

DETAILED ECONOMIC AND FINANCIAL ANALYSIS

A. Introduction

1. The economic analysis of the project has been undertaken according to Asian Development Bank guidelines and describes the economic rationale for public intervention. The analysis quantifies the economic benefits and costs associated with the extension of the Pehur High Level Canal (PHLC) in Swabi District of Khyber Pakhtunkhwa Province (KPP) and measure the impact of the project on the whole economy. Financial values were converted to economic values by removing the effects of government interventions and market distortions.

2. 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* agriculture¹ and intermittent low-value irrigation of wheat and rapeseed and mustard (oilseeds) in *rabi* season² and maize and groundnut crops in *kharif* season.³ The with-project scenario assumes increased irrigation intensities during the rabi and kharif seasons 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 crop production and reduced barani crop production; (ii) higher crop yields; and (iii) a “shift” to the production of high value crops.

B. Macroeconomic Assessments

3. Pakistan’s agriculture sector had modest growth from 1970-2013, where it grew by about 3.4% per annum.⁴ The highest growth rate was achieved in 1985, 1992, and 1996 at 11%, 10% and 12% 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 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% or roughly \$18.3 billion per annum in real terms to the country’s average annual \$73 billion real GDP at 2005 constant prices and was able to employ more than 44% of the country’s labor force.

4. 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 From 2000 to 2013, 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 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

¹ “*barani* agriculture” refers to dry farming practice.

² “*Rabi* season” refers to the dry or winter-spring season, often from October/November to May.

³ “*Kharif* season” refers to the rainy season, often from May/June to October.

⁴ The average annual growth rate for the agricultural sector is 4% from 2000 to 2013.

⁵ FAOSTAT.2015.

⁶ Pakistan Agricultural Census. 2010.

10.8% of the average annual agricultural GDP. Other major agricultural products include rice, cotton lint, sugarcane, maize, and potato.

5. The widespread poverty in Pakistan has been rooted to the highly differentiated structure of land ownership. The landlessness in the country has become so severe that only roughly 2.0% of the households own nearly 50% of the land, while only 0.1% of the households own more than 2.0 hectares (ha). 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 during the period 2010-2015. 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.

C. Demand Analysis

6. On average, around 51.5% of the country's dietary energy is derived from cereals.⁸ 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%. From 1990 to 2009, the average annual per-capita food production value is about \$179.3, increasing at an average annual rate of 0.5%. In spite of 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 2009. Prevalence of undernourishment has remained critical for the period 1996-2016 with 20% incidence.

7. 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. Between 1990 and 2011, 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 have distorted the production decisions of farmers and resulted in productivity losses.

8. Although the share of the agriculture sector to the national GDP has been in decline, it does not necessarily suggest the economic diminution of the sector, because the country's real GDP relies heavily on the performance of the sector. The 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.

9. The project area is water scarce and there is a strong demand by farmers for sustainable supply of irrigation water to increase the efficiency in the use of farm resources. Having a 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 in better and more sustainable rural farm incomes.

10. The favorable climate and cheap labor for growing high value crops, as they need much less land and water for production, will help to increase the farm income in the project area. The

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 FAOSTAT. 2015.

project area is suitable for shifting towards and growing of vegetables, orchards and other high-value crops. Moreover, high-value crops command premium prices, particularly during off-season periods. Net profit against the investment is much higher for these crops compared with traditional crops. The products are in high demand all over Pakistan and could be marketed easily in the project area as well as in nearby urban centers like Swabi, Rawalpindi, Islamabad, Charsada, and Peshawar. Places such as Mardan and the nearby vicinities of the project area are considered important markets after shifting to producing and marketing these crops.

11. As of December 2015, the only crops grown in the project area are wheat, maize, and oilseeds. The annual production is about 4,458 ton of wheat, 956 ton of maize, and 560 ton of oilseeds. Production is expected to increase to 9,374 tons of wheat, 8,230 tons of maize, and 1,017 tons of oilseeds with the project at full development. In addition, annual production of about 26,956 tons of fodders; 29,343 tons of vegetables, and 4,337 tons of fruit are also expected at full project development. These increases are significant for the Khyber Pakhtunkhwa province, which currently provides a moderate proportion to the national production of wheat, maize, rapeseed, and fruits. As such, incremental produces can be marketed easily even within the project area without substantial risk of saturation since these increases are not sizable at both the national and provincial levels (Table 1).

Table 1: Production Profile With- and Without Project

Major Crops	Production 2013-14			Project Area in 2014		Project Area in 2022	
	Pakistan ('000 tons)	KPP ('000 tons)	KPP as % of Pakistan 2014 Production	Production ('000 tons)	% of KPP 2014 Production	Production ('000 tons)	% of KPP 2014 Production
(1)	(2)	(3)	(4) = (3)/(2)*100	(5)	(6) = (5)/(3)*100	(7)	(8) = (7)/(3)*100
Wheat	25,979	1,363	5.2%	4.46	0.33%	9.37	0.7%
Maize	4,944	915	18.5%	0.96	0.10%	8.23	0.9%
Rapeseed	231	7	3.0%	0.56	8.12%	1.02	14.5%
Fruits	6,638	420	6.3%	-	0.00%	4.34	1.0%

KPP = Khyber Pakhtunkhwa Province.

Source: Bureau of Statistics, Government of Pakistan. 2015. *Consultant's Economic Survey, 2015*.

D. Rationale for the Proposed Project Investment

12. The present condition of low yields and traditional crops in the project area is due to the inadequate supply of irrigation water. The increase in cultivated area, crop intensities, and yields in the command area is not possible without improving the facilities for surface irrigation water.

13. The project area is endowed with productive fertile land, plenty of water resources, and a climate that is conducive to the production of many types of food and non-food crops. In order to make agricultural production sustainable and improve the socio-economic conditions, the government has focused on efforts that utilize the potential of the existing irrigation canals. Towards this end, it is planned that irrigation facilities of the Pehur High Level Canal be extended to bring 8,727 ha under canal command, and to turn the rain-fed area into full irrigation for crop cultivation.

14. An intervention such as this project is necessary because farmers, in their own private capacity, are not incentivized to invest on irrigation improvements because of the prohibitively high financial costs. Moreover, the project 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

15. **“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.

