fall within the project area. The economic value of resettlement was based on crop compensations, rebuilding of commercial and residential structures, allowances for the restoration of livelihoods, and other cost associated with the rebuilding of the residential and commercial areas. Details of the derivation of these associated costs are shown in Annex Table 11. Moreover, the Project would also acquire tracts of agricultural land. The economic value of the acquired agricultural land

was calculated as the forgone net economic value from the land's highest and best agricultural use. The cropping pattern and area harvested of the agricultural land based on its highest and best use in agriculture is shown in Annex Tables 12 to 15.

G. Project Costs

22. **Capital Costs.** Total capital costs, based on engineering designs, have been estimated at Rs32,722 million, which includes a physical contingency of Rs953 million (Table 4). Duties and taxes were estimated at Rs3,602 million. The Project's base cost including physical contingencies was converted into respective project economic cost using appropriate conversion factors. In economic terms, the total capital cost amounts to Rs21,928 million (Table 5).

Table 4: Summary of Project Financial Cost

Description	Cost Component		Total (Million Rs)	Equiv. Mill US\$
	Local (Million Rs.)	Foreign (Million Rs.)		
A. Project Components				
OUTPUT 1: Jalalpur irrigation distribution system established	24,721.55	2,063.37	26,784.91	255.09
OUTPUT 2: Water-use Skill Improved in Project Area	4,374.07	-	4,374.07	41.66
OUTPUT 3: Farm Management Capacity Improved in Project Area	610.09	-	610.09	5.81
B. Base Cost	29,705.70	2,063.37	31,769.07	302.56
Physical Contingencies 3% of Base Cost	891.00	62.00	953.07	9.08
Sub-total A+B	30,597.00	2,125	32,722	311.64
C. Price Escalation				
(@ 6% on local component and @2% on foreign component)	3,005.55	65.65	3,071.00	29.25
Sub-total C	33,602.00	2,191.00	35,793.00	340.89
D. Financing Charges				
IDC @ 2.584% on ADB Loan		2,407.39	2,407.00	22.93
Commitment Charges @ 0.15% of Undisbursed Loan Amount		91.82	92.00	0.88
Sub-total D	-	2,499.00	2,499.00	23.80
Grand Total (A+B+C+D)	33,602.00	4,690.00	38,293.00	364.69

Source: Consultants' estimates, 2017.

Table 5: Derivation of the Economic Value of the Total Project Cost
(Rs. Million)

i) Project Base Cost	31,769.01
ii) Physical Contingencies	953.07
iii) Adjusted Project Base Costs Including Physical Contingencies	32,722.08
iv) Foreign Component of Adjusted Project Cost	2,178.55
v) Local Component of Adjusted Project Cost	30,543.53
vi) Less Duties & Taxes	3,602.93
vii) Net Local Component of Adjusted Project Cost	26,940.60
viii) Local Component Cost Adjusted at Economic Prices (See Below)	19,749.84
Total Economic Costs [(iv)+(viii)]	21,928.39

Local Component Derivation	At Market Prices	Conversion Factors	Adjusted at Economic Prices
I. Land Acquisition, Resettlement & Environmental Cost	5,382.27	0.00	1,032.00*
II. Materials			
Steel	1,220.85	0.88	1,074.35
Cement	1,619.25	0.61	987.74
Others	12,250.74	0.91	11,126.06
Sub-Total:	15,090.83		13,188.14
III. Labor			
Skilled	2,587.00	1.00	2,587.00
Unskilled	3,880.50	0.76	2,942.70
Sub-Total:	6,467.50		5,529.70
IV. Total Local Component	26,940.60		19,749.84

*Land acquisition cost was separately dealt as opportunity cost. Financial resettlement and environment costs converted to economic terms.

Source: Consultant's estimates.

23. **Operation and Maintenance Costs.** The annual incremental O&M cost in financial terms for the irrigation system is Rs370 million, which is equivalent to \$3.52 million. Relevant SCF and SWRF have been applied to convert the financial O&M costs into their economic equivalence. In economic terms, the annual O&M cost for the irrigation system is Rs.330.70 million (or \$3.15 million). The O&M is assumed after hiring the operational staff and would be started from Year 5 of the Project. Conservatively, the annual real increase in maintenance costs has also been computed at 10% per annum and accounted for in the cash flows (Annex Table 16).

H. Project Benefits

24. **Quantified Benefits.** The chief quantified benefits of the Project are incremental net returns from the production of different crops during the *kharif* season and wheat crop in *rabi* season. These benefits would arise from (i) greater irrigated area (intensity) of *kharif* crops through the provision of canal water irrigation coverage to the currently rain-fed lands, (ii) increase in crop yields due to better water availability, and (iii) the shifting of crop cultivation from low value to high value crops. In addition, the agricultural benefits will also accrue due to improved long-run

farm and water management, availability of reliable irrigation water supply. The details have been shown in the consolidated cash flow (Annex Table 16).

25. The net incremental benefits have been estimated at the crop level by developing per-hectare crop budgets of all crops under both the without and with-project scenarios.

26. **Un-quantified Benefits.** Aside from the improved productivity of irrigated crops arising from the availability of reliable irrigation water supply, additional agricultural benefits may be generated due to the “shift” in land use from being rain-fed to being fully irrigated. However, the actual pattern of the potential shift is unknown until the Project’s interventions have been completed and until farmers have completely adapted to such a shift in land use.

I. Economic Analysis and Estimated Results

27. **Approach and Methodology.** A benefit-cost analysis has been undertaken to measure the following economic viability criteria: the economic internal rate of return (EIRR) and the economic net present value (ENPV). All costs and benefits have been valued in economic terms by converting the financial values by appropriately using the SCF for non-tradable goods while export/import parity prices have been derived separately for each major tradable good.

28. The analysis estimated the net incremental economic benefits attributable to the Project by comparing the net economic benefits in the “without-project” scenario with that of the “with-project” scenario using a 9% discount rate. The net incremental benefits were estimated at the crop level for each crop considered in the Project.

29. **Economic Returns and Sensitivity Analysis.** Construction of the Project envisages developing irrigated agriculture in the currently un-irrigated below subsistence farming in the Project’s command area. The socio-economic condition of beneficiary farming communities will change for the better. It is estimated that with the provision of regulated irrigation due to project interventions, the cropping intensity will increase from 42.6% to 132.6%. In other words, the annual cropped area will increase from 29,025 ha to 90,522 ha. The yields are expected to increase by between 12% and 141% for the existing crops. The cropping pattern will be diversified with the inclusion of high value crops which are possible to grow only under regulated irrigation supplies. All these development interventions will enhance productivity and increase farm income. Thus, the Project is deemed economically viable given the calculated overall EIRR of 15.2% and the overall ENPV of PRs16,563 million (Table 6). These strong economic results are due to the substantial size of the economic benefit stream relative to the least cost engineering options for the project cost. The consolidated cash flow is shown in Annex Table 16.

30. The future, however, may not perfectly follow the project assumptions on the engineering cost estimates, agricultural productivity improvements, prices, and the project schedule. It is useful to examine, in particular, project risks and check their effects on the economic viability of the Project. The effects of some of these risks on the economic viability of the Project are shown in Table 6 and explained subsequently.