16. 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. Therefore, without regulated irrigation supplies (i.e., without project) the existing agriculture output will not change for the better and the land will become drier and less productive. This scenario is further described as follows: (i) cropping intensity in project command area is estimated at only 52.4%, (ii) the principal kharif crop is maize and 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 water.

17. **“With Project” Scenario.** With the provision of irrigation water supply to the existing un-irrigated command area, the cropping pattern, cropping intensity, and crop yields would improve. In this scenario, an area of 8,727 ha, where rain-fed agriculture is being practiced will be brought under full irrigation. Timely and adequate volume of water availability will be ensured. The present level of cropping intensity will increase from 52.4% to 150.6%. Furthermore, high value crops including fruit and vegetables will be grown alongside traditional crops such as wheat and maize, which will result in good land use practices and increased farm incomes. This will contribute to improved environmental conditions, particularly in the primary impact area, and enhanced living standards in the project area, especially in the secondary impact area.

F. Major Assumptions

18. General Assumptions

- (i) Gravity irrigation by diverting water from the Gandaf tunnel to the Indus Ambar and Janda Boka branches 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 PPTA surveys in late 2015.
- (iii) The economic life of the project is assumed to last 30 years.

19. Project Investment

- (i) The project cost includes: (a) civil works; (b) acquisition of mechanical equipment; (c) survey, study, and design; (d) conduct of training and workshops; (e) contracting of consulting services; and (f) land resettlement and acquisition. Other costs include those of: (a) PMO and PIO 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 PPTA work conducted in 2015.

- (ii) The total investment cost was assumed to phase over five 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 (%)	1.5%	15.5%	32%	26%	15%	10%	100%

Note: The first year represent the period of feasibility and appraisal of the project.

20. For operation and maintenance costs, (i) operation and maintenance costs of the project arise from the operations of the gravity irrigation system; (ii) the estimated operating and maintenance (O&M) cost in financial terms is PRs66.09 million per year—an equivalent of PRs 57.98 million in economic terms. These unit values were based on the PPTA estimates in 2015; (i) annual real increase in maintenance costs has been computed at 10% per annum; and (ii) the O&M is assumed after hiring the operational staff and would be started from fifth year of the project.

21. 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 four.

22. Constant prices for the crops selected were used to value the benefit stream. The financial prices, shown in Table 2, after appropriate economic conversion, were used in the economic analysis.

Table 2: Farm-gate Prices of Selected Crops (PRs/kg)

S. No.	Crop	Unit	Factor	Economic	Financial
1	Maize	Kg	1.38	46.63	33.75
2	Maize Stocks	Kg	0.93	3.49	3.75
3	Kharif Fodders	Kg	0.93	3.72	4.00
4	Tomato	Kg	0.93	40.70	43.75
5	Melons	Kg	0.93	28.49	30.63
6	Cauliflower	Kg	0.93	40.70	43.75
7	Groundnuts	Kg	0.78	62.16	80.00
8	Lady Finger	Kg	0.93	32.56	35.00
9	Sugarcane	Kg	0.76	3.08	4.05
10	Sugarcane tops	Kg	0.93	4.19	4.50
11	Wheat	Kg	0.84	33.18	39.38
12	Wheat Straws	Kg	0.93	11.63	12.50
13	R. Fodders	Kg	0.93	3.72	4.00
14	Sugar beet	Kg	0.76	3.08	4.05
15	Rape and Mustard	Kg	0.78	52.45	67.50
16	Potatoes	Kg	0.93	34.97	37.60
17	Peas	Kg	0.93	40.70	43.75
18	Garlic	Kg	0.93	83.72	90.00
19	Oranges	Kg	0.93	48.83	52.50
20	Plums/Peaches	Kg	0.93	56.97	61.25

Sources: Consultant's Economic Survey, 2015; Pakistan Economic Survey, 2014-15, Ministry of Finance, Islamabad; Financial prices were based on PPTA (2015); For export parity prices - see Annex Table 1 for the derivation; for standard conversion factor (SCF), see Annex Table 2 for the derivation; for shadow wage rate factor, see Annex Table 3 for the derivation.

23. **Assumptions Used in Converting Financial into Economic Values**

- (i) The world price was used as numeraire for the derivation of the export parity prices and the standard conversion factor (SCF).
- (ii) Export parity prices have been derived for wheat and maize, which are the major export commodities of Pakistan (FAOSTAT, 2015) (see Annex Table 1.1 for the detailed derivations). Data used in the derivation were obtained from the PPTA survey in 2015 and the World Bank.
- (iii) Import parity prices have been derived for fertilizer inputs (i.e., urea, diammonium phosphate, potassium chloride) (see Annex Table 1.2 for the detailed derivations). Data used in the derivation were obtained from the World Bank Commodity Markets Outlook (2015), FAO Food Outlook (2015), and the Agricultural Policy Institute.
- (iv) An SCF of 0.93 was used to convert a financial price into its economic price for non-tradable goods (see Annex Table 2 for the derivation). Data used in the derivation of the SCF were obtained from the various local statistical sources and FAOSTAT.
- (v) A shadow wage rate factor (SWRF) of 0.73 was used for unskilled labor (see Annex Table 3 for the derivation). Data used in the derivation of the SWRF were obtained from the World Bank and FAOSTAT.
- (vi) A discount rate of 12% was considered as the opportunity cost of capital.
- (vii) The cash flows have been drawn in the local currency: Rupees (PRs). The PRs-\$ exchange rate of \$1.0=PRs104.75 was used in the economic analysis.

24. **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 4. Moreover, the project would also acquire tracts of agricultural, barren, residential, nullah (valley), hilly, and government lands (including roads and other infrastructures). The derivations of the economic values of these lands (except that of the agricultural lands) are also shown in Annex Table 4. Finally, 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 5.1 to 5.4.

25. Original sources used to estimate crop-related parameters are in Section K.

G. Project Costs

26. **Capital Costs.** Total capital costs, based on engineering designs, have been estimated at \$96.96 million, which includes a physical contingency of \$3.82 million as of June 2016 (Table 3). Duties and taxes were estimated at \$8.99 million. All costs were converted into their respective economic values using appropriate conversion factors. In economic terms, the total capital cost amounts to \$54.01 million, which is equivalent to PRs 5,657.54 million (Table 4).

Table 3: Project Financial Costs
Table 3.1: Output 1- Available Water for Agriculture Use Increased

Sr. No.	Description	Total Costs (Rs Million)			Total Costs Equivalent (US\$ Million)			Duties / Taxes	
		Local Component	Foreign Component	Total	Local Component	Foreign Component	Total	Value in Rs Million	Equivalent to US\$ Million
1	Section 1 - Works								
A	General Item	147.50	-	147.50	1.41	-	1.41	14.75	0.14
B	Indus Ambar								
B.1	Pressure Pipe	1,285.08	1,487.73	2,772.81	12.27	14.20	26.47	503.16	4.80
B.2	Irrigation System	1,285.41	4.83	1,290.24	12.27	0.05	12.32	206.63	1.97
C	Janda Boka								
C.1	Pressure Pipe	133.59	181.82	315.41	1.28	1.74	3.01	57.74	0.55
C.2	Irrigation System	232.57	2.02	234.58	2.22	0.02	2.24	37.61	0.36
	Sub-Total (Section 1)	3,084.15	1,676.39	4,760.54	29.44	16.00	45.45	819.89	7.83
2	Section-2 Social / Environment Safeguards								
2.1	Land Acquisition & Resettlement	-	-	-	-	-	-	-	-
	Indus Ambar	1,336.50	-	1,336.50	12.76	-	12.76	-	-
	Janda Boka	304.50	-	304.50	2.91	-	2.91	-	-
2.2	Environmental Management	10.00	-	10.00	0.10	-	0.10	-	-
	Sub-total (Section 2)	1,651.00	-	1,651.00	15.76	-	15.76	-	-
3	Engineering & Administration								
3.1	Project Implementation Consultants	521.00	55.00	576.00	4.97	0.53	5.50	57.60	0.55
3.2	Project Management Organization / Admin. Cost KPID	269.87	-	269.87	2.58	-	2.58	26.99	0.26
	Sub-total	790.87	55.00	845.87	7.55	0.53	8.08	84.59	0.81
	Grand Total (Output 1)	5,526.02	1,731.39	7,257.41	52.75	16.53	69.28	904.48	8.63

Source: ADB estimates

Table 3.2: Output 2- Increased Water Use and On Farm Management Capacities

Sr. No.	Description	Total Costs (Rs Million)			Total Costs Equivalent (US\$ Million)			Duties / Taxes	
		Local Component	Foreign Component	Total	Local Component	Foreign Component	Total	Value in Rs Million	Equivalent to US\$
A	Construction of Irrigation Network at Farm Level								
1	Construction of Watercourses	364.00	0.00	364.00	3.47	0.00	3.47	32.76	0.31
2	Installation of Farm Turnouts	6.26	0.00	6.26	0.06	0.00	0.06	0.56	0.01
	Sub-total	370.26	0.00	370.26	3.53	0.00	3.53	33.32	0.32
B	Establishment of Demonstration Farms and Training of								
1	Demonstration Plots	173.80	0.00	173.80	1.66	0.00	1.66	0.00	0.00
2	Farmer's Field school	24.00	0.00	24.00	0.23	0.00	0.23	0.00	0.00
3	Studytrip to HEISS Areas	1.05	0.00	1.05	0.01	0.00	0.01	0.00	0.00
	Sub-total	198.85	0.00	198.85	1.90	0.00	1.90	0.00	0.00
C	Capacity building of KPAD / OFWM Staff								
1	Agriculture Extension Services (Equipment & Furniture)	1.00	0.00	1.00	0.01	0.00	0.01	0.10	0.00
2	On Farm Water Management (Equipment & Furniture)	1.50	0.00	1.50	0.01	0.00	0.01	0.15	0.00
	Sub-total	2.50	0.00	2.50	0.02	0.00	0.02	0.25	0.00
D	Establishment of Water User Associations and Their Training								
	Staff and Operating Costs of Project Implementation Office (PIO)	131.43	0.00	131.43	1.25	0.00	1.25	0.00	0.00
	Sub-total	131.43	0.00	131.43	1.25	0.00	1.25	0.00	0.00
E	Engineering and Administration								
	Project Implementation Consultants	34.00	0.00	34.00	0.32	0.00	0.32	3.40	0.03
	Sub-total	34.00	0.00	34.00	0.32	0.00	0.32	3.40	0.03
	Grand Total (Output 2)	737.04	0.00	737.04	7.04	0.00	7.04	36.97	0.35

Source: ADB estimates.

Table 3.3: Summary of Project Financial Costs

Sr. No.	Description	Total Costs (Rs M)			Total Costs Equivalent (US\$ M)			Duties / Taxes	
		Local Component	Foreign Component	Total	Local Component	Foreign Component	Total	Rs Million	Equivalent to US\$ M
A	Section 1 - Project Components								
1	Output 1: Available water for Agriculture Use Increased	5,526.02	1,731.39	7,257.41	52.75	16.53	69.28	904.48	8.63
2	Output 2: Increased Water use & On Farm Management Capacities	737.04	-	737.04	7.04	-	7.04	36.97	0.35
B	Base- Cost (Sub Total)	6,263.05	1,731.39	7,994.45	59.79	16.53	76.32	941.45	8.99
C	Contingencies								
1	Physical Contingencies @ 5% of Base Cost	313.15	86.57	399.72	2.99	0.83	3.82	-	-
2	Price Contingency	965.76	66.75	1,032.51	9.22	0.64	9.86	-	-
	Total Contingencies	1,278.92	153.31	1,432.23	12.21	1.46	13.67	-	-
	Sub-Total (B+C)	7,541.97	1,884.71	9,426.68	72.00	17.99	89.99	941.45	8.99
D	Financing Charges								
1	IDC @ 2.13% on Foreign and 11.79% on Local	274.87	420.83	695.71	2.62	4.02	6.64	-	-
2	Commitment Charges @ 0.15% of undisbursed amount	-	33.79	33.79	-	0.32	0.32	-	-
	Grand-Total(A+B+C+D)	7,816.84	2,339.33	10,156.17	74.62	22.33	96.96	941.45	8.99

Source: ADB estimates.