Table 6: Results of Economic Analysis and Sensitivity Analysis

Results of Evaluation	Change	ENPV (Rs million)	EIRR	Sensitivity Indicator (SI)	Switching Value (SV)
Base Case		16,563	15.2%		
Sensitivity Scenarios					
Case 1 - Increase in Capital Costs	+10%	14,790	14.1%	1.1	93%
Case 2 - Increase in O&M Costs	+10%	16,386	15.1%	0.1	929%
Case 3 - Combined Case 1 and 2	as above	14,579	14.1%	1.3	74%
Case 4 - Decrease in Overall Benefit	-10%	12,922	13.9%	2.8	36%
Case 5 - Benefit Delay by 2 years	-2 yrs	10,720	12.5%	5.4	18%
Case 6 - Combination of Cases 3 & 4	as above	10,939	12.9%	5.1	19%

EIRR = economic internal rate of return; ENPV = economic net present value; n.a = not applicable; SI - sensitivity indicator, the ratio that compares percentage change in ENPV with percentage change in a variable; SV - switching value, the percentage change in a variable sufficient to reduce ENPV to zero.

Source: Asian Development Bank estimates.

31. **Case 1 - Increase in Capital Costs:** To see how vulnerable the economic returns may be to higher construction costs, a 10% increase in capital costs has been considered in the sensitivity analysis. This cost increase causes the EIRR to fall to 14.1%. The level of increase in capital cost at which the EIRR would be equal to the hurdle rate of 9% is 93%. **Case 2 - Increase in O&M Costs:** A 10% increase in O&M costs causes a small change in the EIRR. The level of increase in total O&M cost at which the EIRR would be equal to the hurdle is 929%. **Case 3 - Combination of Cases 1 and 2:** Combination of Cases 1 and 2 will cause the EIRR to fall to 14.1%. **Case 4 - Decrease in Overall Benefit:** A 10% decrease in overall benefits will cause the EIRR to fall to 13.9%. The percentage decrease in the overall project benefit at which the EIRR would be equal to the hurdle rate is 36%. **Case 5 - Two-year Benefit Delay:** A two-year delay in the realization of project benefits will cause the EIRR to fall to 12.5%. **Case 6 - Combination of Cases 3 and 4:** Combination of Cases 3 and 4 will cause the EIRR to fall to 12.9%. Annex Table 17 provides detailed sensitivity tests.

32. The sensitivity analysis indicates that the economic viability of the Project is most sensitive to the two-year delay in the realization of benefits. Therefore, it is essential that the Project is implemented as scheduled through the provision of technical and extension support to the project beneficiaries. It is also important that system maintenance be carried out as required to ensure that the benefits can materialize as estimated during the expected period.

J. Project Benefit Distribution and Poverty Impact

33. **Household Financial Returns.** From the perspective of farm households, the incremental irrigated area would generate an average annual benefit of around \$688 per ha due to project investments in irrigation (non-perennial). With an average farm size of 1.01 ha (footnote 6) in the command areas and average rural family size of six people (footnote 6), a farm household is expected to get an income increase of about \$685 per annum, whereas per capita income in the project beneficiary household will increase by about \$116 per annum.

34. **Distribution of Project Benefits and Poverty Impact.** The distribution of economic benefits and costs over and above financial revenues and expenses are estimated to determine the extent to which public investment policy can affect the share that the various sectors derive from the Project. Table 7 presents the result of the benefit distribution analysis. The project poverty impact ratio is estimated at 48.0% (Table 8).

Table 7: Distribution of Economic Benefits

(Rs. million)

Description	Financial Present Value	Economic Present Value	Economic less Financial	Distribution of Project Benefits			
				Gov.	Economy	Labor	Farmers
Total Benefits	132.7	36,396.7	36,264.0				36,264.0
Capital Costs	30,940.1	18,070.2	(12,869.9)				
O&M costs	2,717.6	1,922.8	(794.8)				
Project Costs:							
• Traded	6,058.4	3,570.2	(2,488.2)		2,488.2		
• Skilled labor	3,365.8	1,983.4	(1,382.3)			1,382.3	
• Unskilled labor	4,712.1	2,776.8	(1,935.3)			1,935.3	
• Non-traded	19,521.4	11,503.8	(8,017.6)		8,017.6		
Total Costs	33,657.7	19,834.2	(13,823.5)				
Net Benefits	(33,525.0)	16,562.6	50,087.5	(33,525.0)			
			Gains/Losses	(33,525.0)	10,505.8	3,317.6	36,264.0

Source: Asian Development Bank estimates.

Table 8: Poverty Impact Analysis

(Rs million)

Particulars	Govt/ Economy	Labor	Farmers	Total
Benefits (Losses)	10,505.8	3,317.6	36,264.0	50,087.5
Financial Return to Government	(33,525.0)			(33,525.0)
Total Benefits (Losses)	(23,019.1)	3,317.6	36,264.0	16,562.6
Proportion of the Poor (%)*	22.3%	75.2%	29.2%	
Benefits to the Poor	(5,133.3)	2,493.9	10,589.1	7,949.7
Poverty Impact Ratio (%)				48.0%

Source: Asian Development Bank estimates.

***Govt'/Economy:** World Bank. 2014. *World Development Indicators*. <http://data.worldbank.org/data-catalog/world-development-indicators>; **Labor:** NASIR, Z.M. 2001. *Poverty and Labor Market Linkages in Pakistan, Micro Impact of Macroeconomic Adjustment Policies (MIMAP) Technical Paper Series No. 7*, Pakistan Institute of Development Economics, Islamabad, Pakistan; **Farmers:** United National Development Program. 2011. *Khyber Pakhtunkhwa Millennium Development Goals*. Peshawar.

K. Sources Used to Estimate Crop-Related Parameters**35. Land use Data:**

- (i) Revenue department data 2008–2009 to 2012–2013 for project villages, Tehsil Pind Dadan Khan District Jhelum and Tehsil Khushab District Khushab
- (ii) Land Utilization Statistics 2010–2011, Directorate of Agriculture, Crop Reporting Services Punjab, Lahore for District Jhelum and Khushab.
- (iii) Soil studies report ADB TA 8404 PAK - Preparing Jalalpur Irrigation project 2014.

36. Farm area, number of farms and average farm size by categories, Land Tenure System and Fragmentation of farms:

- (i) Pakistan Census of Agriculture, Punjab Province (2010) for District Jhelum and Khushab

37. Existing, Without and With Project Development (Cropping Pattern & intensities, Crop yield & Production and Cultural Practices):

- (i) Cropping (Jinswara) data from Revenue Department, Tehsil Pind Dadan Khan District Jhelum and Tehsil Khushab District Khushab (2008–2009 to 2012–2013);

- (ii) Agriculture Statistics, published by Directorate of Agriculture, Crop Reporting Services, Punjab Lahore (2008–2009 to 2012–2013);
- (iii) Field survey of the project area by consultants (2014 & 2017);
- (iv) Consultation with technical staff of Agriculture Support Services through Assistant Directors (Agri. Extension) Pind Dadan Khan and Khushab;
- (v) Participation of progressive farmers practicing irrigated farming on river Jhelum and rain fed area;
- (vi) Development Statistics, Punjab 2014, Bureau of Statistics Planning & Development Department, Government of Punjab, Pakistan;
- (vii) Previous feasibility study of Jalapur canal conducted during 1992-93 and updated by National Development Consultants (NDC) in 2008;
- (viii) Expected impact on crop agronomy due to improved irrigation supplies with project interventions regarding crop yields, cropping pattern, cultural practices and farm inputs reviewed based on adjacent irrigated areas of Lower Chenab Canal (LCC) New Khanki Barrage, Design and Monitoring Framework/Project Performance Monitoring System from 2011–2012 to 2014–2015;
- (ix) Historical cropping and yield trend in Jhelum and surrounding irrigated areas of Lower Chenab Canal (2004–2005 to 2012–2013) for projection of yield and cropped area based on Agriculture Statistics, published by Directorate of Agriculture, Crop Reporting Services, Punjab Lahore;
- (x) Previous Feasibility Studies and Design of New Barrage at Khanki with Storage and Power, Punjab, Pakistan (2007–2008). Feasibility Study Mailsi Syphon Project, Punjab, Pakistan (2007-08). Rehabilitation of Lower Chenab Canal East Punjab, Pakistan (1999). Feasibility Study Second Irrigation and Drainage Sukh Beas / Lower Bari Doab Canal Project, Punjab, Pakistan (1995). Souvenir, Punjab Agriculture (2006), published by Ayub Agricultural Research Institute, Faisal Abad Agriculture Department, Government of the Punjab; and
- (xi) Water availability/ irrigation supplies data from Punjab Irrigation Department from 1992–2012.

38. **Crop Water Requirements:**

- (i) The climatic input data (air temperature, relative humidity, sunshine hours, rainfall and wind speed) for Jhelum climatic station from 1981-2010 obtained from Pakistan Meteorology Department to compute evapotranspiration (ET_o).
- (ii) Crop growth development stages data about the sowing and harvesting time of different proposed crops collected from Department of Agriculture, Ayub Agriculture Research Institute, Faisalabad; Rice Research Institute, Kala Shah Kaku, Pakistan Agricultural Research Council, Islamabad and Barani Agriculture Research Institute Chakwal and interview of project farmers then developed by using FAO 24 paper.
- (iii) To estimate the effective precipitation U.S. Bureau of Reclamation method is used.
- (iv) To predict the potential ET_o Modified Penman-Monteith method is used through FAO Cropwat 8.0 program.

AUXILIARY AND ANNEX TABLES

(SUPPORTED BY DETAILED MS EXCEL MODEL – AVAILABLE UPON REQUEST)

Auxiliary Table 1: Cropping Intensities 'Without' Project - (Intensity in Percent)

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5 & Onward
Kharif						
Cotton	0.5	0.5	0.5	0.5	0.5	0.5
Rice (Basmati)	0.5	0.5	0.5	0.5	0.5	0.5
Bajra	5.0	5.0	5.0	5.0	5.0	5.0
Sorghum	2.7	2.7	2.7	2.7	2.7	2.7
Maize	1.4	1.4	1.4	1.4	1.4	1.4
Oilseeds	0.4	0.4	0.4	0.4	0.4	0.4
Pulses	0.1	0.1	0.1	0.1	0.1	0.1
Vegetables	0.1	0.1	0.1	0.1	0.1	0.1
Fodder	1.8	1.8	1.8	1.8	1.8	1.8
Gowara	0.6	0.6	0.6	0.6	0.6	0.6
Kh. Total	13.0	13.0	13.0	13.0	13.0	13.0
Rabi						
Wheat	23.0	23.0	23.0	23.0	23.0	23.0
Oilseeds	1.3	1.3	1.3	1.3	1.3	1.3
Pulses	1.6	1.6	1.6	1.6	1.6	1.6
Potato	1.5	1.5	1.5	1.5	1.5	1.5
Vegetables	0.1	0.1	0.1	0.1	0.1	0.1
Condiments	0.0	0.0	0.0	0.0	0.0	0.0
Fodder	1.8	1.8	1.8	1.8	1.8	1.8
Rb. Total	29.3	29.3	29.3	29.3	29.3	29.3
Perennial						
Sugarcane	0.03	0.03	0.03	0.03	0.03	0.03
Orchards	0.05	0.05	0.05	0.05	0.05	0.05
Pr. Total	0.1	0.1	0.1	0.1	0.1	0.1
Annual	42.6	42.6	42.6	42.6	42.6	42.6

Source: Project Design Advance surveys, analysis, and estimates.

Auxiliary Table 2: Cropped Area 'Without' Project (Area in Hectares)

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5 & Onward
<i>Kharif</i>						
Cotton	315.3	315.3	315.3	315.3	315.3	315.3
Rice (Basmati)	366.3	366.3	366.3	366.3	366.3	366.3
Bajra	3,430.9	3,430.9	3,430.9	3,430.9	3,430.9	3,430.9
Sorghum	1,846.4	1,846.4	1,846.4	1,846.4	1,846.4	1,846.4
Maize	932.8	932.8	932.8	932.8	932.8	932.8
Oilseeds	276.3	276.3	276.3	276.3	276.3	276.3
Pulses	71.6	71.6	71.6	71.6	71.6	71.6
Vegetables	54.3	54.3	54.3	54.3	54.3	54.3
Fodder	1,234.6	1,234.6	1,234.6	1,234.6	1,234.6	1,234.6
Gowara	376.5	376.5	376.5	376.5	376.5	376.5
Kh.Total	8,905.0	8,905.0	8,905.0	8,905.0	8,905.0	8,905.0
<i>Rabi</i>						
Wheat	15,669.1	15,669.1	15,669.1	15,669.1	15,669.1	15,669.1
Oilseeds	896.6	896.6	896.6	896.6	896.6	896.6
Pulses	1,112.6	1,112.6	1,112.6	1,112.6	1,112.6	1,112.6
Potato	1,027.5	1,027.5	1,027.5	1,027.5	1,027.5	1,027.5
Vegetables	42.0	42.0	42.0	42.0	42.0	42.0
Condiments	15.7	15.7	15.7	15.7	15.7	15.7
Fodder	1,256.8	1,256.8	1,256.8	1,256.8	1,256.8	1,256.8
Rb.Total	20,020.4	20,020.4	20,020.4	20,020.4	20,020.4	20,020.4
<i>Perennial</i>						
Sugarcane	17.35	17.35	17.35	17.35	17.35	17.35
Orchards	32.66	32.66	32.66	32.66	32.66	32.66
Pr.Total	50.0	50.0	50.0	50.0	50.0	50.0
Annual	29,025.4	29,025.4	29,025.4	29,025.4	29,025.4	29,025.4

Source: Project Design Advance surveys, analysis, and estimates.