Explanatory Notes: a. Taxes and Duties amounting to PKR 941.45 million are included in base cost; b. Staffing cost within EMP is incorporated in relevant cost items of PIC, PMO and Contractor's cost-estimate; c. Price contingency computed as per MUV Index for International and Domestic Cost Escalation Factor for Pakistan for local cost component; d. IDC computed at 5 year Fixed-LIBOR rate of 1.625% plus 0.5% premium on sovereign loan. For Local component, IDC is computed @ 11.78% as per GoP Notification; e. Commitment Charges @ 0.15% of undisbursed loan amount

Table 4: Derivation of the Economic Value of the Total Project Cost

Sr.	Item	Rs million	US\$ million
	Base Cost	7,994.45	76.32
	Add: Physical Contingency (5% of Base Cost)	399.72	3.82
	Equals: Adjusted Project Cost	8,394.17	80.14
A	Less: Foreign Component of Adjusted Project Cost	1,817.96	17.36
	Equals: Local Component of Adjusted Project Cost	6,576.20	62.78
	Less: Duties and Taxes	941.45	8.99
	Equals: Net Local Component of Adjusted Project Cost	5,634.75	53.79
	Multiplied by: the Percentage of Unskilled Labor from the Net Local Component	26%	26%
	Equals: Financial Cost of Unskilled Labor	1,465.04	13.99
	Multiply by: SWRF	0.73	0.73
B	Equals: Economic Cost of Unskilled Labor	1,070.15	10.22
	Net Local Component of Adjusted Project Cost	5,634.75	53.79
	Less: Financial Cost of Unskilled Labor	1,465.04	13.99
	Equals: Financial Cost of Remaining Local Cost Items	4,169.72	39.81
	Multiply by: SCF	0.93	0.93
C	Equals: Economic Cost of Remaining Local Cost Items	3,878.59	37.03
D	Economic Value of Local Cost Component	4,948.74	47.24
E	Land Acquisition and Resettlement Cost (Financial)	1,641.00	15.67
F	Economic Land Acquisition and Resettlement Cost (Excluding the Opportunity Cost of Agricultural Land)	531.84	5.08
G	Total Economic Cost	5,657.54	54.01

Source: ADB estimates.

27. **Operation and Maintenance Costs.** The annual incremental O&M cost in financial terms for the irrigation system is PRs66.09 million, which is equivalent to \$0.63 million. Relevant SCF and shadow wage rate factor 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 PRs57.98 million (or \$0.55 million). The O&M is assumed after hiring the operational staff and would be started from 5th year 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 (see Annex Table 6).

H. Project Benefits

28. **Quantified Benefits.** The chief quantified benefits of the project are incremental net returns from the production of different crops during the kharif and rabi seasons. These benefits would arise from (i) higher irrigated command area through the provision of full irrigation coverage to the currently rain-fed lands, and (ii) 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 at Annex Table 6, i.e., consolidated cash flow.

29. 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. The intensity at full development has been estimated as 150.6% after the project interventions, which is a significant improvement from the existing cropping intensity of 52.4%.

30. **Unquantified 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

31. **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 evaluated in economic terms by converting the financial values by appropriately using the SCF for non-traded goods and export/import parity prices for traded goods.

32. 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 over the 30-year project life using a 12% discount rate. The net incremental benefits were estimated at crop level for each of the 17 crops considered in the project.

33. **Economic Returns and Sensitivity Analysis.** Construction of the project envisages developing irrigated agriculture in the currently unirrigated, below subsistence farming in the project 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 52.4% to 150.6%. In other words, the annual cropped area will increase from 4,573 ha to 13,138 ha. Yields for the existing crops are expected to increase from 39% to 123%. 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 economic internal rate of return (EIRR) of 16.1% and the overall economic net present value (ENPV) of PRs1,602 million (Table 5). These strong economic results are due to the substantial size of the economic benefit stream relative to the lower cost engineering options for the project cost. The consolidated cash flow is shown in Annex Table 6.

34. 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 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 5 and explained subsequently.

Table 5: Results of Economic Analysis and Sensitivity Analysis

Results of Evaluation	Change	ENPV (PRs million)	EIRR	Sensitivity Indicator (SI)	Switching Value (SV)
Base Case		1,602.1	16.1%		
Sensitivity Scenarios					
Case 1 - Increase in Capital Costs	+10%	1,260.6	15.1%	2.13	47%
Case 2 - Increase in O&M Costs	+10%	1,585.8	16.1%	0.10	973%
Case 3 - Combined Case 1 and 2	as above	1,189.0	14.9%	3.47	29%
Case 4 - Decrease in Overall Benefit	-10%	1,028.8	14.7%	5.57	18%
Case 5 - Benefit Delay by 2 years	-2 years	354.0	12.8%	n.a	6 years
Case 6 - Combination of Cases 3 and 4	as above	615.8	13.5%	n.a	n.a

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

Source: ADB estimates.

35. **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 15.1%. The level of increase in capital cost at which the EIRR would be equal to the hurdle rate of 12% is 47%. **Case 2-Increase in O&M Costs**—A 10% increase in O&M costs causes no change in the EIRR. The level of increase in total O&M cost at which the EIRR would be equal to the hurdle is 973%. **Case 3-Combination of Cases 1 and 2**—Combination of Cases 1 and 2 will cause the EIRR to fall to 14.9%. **Case 4-Decrease in Overall Benefit**—A 10% decrease in overall benefits will cause the EIRR to fall to 14.7%. The percentage decrease in the overall project benefit at which the EIRR would be equal to the hurdle rate is 18%. **Case 5- Two-year Benefit Delay**—A two-year delay in the realization of project benefits will cause the EIRR to fall to 12.8%. The length of delay at which the EIRR would be equal to the hurdle rate is about 6 years. **Case 6 - Combination of Cases 3 and 4**—Combination of Cases 3 and 4 will cause the EIRR to fall to 13.5%. Annex Table 7 provides detailed sensitivity tests.