Auxiliary Table 3: Crop Yields 'Without' Project (Kg/Hectare)

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5 & Onward
Kharif						
Cotton	581	584	587	590	593	596
Rice (Basmati)	1,660	1,668	1,676	1,685	1,693	1,702
Bajra	358	358	358	358	358	358
Sorghum	529	529	529	529	529	529
Maize	6,945	6,980	7,014	7,050	7,085	7,120
Oilseeds	312	312	312	312	312	312
Pulses	281	281	281	281	281	281
Vegetables	7,562	7,562	7,562	7,562	7,562	7,562
Fodder	7,917	7,917	7,917	7,917	7,917	7,917
Gowara	404	404	404	404	404	404
Kh.Total						
Rabi						
Wheat	1,656	1,672	1,689	1,706	1,723	1,740
Oilseeds	451	451	451	451	451	451
Pulses	549	549	549	549	549	549
Potato	17,547	17,722	17,899	18,078	18,259	18,442
Vegetables	15,016	15,016	15,016	15,016	15,016	15,016
Condiments	14,851	14,851	14,851	14,851	14,851	14,851
Fodder	21,542	21,628	21,649	21,736	21,823	21,910
Rb.Total						
Perennial						
Sugarcane	39,030	39,030	39,030	39,030	39,030	39,030
Orchards	8,971	9,060	9,151	9,242	9,335	9,428
Pr.Total						
Annual						

Source: Project Design Advance surveys, analysis, and estimates.

Auxiliary Table 4: Crop Production 'Without' Project (Production in Tons)

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5 & Onward
<i>Kharif</i>						
Cotton	183.1	184.0	185.0	185.9	186.8	187.7
Rice (Basmati)	608.0	611.0	614.1	617.1	620.2	623.3
Bajra	1,229.8	1,229.8	1,229.8	1,229.8	1,229.8	1,229.8
Sorghum	977.1	977.1	977.1	977.1	977.1	977.1
Maize	6,478.1	6,510.5	6,543.0	6,575.7	6,608.6	6,641.7
Oilseeds	86.1	86.1	86.1	86.1	86.1	86.1
Pulses	20.1	20.1	20.1	20.1	20.1	20.1
Vegetables	410.9	410.9	410.9	410.9	410.9	410.9
Fodder	9,774.1	9,774.1	9,774.1	9,774.1	9,774.1	9,774.1
Gowara	152.0	152.0	152.0	152.0	152.0	152.0
Kh.Total	19,919.3	19,955.7	19,992.2	20,028.9	20,065.8	20,102.9
<i>Rabi</i>						
Wheat	25,942.9	26,202.3	26,464.4	26,729.0	26,996.3	27,266.3
Oilseeds	404.7	404.7	404.7	404.7	404.7	404.7
Pulses	611.0	610.3	610.3	610.3	610.3	610.3
Potato	18,030.0	18,210.3	18,392.4	18,576.3	18,762.1	18,949.7
Vegetables	631.3	631.3	631.3	631.3	631.3	631.3
Condiments	233.3	233.3	233.3	233.3	233.3	233.3
Fodder	27,074.0	27,182.2	27,209.4	27,318.3	27,427.5	27,537.3
Rb.Total	72,927.2	73,474.5	73,945.9	74,503.3	75,065.6	75,632.9
<i>Perennial</i>						
Sugarcane	677.1	677.1	677.1	677.1	677.1	677.1
Orchards	293.0	295.9	298.9	301.8	304.9	307.9
Pr.Total	970.0	973.0	975.9	978.9	981.9	985.0
Annual	93,816.5	94,403.2	94,913.9	95,511.1	96,113.3	96,720.7

Source: Project Design Advance surveys, analysis, and estimates.

Auxiliary Table 5: Cropping Intensities 'With' Project - (Intensity in Percent)

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5 & Onward
<i>Kharif</i>						
Cotton	0.5	6.3	10.6	15.0	15.0	15.0
Rice (Basmati)	0.5	4.1	6.8	9.5	9.5	9.5
Bajra	5.0	4.2	3.6	3.0	3.0	3.0
Sorghum	2.7	2.4	2.2	2.0	2.0	2.0
Maize	1.4	15.4	26.0	36.5	36.5	36.5
Oilseeds	0.4	1.0	1.5	2.0	2.0	2.0
Pulses	0.1	0.9	1.4	2.0	2.0	2.0
Vegetables	0.1	4.0	7.0	10.0	10.0	10.0
Fodder	1.8	5.1	7.5	10.0	10.0	10.0
Gowara	0.6	0.0	0.0	0.0	0.0	0.0
Kh.Total	13.0	43.5	66.8	90.0	90.0	90.0
<i>Rabi</i>						
Wheat	23.0	25.8	29.7	36.1	36.1	36.1
Oilseeds	1.3	1.3	1.3	1.3	1.3	1.3
Pulses	1.6	1.5	1.5	1.5	1.5	1.5
Potato	1.5	1.5	1.5	1.5	1.5	1.5
Vegetables	0.1	0.1	0.1	0.1	0.1	0.1
Condiments	0.0	0.0	0.0	0.0	0.0	0.0
Fodder	1.8	1.9	1.9	1.9	1.9	1.9
Rb.Total	29.3	32.2	36.0	42.5	42.5	42.5
<i>Perennial</i>						
Sugarcane	0.03	0.03	0.03	0.03	0.03	0.03
Orchards	0.05	0.05	0.05	0.05	0.05	0.05
Pr.Total	0.1	0.1	0.1	0.1	0.1	0.1
Annual	42.6	75.9	103.0	132.6	132.6	132.6

Source: Project Design Advance surveys, analysis, and estimates.

Auxiliary Table 6: Cropped Area 'With' Project - (Area in Hectares)

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5 & Onward
Kharif						
Cotton	315.3	4,288.0	7,263.7	10,239.4	10,239.4	10,239.4
Rice (Basmati)	366.3	2,817.4	4,651.2	6,485.0	6,485.0	6,485.0
Bajra	3,430.9	2,900.8	2,474.3	2,047.9	2,047.9	2,047.9
Sorghum	1,846.4	1,641.7	1,503.5	1,365.3	1,365.3	1,365.3
Maize	932.8	10,534.6	17,725.2	24,915.9	24,915.9	24,915.9
Oilseeds	276.3	711.3	1,038.3	1,365.3	1,365.3	1,365.3
Pulses	71.6	588.3	976.8	1,365.3	1,365.3	1,365.3
Vegetables	54.3	2,763.7	4,795.0	6,826.3	6,826.3	6,826.3
Fodder	1,234.6	3,476.6	5,151.4	6,826.3	6,826.3	6,826.3
Gowara	376.5	0.0	0.0	0.0	0.0	0.0
Kh.Total	8,905.0	29,722.3	45,579.4	61,436.4	61,436.4	61,436.4
Rabi						
Wheat	15,669.1	17,625.6	20,257.1	24,642.8	24,642.8	24,642.8
Oilseeds	896.6	896.6	896.6	896.6	896.6	896.6
Pulses	1,112.6	1,112.6	1,112.6	1,112.6	1,112.6	1,112.6
Potato	1,027.5	1,027.5	1,027.5	1,027.5	1,027.5	1,027.5
Vegetables	42.0	42.0	42.0	42.0	42.0	42.0
Condiments	15.7	15.7	15.7	15.7	15.7	15.7
Fodder	1,256.8	1,256.8	1,256.8	1,256.8	1,256.8	1,256.8
Rb.Total	20,020.4	21,976.9	24,608.3	28,994.1	28,994.1	28,994.1
Perennial						
Sugarcane	17.35	17.35	17.35	17.35	17.35	17.35
Orchards	32.66	32.66	32.66	32.66	32.66	32.66
Pr.Total	50.0	50.0	50.0	50.0	50.0	50.0
Annual	29,025.4	51,749.2	70,237.7	90,480.5	90,480.5	90,480.5

Source: Project Design Advance surveys, analysis, and estimates.