36. 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 proposed in the Project's Operation and Maintenance Requirements and Sustainability Plan to ensure that the benefits can materialize as estimated during the expected period.

J. Project Benefit Distribution and Poverty Impact

37. **Household Financial Returns.** From the perspective of farm households, the incremental irrigated area would generate an average annual benefit of around \$1,897 per ha due to project investments in irrigation. With an average farm size of 1.01 ha⁹ in the command areas and average rural family size of six people,¹⁰ a farm household is expected to get an income increase of about \$1,744 per annum, whereas per capita income in the project beneficiary household will increase by about \$291 per annum.

Table 6: Distribution of Economic Benefits
(PRs million)

Description	Financial Present Value	Economic Present Value	Economic less Financial	Distribution of Project Benefits			
				Government	Economy	Labor	Farmers
Total Benefits	34.8	5,732.6	5,697.8				5,697.8
Project Costs							
Traded	2,352.4	1,236.1	(1,116.3)		1,116.3		
Skilled labor	1,021.9	537.0	(484.9)			484.9	
Unskilled labor	1,650.7	867.4	(783.3)			783.3	
Non-traded	2,835.6	1,490.0	(1,345.5)		1,345.5		
Total Project Costs	7,860.6	4,130.5	(3,730.0)				
Net Benefits	(7,825.8)	1,602.1	9,427.9	(7,825.8)			
			Gains/Losses	(7,825.8)	2,461.8	1,268.2	5,697.8

Source: ADB estimates.

38. **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 6 presents the result of the benefit distribution analysis. The project poverty impact ratio is estimated at 88.7% (Table 7).

⁹ Pakistan Census Organization. 2010. Census of Agriculture (2010).

¹⁰ Pakistan Bureau of Statistics. 2008.

Table 7: Poverty Impact Analysis
(PRs million)

Particulars	Govt'/ Economy	Labor	Farmers	Total
Benefits (Losses)	2,461.8	1,268.2	5,697.8	9,427.9
Financial Return to Government	(7,825.8)			(7,825.8)
Total Benefits (Losses)	(5,364.0)	1,268.2	5,697.8	1,602.1
Proportion of the Poor (%)*	22.3%	75.17%	29.2%	
Benefits to Poor	(1,196.2)	953.3	1,663.8	1,420.9
Poverty Impact Ratio (%)				88.7%

Source: ADB estimates.

* (Government/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 Programme. 2011. *Khyber Pakhtunkhwa Millennium Development Goals*. Peshawar.

K. Sources Used to Estimate Crop-Related Parameters

39. Existing land use, cropping pattern, cropped area and intensities in the Project command area were based on the data from the following sources:

- (i) Land Use & Cropping Data Records of the Department of Revenue District Swabi, 2009-2013, Office of the District Revenue Officer, Swabi. Khyber Pakhtunkhwa.
- (ii) Land Use and Area Production Data: Crop Statistics Khyber Pakhtunkhwa 2009-2013, Directorate of crop Reporting Services Department of Agriculture, Khyber Pakhtunkhwa Peshawar.
- (iii) Field visit of the command area and Interview with Farmers by PPTA Consultant.
- (iv) Consultation with District Agriculture Officers (Extension), Swabi.
- (v) Consultation with District Agriculture Officer (OFWM) Swabi.
- (vi) Previous Feasibility Report by BAK Consulting Engineers & Al-Kasib Group of Engineering Services (AGES) 2012.
- (vii) Development Statistics of Khyber Pakhtunkhwa 2014, Bureau of Statistics Planning & Development Department, Government of Khyber Pakhtunkhwa Pakistan www.kpbos.gov.pk

40. Existing crop yields in project command area were estimated on the bases of the data/information from the following Publications, Reports and Consultations:

- (i) Crop Statistics Khyber Pakhtunkhwa 2009-2013, Directorate of crop Reporting Services Department of Agriculture, Khyber Pakhtunkhwa Peshawar.
- (ii) Field Visit of the command area and Interview with Farmers by PPTA Consultant
- (iii) Consultation with District Agriculture Officer (Extension), Swabi.
- (iv) Previous Feasibility Report by BAK Consulting Engineers & Al-Kasib Group of Engineering Services (AGES) 2012.

41. Future cropping pattern and intensities with project interventions were estimated on the bases of data/information from the following sources:

- (i) Cropping Pattern & Intensities: Land & cropped area Records of the Department of Revenue District Swabi, 2009-2013, Office of the District Revenue Officer, Swabi. Khyber Pakhtunkhwa.
- (ii) Cropped Area & Production Data: Crop Statistics Khyber Pakhtunkhwa 2009-2013, Directorate of crop Reporting Services Department of Agriculture, Khyber Pakhtunkhwa Peshawar.
- (iii) Field Visit of the project command area and interviews with Farmers by PPTA Consultant.
- (iv) Consultation with District Agriculture Officers (Extension), Swabi.
- (v) Consultation with District Agriculture Officer (OFWM) Swabi.
- (vi) Previous Feasibility Report by BAK Consulting Engineers & Al-Kasib Group of Engineering Services (AGES) 2012.
- (vii) ADB Project Completion Report: Pehur High-Level Canal Project, November 2005: Project Number: PAK 19141 Pakistan: Asian Development Bank.

42. Future increase in yields with project interventions were based on the data/information from the following sources:

- (i) Cropped Area & Production Data: Crop Statistics Khyber Pakhtunkhwa, 2009-2013, Directorate of crop Reporting Services Department of Agriculture, Khyber Pakhtunkhwa Peshawar.
- (ii) Expected effect on crop agronomy due to improved irrigation supplies with project interventions, and crop yields under irrigated areas in the adjacent areas of project command area based on (a) ADB Project Completion Report: Pehur High-Level Canal Project, November 2005: Project Number: PAK 19141 Pakistan: Asian Development Bank. (adjacent to the proposed project location); (b) interviews with various farmers by crop practices; and (c) consultations with the local agriculture experts in the Department of Agriculture, Swabi District Agriculture Officers (see above as well).