Auxiliary Table 7: Crop Yields 'With' Project (Kg/Ha)

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5 & Onward
<i>Kharif</i>						
Cotton	581	786	958	1,121	1,261	1,400
Rice (Basmati)	1,660	1,732	1,793	1,851	1,901	1,950
Bajra	358	481	585	683	766	850
Sorghum	529	597	654	708	754	800
Maize	6,945	7,164	7,347	7,522	7,671	7,820
Oilseeds	312	321	329	337	343	350
Pulses	281	330	370	409	442	475
Vegetables	7,562	8,109	8,569	9,006	9,378	9,750
Fodder	7,917	8,812	9,565	10,282	10,891	11,500
Gowara	404	0	0	0	0	0
Kh.Total						
<i>Rabi</i>						
Wheat	1,656	1,929	2,159	2,378	2,564	2,750
Oilseeds	451	451	451	451	451	451
Pulses	549	549	549	549	549	549
Potato	17,547	17,722	17,899	18,078	18,259	18,442
Vegetables	15,016	15,016	15,016	15,016	15,016	15,016
Condiments	14,851	14,851	14,851	14,851	14,851	14,851
Fodder	21,542	21,628	21,649	21,736	21,823	21,910
Rb.Total						
Perennial						
Sugarcane	39,030	39,030	39,030	39,030	39,030	39,030
Orchards	8,971	9,060	9,151	9,242	9,335	9,428
Pr.Total						
Annual						

Source: Project Design Advance surveys, analysis, and estimates.

Auxiliary Table 8: Crop Production 'With' Project (Production in Tons)

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5 & Onward
<i>Kharif</i>						
Cotton	183.1	3,368.9	6,956.2	11,483.4	12,909.3	14,335.2
Rice (Basmati)	608.0	4,880.8	8,341.0	12,005.9	12,325.8	12,645.7
Bajra	1,229.8	1,396.3	1,446.4	1,398.5	1,569.6	1,740.7
Sorghum	977.1	979.9	982.9	966.5	1,029.3	1,092.2
Maize	6,478.1	75,465.7	130,234.4	187,428.2	191,135.2	194,842.3
Oilseeds	86.1	228.4	341.8	460.0	468.9	477.8
Pulses	20.1	194.1	361.9	558.7	603.6	648.5
Vegetables	410.9	22,410.8	41,085.8	61,478.1	64,017.1	66,556.1
Fodder	9,774.1	30,637.3	49,273.2	70,185.3	74,343.7	78,502.1
Gowara	152.0	0.0	0.0	0.0	0.0	0.0
Kh.Total	19,919.3	139,562.1	239,023.7	345,964.5	358,402.5	370,840.6
<i>Rabi</i>						
Wheat	25,942.9	34,004.3	43,736.3	58,598.9	63,183.4	67,767.8
Oilseeds	404.7	404.7	404.7	404.7	404.7	404.7
Pulses	611.0	610.3	610.3	610.3	610.3	610.3
Potato	18,030.0	18,210.3	18,392.4	18,576.3	18,762.1	18,949.7
Vegetables	631.3	631.3	631.3	631.3	631.3	631.3
Condiments	233.3	233.3	233.3	233.3	233.3	233.3
Fodder	27,074.0	27,182.2	27,209.4	27,318.3	27,427.5	27,537.3
Rb. Total	72,927.2	81,276.5	91,217.8	106,373.2	111,252.6	116,134.4
<i>Perennial</i>						
Sugarcane	677.1	677.1	677.1	677.1	677.1	677.1
Orchards	293.0	295.9	298.9	301.8	304.9	307.9
Pr. Total	970.0	973.0	975.9	978.9	981.9	985.0
Annual	93,816.5	221,811.6	331,217.5	453,316.5	470,637.1	487,960.0

Source: Project Design Advance surveys, analysis, and estimates.

Annex Tables
Annex Table 1: Derivation of Standard Conversion Factor

No.	Description/Years	2010–2011	2011–2012	2012–2013	2013–2014	2014–2015	Average
1	Total Imports*	3,455,286	4,009,093	4,349,879	4,630,521	4,644,152	4,217,786
2	Total Exports*	2,120,847	2,110,605	2,366,478	2,583,463	2,397,513	2,315,781
3	Import Duties**	187,695	219,597	242,989	244,947	308,950	240,836
4	Sales Tax on Imports**	308,648	430,399	429,831	495,330	553,028	443,447
5	Subsidies on Imports***	20,200	49,198	10,000	30,000	23,700	26,620
6	Export Duties**	5,685	5,762	6,832	6,595	6,361	6,247
7	Export Rebates**	8,527	8,453	10,362	8,732	9,091	9,033

$$\text{Standard Conversion Factor (SCF)} = \frac{M + X}{(M+Tm)+(X-TX)} = \frac{6,533,567}{7,194,016}$$

$$= \mathbf{0.908}$$

M = CIF Value of Imports
X = FOB value of Exports
TM= Net Value of Taxes on Imports
TX= Net Value of Taxes on Exports

* Economic Survey 2015-16

**FBR Year Book 2014-15

*** Ministry of Finance, Islamabad

Annex Table 2: Shadow Wage Rate Factor for Unskilled Labor

Wage Rates for Unskilled Labor (PKR per Day)						
Years	LAHORE	R.PINDI	PESHAWAR	KARACHI	QUETTA	PAKISTAN
1998	118.00	101.00	76.00	156.00	95.00	109.20
1999	128.00	110.00	80.00	160.00	108.00	117.20
2000	145.00	118.00	83.00	170.00	110.00	125.20
2001	145.00	120.00	90.00	183.00	100.00	127.60
2002	145.00	120.00	90.00	183.00	100.00	127.60
2003	145.00	123.33	90.00	182.71	112.09	130.63
2004	146.25	135.42	90.00	183.83	114.58	134.02
2005	194.58	196.95	143.34	226.16	181.25	188.46
2006	209.79	199.52	146.67	228.08	190.64	194.94
2007	241.52	243.75	174.30	264.84	258.33	236.55
2008	259.08	282.99	202.78	318.75	300.00	272.72
2009	300.00	300.00	236.11	352.08	300.00	297.64
2010	312.50	322.92	275.00	375.00	300.00	317.09
2011	362.50	364.59	300.00	375.00	358.34	352.09
2012	406.25	400.00	345.75	447.92	418.75	403.73

Source: Pakistan Bureau of Statistics.