AUXILIARY TABLES

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

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5 & onward
Maize	10.36	10.36	10.36	10.36	10.36	10.36
Kharif Fodders						
Tomato						
Melons						
Kh Cauliflower						
Kh. Oilseeds	3.72	3.72	3.72	3.72	3.72	3.72
Lady's Fingers						
Sugarcane						
Kh. Orchards (Plant)						
Kh. Orchards (Fruit)						
Kharif Total	14.08	14.08	14.08	14.08	14.08	14.08
Wheat	36.92	36.92	36.92	36.92	36.92	36.92
R.Fodders						
Sugarbeet						
R.Oilseeds	1.40	1.40	1.40	1.40	1.40	1.40
Potatoes						
R. Vegetables						
Garlic						
R. Orchards (Plant)						
R. Orchards (Fruit)						
Rabi Total	38.32	38.32	38.32	38.32	38.32	38.32
Grand Total	52.40	52.40	52.40	52.40	52.40	52.40

Source: PPTA 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
Maize	904	904	904	904	904	904
Kharif Fodders	-	-	-	-	-	-
Tomato	-	-	-	-	-	-
Melons	-	-	-	-	-	-
Kh Cauliflower	-	-	-	-	-	-
Kh. Oilseeds	324	324	324	324	324	324
Lady's Fingers	-	-	-	-	-	-
Sugarcane	-	-	-	-	-	-
Kh. Orchards (Plant)	-	-	-	-	-	-
Kh. Orchards (Fruit)	-	-	-	-	-	-
Kharif Total	1,229	1,229	1,229	1,229	1,229	1,229
Wheat	3,222	3,222	3,222	3,222	3,222	3,222
R.Fodders	-	-	-	-	-	-
Sugarbeet	-	-	-	-	-	-
R.Oilseeds	123	123	123	123	123	123
Potatoes	-	-	-	-	-	-
R. Vegetables	-	-	-	-	-	-
Garlic	-	-	-	-	-	-
R. Orchards (Plant)	-	-	-	-	-	-
R. Orchards (Fruit)	-	-	-	-	-	-
Rabi Total	3,345	3,345	3,345	3,345	3,345	3,345
Grand Total	4,573	4,573	4,573	4,573	4,573	4,573

Source: PPTA 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 Crops						
Maize	1058	1058	1058	1058	1058	1058
Kharif Fodders						
Tomato						
Melons						
Kh Cauliflower						
Kh. Oilseeds	1436	1436	1436	1436	1436	1436
Lady's Fingers						
Sugarcane						
Kh. Orchards (Plant)						
Kh. Orchards (Fruit)						
Rabi Crops						
Wheat	1384	1384	1384	1384	1384	1384
R.Fodders						
Sugarbeet						
R.Oilseeds	768	768	768	768	768	768
Potatoes						
R. Vegetables						
Garlic						
R. Orchards (Plant)						
R. Orchards (Fruit)						

Source: PPTA 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
Kharif Crops						
Maize	956	956	956	956	956	956
Kharif Fodders	0	0	0	0	0	0
Tomato	0	0	0	0	0	0
Melons	0	0	0	0	0	0
Kh Cauliflower	0	0	0	0	0	0
Kh. Oilseeds	466	466	466	466	466	466
Lady's Fingers	0	0	0	0	0	0
Sugarcane	0	0	0	0	0	0
Kh. Orchards (Plant)	0	0	0	0	0	0
Kh. Orchards (Fruit)	0	0	0	0	0	0
Kharif Total	1,422	1,422	1,422	1,422	1,422	1,422
Rabi Crops						
Wheat	4,458	4,458	4,458	4,458	4,458	4,458
R. Fodders	0	0	0	0	0	0
Sugarbeet	0	0	0	0	0	0
R. Oilseeds	94	94	94	94	94	94
Potatoes	0	0	0	0	0	0
R. Vegetables	0	0	0	0	0	0
Garlic	0	0	0	0	0	0
R. Orchards (Plant)	0	0	0	0	0	0
R. Orchards (Fruit)	0	0	0	0	0	0
Rabi Total	4,553	4,553	4,553	4,553	4,553	4,553
Grand Total	5,975	5,975	5,975	5,975	5,975	5,975

Source: PPTA surveys, analysis, and estimates.

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

Crops	Base Year	(Intensity in Percent)										CCA (Ha)	8727
		Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10 & Onward		
Maize	10.36	17.77	25.18	31.11	37.04	40.00	40.00	40.00	40.00	40.00	40.00	40.00	
Kharif Fodders	0.00	1.21	2.42	3.39	4.36	4.85	4.85	4.85	4.85	4.85	4.85	4.85	
Tomato	0.00	0.75	1.50	2.10	2.70	3.00	3.00	3.00	3.00	3.00	3.00	3.00	
Melons	0.00	0.54	1.08	1.51	1.94	2.15	2.15	2.15	2.15	2.15	2.15	2.15	
Kh Cauliflower	0.00	0.71	1.42	1.99	2.56	2.85	2.85	2.85	2.85	2.85	2.85	2.85	
Kh. Oilseeds	3.72	3.85	3.98	4.09	4.19	4.25	4.25	4.25	4.25	4.25	4.25	4.25	
Lady's Fingers	0.00	0.96	1.92	2.69	3.46	3.85	3.85	3.85	3.85	3.85	3.85	3.85	
Sugarcane	0.00	2.34	4.68	6.55	8.42	9.36	9.36	9.36	9.36	9.36	9.36	9.36	
Kh. Orchards (Plant)	0.00	0.46	0.92	1.29	1.66	1.85	1.40	0.95	0.59	0.23	0.05	0.05	
Kh. Orchards (Fruit)	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.90	1.26	1.62	1.80	1.80	
Kharif Total	14.08	28.60	43.12	54.73	66.34	72.15	72.15	72.15	72.15	72.15	72.15	72.15	
Wheat	36.92	39.40	41.88	43.87	45.86	46.85	46.85	46.85	46.85	46.85	46.85	46.85	
R.Fodders	0.00	1.67	3.35	4.69	6.03	6.70	6.70	6.70	6.70	6.70	6.70	6.70	
Sugarbeet	0.00	1.00	2.00	2.80	3.60	4.00	4.00	4.00	4.00	4.00	4.00	4.00	
R.Oilseeds	1.40	1.77	2.13	2.42	2.70	2.85	2.85	2.85	2.85	2.85	2.85	2.85	
Potatoes	0.00	1.04	2.08	2.91	3.74	4.15	4.15	4.15	4.15	4.15	4.15	4.15	
R. Vegetables	0.00	1.79	3.58	5.01	6.44	7.15	7.15	7.15	7.15	7.15	7.15	7.15	
Garlic	0.00	0.64	1.27	1.78	2.29	2.55	2.55	2.55	2.55	2.55	2.55	2.55	
R. Orchards (Plant)	0.00	1.04	2.08	2.91	3.74	4.15	3.14	2.13	1.32	0.51	0.11	0.11	
R. Orchards (Fruit)	0.00	0.00	0.00	0.00	0.00	0.00	1.01	2.02	2.83	3.64	4.04	4.04	
Rabi Total	38.32	48.34	58.36	66.37	74.39	78.40	78.40	78.40	78.40	78.40	78.40	78.40	
Grand Total	52.40	76.94	101.48	121.10	140.73	150.55	150.55	150.55	150.55	150.55	150.55	150.55	