Wage Rate for Agriculture Labor (PKR per Day)			Shadow Wage Rate Factor	
Years	Financial	Economic	Years	Ratio*
1998	91.20	81.62	1998	0.75
1999	99.20	88.49	1999	0.76
2000	105.20	95.00	2000	0.76
2001	105.60	95.57	2001	0.75
2002	105.60	96.84	2002	0.76
2003	110.00	100.87	2003	0.77
2004	130.00	119.60	2004	0.89
2005	150.00	138.00	2005	0.73
2006	150.00	138.00	2006	0.71
2007	200.00	182.00	2007	0.77
2008	200.00	184.00	2008	0.67
2009	225.00	204.53	2009	0.69
2010	275.00	249.98	2010	0.79
2011	300.00	276.00	2011	0.78
2012	350.00	322.00	2012	0.80
			Average	0.76

* Economic wage rates for agriculture labor are calculated by applying the SCF for the respective year.

Annex Table 3: Conversion Factor for Other Commodities and Operations

Input and Operations	Traded Commodity	Import/Regulatory Duty	Sales Tax on Imports	Excise Duty on local Production	Net Protection Rate	Conversion Factor
Ploughing, Deep Ploughing, Ridge Making, Leveling etc.	Petroleum	9.00%	20.50%	-	0.31	0.76
Weedicide/ Insecticide/Pesticides Sprays	Plant Protection Chemicals	5.00%	0%	-	0.05	0.95
Cement*	Cement					0.61
Steel*	Steel					0.88

* Conversion Factors for Cement and Steel have been adopted from "Feasibility Study of Diamar Basha Dam Project, 2004"

Net Protection Rate = $(1 + \text{import duty})(1 + \text{sales Tax on Imports}) (1 - \text{Excise duty on local production}) - 1$

Conversion Factor = $1 / (\text{Net Protection Rate} + 1)$

**Annex Table 4: Economic Price of Wheat
(Import Parity)**

Description	Amount
Wheat US (No.1) Hard Red Winter, US Gulf port (US\$/M.Ton) ^a	180.50
Adjusted by Quality Adjustment factor of 1.01 ^b	182.53
Freight and insurance (US\$/M.Ton)	45.00
CIF Karachi, constant US\$ Per M.Ton	227.53
Exchange rate ^c	105.00
CIF Karachi, constant Rs.per M.Ton	23,890.33
LC Opening Charges (@0.4% of CIF cost)	95.56
Port charges (@ 2% of CIF Cost)-Rs. per M.Ton ^d	477.81
TCP Commission @ 2% of CIF cost - Rs per MT	477.81
Landed Cost- Karachi	24,941.50
Transport to project area market- Rs. per M Ton (adjusted by SCF) ^e	2,522.51
Local market value - Rs/M.Ton	27,464.02
Handling and Transport b/w farm gate and market Rs/M.Ton (adjusted by SCF)	227.05
Farm gate price of wheat (Rs per M.Ton)	27,236.97
Farm Gate Import Parity Price of Wheat (Rs Per Kg)	27.24

^a World Bank Commodity Price Data June 2017.

^b For differences in quality and relationship between export unit price and world prices of reference quality.

^c US\$ 1 = Rs.105 as on July2017.

^d Port charges including storage and handling charges.

^e Railway freight charges from Karachi to respective market.

**Annex Table 5: Economic Price of Sugarcane
(Import Parity)**

Description	Amount
ISA Daily Price, FOB and Stowed at Caribbean Ports (US\$/M.Ton) ^a	350.00
Freight & Insurance (US\$/M.Ton)	70.00
CIF Karachi Port, US\$ per M.Ton	420.00
Exchange Rate ^b	105.00
CIF Karachi, constant Rs per M.Ton	44,100.00
Port Charges, Handling and Storage -Rs. per M.Ton (adjusted by SCF) ^c	1,602.06
L.C, Bank Charges etc. and Losses provision	171.99
Importer Commission (@ 2% of CIF Value) -Rs. per M.T	882.00
Transport to Project Area Market- Rs. per M Ton (adjusted by SCF) ^d	2,874.44
Ex-mill/Market Cost of Imported Sugar- (Rs/M.Ton)	49,630.48
Processing cost of Sugar - (Rs/M.Ton)	5,955.66
Value of Cane to produce one Ton of Sugar - (Rs/M.Ton)	43,674.82
Provincial Base Sugar Recovery- Percent	9.85
Quantity of Cane (Tons) required for one ton of Sugar	10.15
Value of One Ton of Sugarcane	4,301.97
Value of Molasses Per Ton of Sugarcane	550.00
Handling & Transport b/w Farm and Mill/Market - Rs/Ton	246.78
Farm Gate Price of Sugarcan (Rs.per M.Ton)	4,605.19
Farm Gate Import Parity Price of Sugarcane (Rs Per Kg)	4.61

^a World Bank Commodity Price Data June 2017.

^b US\$ 1 = Rs.105 as on July 2017.

^c Adjusted by SCF of 0.914.

^d Railway freight charges from Karachi to market.

^e As per provincial average sugar recovery rate (Percentage).

**Annex Table 6: Economic Price of Rice
(Export Parity)**

Description	Amount
Thai 5% broken milled White Rice FOB Bangkok (US\$/M.Ton) ^a	421.00
Adjusted by quality adjustment factor ^b	758.95
Freight & Insurance (US\$/M.Ton)	45.00
Exchange Rate ^c	105.00
FOB Karachi-Rs per M.Ton	74,965.22
Karachi port handling, Storage Charges-Rs per M.Ton	1,361.66
Packing Charges-Rs per M.Ton	726.56
Losses@ 2%	1,361.66
Storage and Handling-Rs per M.Ton	363.28
Transport Charges from Project Area Mill to Karachi-Rs per M.Ton(adjusted by SCF) ^d	1,604.10
Ex.Mill value of Rice- Rs per M.Ton	69,547.97
Conversion to Paddy	
Milled Rice, Export Parity (67%) ^e	46,597.14
Broken Rice Value-Rs per M.Ton	1,164.93
Husk Value-Rs per M.Ton	400.00
Bran Powder Value-Rs per M.Ton	559.17
Total Value Paddy Rice-Rs per M.Ton	48,721.23
Milling Charges-Rs per M.Ton	3,405.73
Handling,Transport and Market Charges form Farm gate to Mill-Rs per M.Ton	741.69
Farm Gate Price of Rice- Rs/M.Ton	44,573.81
Farm Gate Export Parity Price of Rice (Rs Per Kg)	44.57

^a World Bank Commodity Price Data June, 2017

^b For differences in quality and relationship between export unit price and prices of reference quality.

^c US\$ 1 = Rs.105 as on Jan 2016.

^d Railway Freight Charges from market to Karachi Port.

^e As per ratio of rice to paddy.