Source: PPTA 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	Year 6	Year 7	Year 8	Year 9	Year 10 & Onward
Maize	904	1551	2198	2715	3232	3491	3491	3491	3491	3491	3491
Kharif Fodders	0	106	212	296	381	423	423	423	423	423	423
Tomato	0	65	131	183	236	262	262	262	262	262	262
Melons	0	47	94	131	169	188	188	188	188	188	188
Kh Cauliflower	0	62	124	174	224	249	249	249	249	249	249
Kh. Oilseeds	324	336	348	357	366	371	371	371	371	371	371
Lady's Fingers	0	84	168	235	302	336	336	336	336	336	336
Sugarcane	0	204	408	572	735	817	817	817	817	817	817
Kh. Orchards (Plant)	0	40	81	113	145	161	121	81	48	16	0
Kh. Orchards (Fruit)	0	0	0	0	0	0	40	81	113	145	161
Kharif Total	1229	2496	3763	4776	5790	6297	6297	6297	6297	6297	6297
Wheat	3222	3439	3655	3829	4002	4089	4089	4089	4089	4089	4089
R. Fodders	0	146	292	409	526	585	585	585	585	585	585
Sugarbeet	0	87	175	244	314	349	349	349	349	349	349
R. Oilseeds	123	154	186	211	236	249	249	249	249	249	249
Potatoes	0	91	181	254	326	362	362	362	362	362	362
R. Vegetables	0	156	312	437	562	624	624	624	624	624	624
Garlic	0	56	111	156	200	222	222	222	222	222	222
R. Orchards (Plant)	0	91	181	254	326	362	272	181	109	36	0
R. Orchards (Fruit)	0	0	0	0	0	0	91	181	254	326	362
Rabi Total	3345	4219	5093	5793	6492	6842	6842	6842	6842	6842	6842
Grand Total	4,573	6,715	8,856	10,569	12,282	13,138	13,138	13,138	13,138	13,138	13,138

Source: PPTA 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	Year 6	Year 7	Year 8	Year 9	Year 10 & Onward
Kharif Crops											
Maize	1058	1578	1903	2163	2293	2358	2358	2358	2358	2358	2358
Kharif Fodders	0	10200	16575	21675	24225	25500	25500	25500	25500	25500	25500
Tomato	0	5103	8293	10845	12121	12759	12759	12759	12759	12759	12759
Melons	0	4595	7468	9765	10914	11489	11489	11489	11489	11489	11489
Kh Cauliflower	0	5487	8916	11659	13031	13717	13717	13717	13717	13717	13717
Kh. Oilseeds	1436	1661	1802	1915	1972	2000	2000	2000	2000	2000	2000
Lady's Fingers	0	4153	6748	8825	9863	10382	10382	10382	10382	10382	10382
Sugarcane	0	19619	29428	35314	37276	39238	39238	39238	39238	39238	39238
Kh. Orchards (Plant)	0	0	0	0	0	0	0	0	0	0	0
Kh. Orchards (Fruit)	0	0	0	0	0	0	3265	5306	6939	7755	8163
Rabi Crops											
Wheat	1384	1747	1975	2156	2247	2293	2293	2293	2293	2293	2293
R.Fodders	0	11061	17974	23505	26270	27653	27653	27653	27653	27653	27653
Sugarbeet	0	8958	14557	19036	21275	22395	22395	22395	22395	22395	22395
R.Oilseeds	768	906	991	1060	1094	1112	1112	1112	1112	1112	1112
Potatoes	0	4741	7704	10075	11260	11853	11853	11853	11853	11853	11853
R. Vegetables	0	2855	4640	6068	6782	7139	7139	7139	7139	7139	7139
Garlic	0	4567	7422	9706	10848	11418	11418	11418	11418	11418	11418
R. Orchards (Plant)	0	0	0	0	0	0	0	0	0	0	0
R. Orchards (Fruit)	0	0	0	0	0	0	3334	5418	7084	7918	8335