**Annex Table 7: Economic Price of Cotton
(Export Parity)**

Description	Amount
Mkidding,1-3/32 Inch, CIF Europe (Current US\$/M.Ton) ^a	1,950.00
Adjusted by quality adjustment factor ^b	1,571.40
Freight and Insurance	26.00
Exchange Rate ^c	105.00
FOB value Karachi Port -Rs/M.Ton	162,267.17
Port Charges, Port Handling and Storage -Rs. per M.Ton (adjusted by SCF)	2947.40
Handling and Transport Charges from Project Area Mill to Karachi Port ^d	1469.84
Ex-Ginnery Price of 1 Ton Lint	157,849.92
Value of 2 Ton of Cottonseed	65,844.1138
Value of 3 ton of Seed cotton	223,694.03
Value of 1 ton Seed Cotton	74,564.68
Ginning Baling etc. adjusted by SCF-Rs/M.Ton	4,540.97
Handling and Transport b/w farm gate and mill - Rs/M.Ton	227.045
Price at Farm gate, Rs/M.Ton of Seed Cotton	69,796.66
Farm Gate Export Parity Price of Seed Cotton (Rs Per Kg)	69.80

^a World Bank Commodity Price Data June 2017.

^b For differences in quality and relationship between export unit price and prices of reference quality.

^c US\$ 1 = Rs.105 as on July 2017.

^d Railway Freight Charges from market to Karachi Port.

**Annex Table 8: Economic Price of Urea
(Import Parity)**

Description	Amount
Urea (Varying Origin), Bagged, FOB W Europe (US\$/M.Ton) ^a	180.00
Freight and Insurance (US\$/M.Ton)	26.00
CIF Karachi, constant US\$ per metric ton	206.00
Exchange Rate ^b	105.00
CIF Karachi, Rs/M.T	21,630.00
Handling and Transport b/w port and market- Rs/M.Ton(adjusted by SCF) ^c	3,308.28
Local Market Prices (Rs/M.Ton)	24,938.28
Handling and Transport b/w market and farm gate - Rs/M.Ton (adjusted by scf)	363.28
Farm Gate Price of Urea (Rs/M.Ton)	25,301.56
Nutrient (Nitrogen) Percentage	46%
Farm Gate Price of Nitrogen (Rs. per M.Ton)	55,003.39
Farm Gate Import Parity Price of Nitrogen (Rs. Per Kg)	55.00

^a World Bank Commodity Price Data June 2017.

^b US\$ 1 = Rs.105 as on July 2017.

^c Railway freight charges from Karachi to market.

**Annex Table 9: Economic Price of DAP
(Import Parity)**

Description	Amount
Di-ammonium, Phosphate, Bulk, FOB (US\$/M.Ton) Gulf ^a	357.00
Freight and Insurance (US\$/M.Ton)	26.00
CIF Karachi, constant US\$ per metric ton	383.00
Exchange Rate ^b	105.00
CIF Karachi, Rs/M.T	40,215.00
Handling and Transport b/w port and market- Rs/M.Ton (adjusted by SCF) ^c	3671.56
Local Market Prices (Rs/M.Ton)	43,886.56
Handling and Transport b/w market and farm gate - Rs/M.Ton (adjusted by scf)	363.28
Farm Gate Price of DAP (Rs. per M.T)	44,249.84
Nutrient (Phosphate) Percentage	46%
Farm Gate Price of Phosphate (Rs. per M.Ton)	86,294.69
Farm Gate Import Parity Price of Phosphate (Rs. Per Kg)	86.29

^a World Bank Commodity Price Data June 2017.

^b US\$ 1 = Rs.105 as on July 2017.

^c Railway freight charges from Karachi to market.

**Annex Table 10: Economic Price of Potash
(Import Parity)**

Description	Amount
Muriate of Potash, Bulk, FOB Vancouver (US\$/M.Ton) ^a	216.00
Freight and Insurance (US\$/M.Ton)	26.00
CIF Karachi, constant US\$ per metric ton	242.00
Exchange Rate ^b	105.00
CIF Karachi, Rs/M.T	25,410.00
Handling and Transport b/w port and market- Rs/M.Ton(adjusted by SCF) ^c	3,671.56
Local Market Prices (Rs/M.Ton)	29,081.56
Handling and Transport b/w market and farm gate - Rs/M.Ton(adjusted by scf)	363.28
Farm Gate Price of MoP (Rs/M.Ton)	29,444.84
Nutrient (Potash) Percentage	50%
Farm Gate Price of Potash (Rs. per M.Ton)	58,889.67
Farm Gate Import Parity Price of Potash (Rs. Per Kg)	58.89

^a World Bank Commodity Price Data June 2017.

^b US\$ 1 = Rs.105 as on July 2017.

^c Railway freight charges from Karachi to market.

Annex Table 11: Economic Cost of Resettlement and Land Acquisition

Item	Resettlement Activity	Unit	Qty	Unit Rate (Rs.)	Total Financial Costs (Mln Rs.)	Conversion Factor	Economic Values (Mln Rs.)
A	Land Acquisition (*)	Acres	8,105		4,246.00		(*)
B	Crops Compensations	Acres	4,000.0		112.00	0.908	101.7
C	Residential Structures				49.13	0.908	44.6
D	Cattle Structures				10.71	0.908	9.7
E	Commercial Structures				2.38	0.908	2.2
F	Public/Govt Structures				3.33	0.908	3.0
G	Community Structures				0.42	0.908	0.4
H	Tube wells				5.98	0.908	5.4
I	Private Trees				58.60	0.908	53.2
J	Income Disturbance Allowance				1.00	0.908	0.9
K	Vulnerable Allowance				53.10	0.908	48.2
L	Shifting Allowance				1.72	0.908	1.6
M	Livelihood Allowance				2.75	0.908	2.5
N	M&E Cost				42.75	0.908	38.8
O	Contingencies				427.45	0.908	388.2
P	Training Cost				1.00	0.908	0.9
	Sub-Total (A to P)				5,018.00		701
	Environment Management Cost				364.00	1.00	364.0
	Total Land Acquisition, Resettlement and Environment				5,382.00		1,065.4

(*) Notes: Economic opportunity cost of agricultural land is dealt with separately, i.e., derived from crop budget outlined in Annex Tables 12, 13, 14, and 15, and included in the consolidated cash flow.

**Annex Table 13: Crop Yields on 3,280 ha of Agriculture Land for Acquisition
(Without Project)- Kg/ha**

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5
Cotton (Desi)	580.86	583.76	586.68	589.62	592.57	595.53
Rice (Basmati)	1,659.86	1,668.15	1,676.50	1,684.88	1,693.30	1,701.77
Bajra	358.46	358.46	358.46	358.46	358.46	358.46
Sorghum	529.18	529.18	529.18	529.18	529.18	529.18
Maize	6,944.81	6,979.53	7,014.43	7,049.50	7,084.75	7,120.18
Oilseeds	311.56	311.56	311.56	311.56	311.56	311.56
Pulses	281.47	281.47	281.47	281.47	281.47	281.47
Vegetables	7,562.05	7,562.05	7,562.05	7,562.05	7,562.05	7,562.05
Fodder	7,916.59	7,916.59	7,916.59	7,916.59	7,916.59	7,916.59
Gowara	403.58	403.58	403.58	403.58	403.58	403.58
Wheat	1,655.67	1,672.23	1,688.95	1,705.84	1,722.90	1,740.13
Oilseeds	451.44	451.44	451.44	451.44	451.44	451.44
Pulses	549.18	549.18	549.18	549.18	549.18	549.18
Potato	17,546.62	17,722.08	17,899.30	18,078.30	18,259.08	18,441.67
Vegetables	15,016.10	15,016.10	15,016.10	15,016.10	15,016.10	15,016.10
Condiments	14,851.20	14,851.20	14,851.20	14,851.20	14,851.20	14,851.20
Fodder	21,541.59	21,627.76	21,649.39	21,735.99	21,822.93	21,910.22
Sugarcane	39,030.10	39,030.10	39,030.10	39,030.10	39,030.10	39,030.10
Orchards	8,970.56	9,060.26	9,150.87	9,242.38	9,334.80	9,428.15

**Annex Table 14: Per Hectare Net Value of Crops - Economic Terms - MIn Rs.
for 3,280 ha of Agriculture Land for Acquisition**

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5
Cotton (Desi)	13,908.88	14,075.17	14,242.29	14,410.25	14,579.96	14,749.60
Rice (Basmati)	41,245.40	41,620.12	41,768.05	41,996.03	42,376.40	42,379.50
Bajra	3,274.59	3,274.59	3,274.59	3,274.59	3,274.59	3,274.59
Sorghum	6,668.83	6,668.83	6,668.83	6,668.83	6,668.83	6,668.83
Maize	88,672.94	88,992.98	89,695.68	90,401.90	90,732.48	91,445.77
Oilseeds	24,929.96	24,929.96	24,929.96	24,929.96	24,929.96	24,929.96
Pulses	6,595.55	6,595.55	6,595.55	6,595.55	6,595.55	6,595.55
Vegetables	130,930.49	130,930.49	130,930.49	130,930.49	130,930.49	130,930.49
Fodder	13,661.30	13,661.30	13,661.30	13,661.30	13,661.30	13,661.30
Gowara	1,373.16	1,373.16	1,373.16	1,373.16	1,373.16	1,373.16
Wheat	21,329.92	21,808.07	21,911.84	22,399.61	22,892.25	23,010.65
Oilseeds	21,101.19	21,101.19	21,101.19	21,101.19	21,101.19	21,101.19
Pulses	18,876.45	18,876.45	18,876.45	18,876.45	18,876.45	18,876.45
Potato	78,029.55	79,777.39	80,980.33	81,707.99	82,644.81	85,256.36
Vegetables	70,015.40	70,015.40	70,015.40	70,015.40	70,015.40	70,015.40
Condiments	158,906.56	158,906.56	158,906.56	158,906.56	158,906.56	158,906.56
Fodder	41,879.88	42,139.09	42,204.15	42,464.66	42,726.22	42,988.82
Sugarcane	115,641.11	115,641.11	115,641.11	115,641.11	115,641.11	115,641.11
Orchards	150,621.59	152,361.78	154,123.18	155,905.97	157,710.39	159,536.64

**Annex Table 15: Total Net Value of Crops - Economic Terms (Mln Rs.)
for 3,280 ha of Agriculture Land for Acquisition**

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5
Cotton (Desi)	0.215	0.218	0.220	0.223	0.226	0.228
Rice (Basmati)	0.741	0.748	0.751	0.755	0.762	0.762
Bajra	0.548	0.548	0.548	0.548	0.548	0.548
Sorghum	0.583	0.583	0.583	0.583	0.583	0.583
Maize	4.053	4.067	4.100	4.132	4.147	4.180
Oilseeds	0.329	0.329	0.329	0.329	0.329	0.329
Pulses	0.022	0.022	0.022	0.022	0.022	0.022
Vegetables	0.349	0.349	0.349	0.349	0.349	0.349
Fodder	0.818	0.818	0.818	0.818	0.818	0.818
Gowara	0.024	0.024	0.024	0.024	0.024	0.024
Wheat	16.267	16.631	16.710	17.082	17.458	17.548
Oilseeds	0.920	0.920	0.920	0.920	0.920	0.920
Pulses	0.944	0.944	0.944	0.944	0.944	0.944
Potato	3.934	4.022	4.083	4.120	4.167	4.298
Vegetables	0.144	0.144	0.144	0.144	0.144	0.144
Condiments	0.122	0.122	0.122	0.122	0.122	0.122
Fodder	2.583	2.599	2.603	2.619	2.635	2.651
Sugarcane	0.098	0.098	0.098	0.098	0.098	0.098
Orchards	0.241	0.244	0.247	0.250	0.253	0.256
Total	32.94	33.430	33.620	34.080	34.550	34.830

Annex Table 16: Consolidated Cash Flow- Base Case (Rs. Million)

Cash Flow of Costs and Benefits (Rs Million)					Base case			
YEAR	Investment Costs	Opportunity Cost of Land	O&M	Total Costs	Agriculture Benefits			Net Incremental Benefits
					Without Project	With Project	Incremental Benefits	
1	6,100.58	-	-	6,100.58	491.83	491.83	-	(6,100.58)
2	5,322.88	33.43	-	5,356.32	491.83	491.83	-	(5,356.32)
3	5,536.11	33.62	-	5,569.73	491.83	491.83	-	(5,569.73)
4	3,110.95	34.08	-	3,145.03	491.83	491.83	-	(3,145.03)
5	1,076.44	34.55	154.94	1,265.93	499.81	2,153.24	1,653.43	387.50
6	781.43	34.83	159.33	975.59	502.20	3,592.14	3,089.94	2,114.35
7		34.83	164.17	198.99	510.64	5,229.86	4,719.22	4,520.22
8		34.83	169.48	204.31	518.86	5,430.00	4,911.13	4,706.82
9		34.83	175.33	210.16	521.44	5,710.79	5,189.35	4,979.20
10		34.83	181.76	216.59	521.44	5,710.79	5,189.35	4,972.76
11		34.83	188.84	223.67	521.44	5,710.79	5,189.35	4,965.69
12		34.83	196.63	231.45	521.44	5,710.79	5,189.35	4,957.90
13		34.83	205.19	240.01	521.44	5,710.79	5,189.35	4,949.34
14		34.83	214.61	249.43	521.44	5,710.79	5,189.35	4,939.92
15		34.83	224.97	259.79	521.44	5,710.79	5,189.35	4,929.56
16		34.83	236.36	271.19	521.44	5,710.79	5,189.35	4,918.16
17		34.83	248.90	283.73	521.44	5,710.79	5,189.35	4,905.63
18		34.83	262.69	297.52	521.44	5,710.79	5,189.35	4,891.84
19		34.83	277.86	312.69	521.44	5,710.79	5,189.35	4,876.67
20		34.83	294.55	329.37	521.44	5,710.79	5,189.35	4,859.98
21		34.83	312.90	347.73	521.44	5,710.79	5,189.35	4,841.63
22		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
23		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
24		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
25		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
26		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
27		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
28		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
29		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
30		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
31		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
32		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
33		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
34		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
35		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
36		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
37		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
38		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
39		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
40		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
41		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
42		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
43		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
44		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
45		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
46		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
47		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
48		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
49		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
50		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
51		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
52		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
53		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
54		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
55		34.83	330.70	365.53	521.44	5,710.79	5,189.35	4,823.83
ENPV	17,721.35	348.81	1,922.77	19,834.17	5,614.47	42,011.20	36,396.73	16,562.56
							EIRR	15.17%
Total							ENPV	16,562.555
							BC Ratio	1.84