Source: PPTA 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	Year 6	Year 7	Year 8	Year 9	Year 10 & Onward
Kharif Crops											
Maize	956	2,447	4,181	5,871	7,410	8,230	8,230	8,230	8,230	8,230	8,230
Kharif Fodders	0	1,079	3,507	6,421	9,227	10,791	10,791	10,791	10,791	10,791	10,791
Tomato	0	334	1,086	1,987	2,856	3,340	3,340	3,340	3,340	3,340	3,340
Melons	0	216	701	1,283	1,844	2,156	2,156	2,156	2,156	2,156	2,156
Kh Cauliflower	0	341	1,108	2,029	2,916	3,411	3,411	3,411	3,411	3,411	3,411
Kh. Oilseeds	466	558	626	683	722	741	741	741	741	741	741
Lady's Fingers	0	349	1,133	2,075	2,982	3,488	3,488	3,488	3,488	3,488	3,488
Sugarcane	0	4,005	12,016	20,186	27,396	32,042	32,042	32,042	32,042	32,042	32,042
Kh. Orchards (Plant)	0	0	0	0	0	0	0	0	0	0	0
Kh. Orchards (Fruit)	0	0	0	0	0	0	132	428	784	1,126	1,318
Kharif Total	1,422	9,329	24,359	40,537	55,352	64,199	64,331	64,627	64,983	65,325	65,517
Rabi Crops											
Wheat	4,458	6,009	7,218	8,256	8,994	9,374	9,374	9,374	9,374	9,374	9,374
R.Fodders	0	1,617	5,254	9,618	13,821	16,165	16,165	16,165	16,165	16,165	16,165
Sugarbeet	0	782	2,541	4,652	6,684	7,818	7,818	7,818	7,818	7,818	7,818
R.Oilseeds	94	140	184	224	258	276	276	276	276	276	276
Potatoes	0	429	1,395	2,555	3,671	4,294	4,294	4,294	4,294	4,294	4,294
R. Vegetables	0	445	1,448	2,651	3,809	4,455	4,455	4,455	4,455	4,455	4,455
Garlic	0	254	825	1,511	2,171	2,539	2,539	2,539	2,539	2,539	2,539
R. Orchards (Plant)	0	0	0	0	0	0	0	0	0	0	0
R. Orchards (Fruit)	0	0	0	0	0	0	302	981	1,796	2,581	3,019
Rabi Total	4,553	9,675	18,865	29,465	39,408	44,921	45,223	45,902	46,717	47,502	47,940
Grand Total	5,975	19,004	43,223	70,002	94,759	109,120	109,553	110,529	111,700	112,827	113,456

Source: PPTA surveys, analysis, and estimates.

ANNEX TABLES

Annex Table 1.1: Derivation of the export parity prices of wheat and maize

Item	Wheat	Maize
CIF Price (in Indonesia), US\$/mt (A)	375.00	508.00
Less: Freight and insurance charges (to ship the product to Indonesia), US\$	46.97	46.97
Net CIF Price (C = A-B)	328.03	461.03
Official Exchange rate (Rs/US\$) (D)	104.75	104.75
Shadow exchange rate factor (E)	1.08	1.08
Effective exchange rate (F = D x E)	112.61	112.61
Net CIF Price at local currency (G)	36,940.30	51,917.78
Less: Port charges (Rs/mt) (0.28% of Net CIF price) (H)	1,034.33	1,453.70
Net CIF price less port charges (Rs/mt) (I)	35,905.98	50,464.08
Add: Export subsidies (0.42% of export value) (J)	861.74	1,211.14
Less: Transport, handling, and marketing costs (Rs/mt) (10%) (K)	3,590.60	5,046.41
Export parity price at the farmgate (Rs/mt) (L = I + J - K)	33,177.12	46,628.81
Export parity price at the farmgate (Rs/kg) (M = L/1000)	33.18	46.63
Export parity price at the farmgate (US\$/mt) (M =L/D)	316.73	445.14

Source: ADB estimates.

Commodity Markets Outlook - World Bank Quarterly Reports, October, 2013 & October, 2015

Food Outlook, Global Market Analysis, 2011 to 2015, FAO

Agricultural Policy Institute, Islamabad

Annex Table 1.2: Derivation of Import Parity Prices of Urea, Diammonium, Phosphate, and Potassium Chloride

Item	Commodities		
	Urea	DAP	Potassium Chloride
World Commodity Prices (US \$/ tonne) : 5-year Average 2011-15	352.5	509.5	375.1
Adjustment factor	1.0	1.0	1.2
Adjusted price US \$ /tonne	352.5	509.5	450.1
Freight charges US \$ /tonne	26.4	26.4	26.4
C&F price at Karachi US \$ /tonne	378.9	535.9	476.5
US Dollar conversion rate	104.8	104.8	104.8
C&F price at Karachi Rs /tonne	39,692.9	56,138.0	49,908.7
Marine Insurance @ 0.23% of C&F price	91.3	129.1	114.8
CIF Karachi Price Rs /tonne	39,784.2	56,267.1	50,023.5
Port Handling cost Rs /tonne	800.0	800.0	800.0
Bank Mark up @ 1% for one month	396.9	561.4	499.1
TCP Commission @ 2% of C&F value	793.9	1,122.8	998.2
Upcountry Expenses to the Project Area Rs /tonne	4,000.0	4,000.0	4,000.0
Parity Price in the Project Area Rs/ tonne	45,775.0	62,751.2	56,320.7
Transport from farm to market Rs/ tonne	400.0	400.0	400.0
Parity Price at Farmgate Rs/tonne	45,375.0	62,351.2	55,920.7
Parity Price at Farmgate Rs/ Kg	45.4	62.4	55.9
Parity Price at Farmgate Rs/ Nutrient Kg	98.6	117.8	111.8
Sources:			
1. Commodity Markets Outlook - World Bank Quarterly Reports, October, 2013 & October, 2015			
2. Food Outlook, Global Market Analysis, 2011 to 2015, FAO			
3. Agricultural Policy Institute, Islamabad			
Notes :			
a) due to highly fluctuating world commodity prices a 5-years average price has been used			
b) Adjustment factor applied for considering quality difference.			
c) US \$ exchange rate for Rupee was 105 as in October, 2015.			

Annex Table 2: Calculation of the Standard Conversion Factor (SCF)

	Description/Years	2008-09	2009-10	2010-11	2011-12	2012-13	Average
1	Total Imports*	2,723,570	2,910,975	3,455,287	4,009,093	4,349,879	3,489,761
2	Total Exports*	1,383,718	1,617,458	2,120,847	2,110,605	2,366,478	1,919,821
3	Import Duties**	155,153	161,504	187,695	219,597	242,989	193,388
4	Sales Tax on Imports**	203,778	247,273	308,694	430,406	430,423	324,115
5	Subsidies on Imports***	29,300	37,725	20,200	49,198	434,988	114,282
6	Export Duties**	3,815	4,551	5,685	5,762	6,832	5,329
7	Export Rebates**	7,646	5,783	8,527	8,453	10,362	8,154
Standard Conversion Factor $[M+X / (M+T_m)+(X-T_x)] =$				0.93			
Where;					T _m =	403220.26	
					T _x =	-2825.2	
M= CIF value of imports					M + X=	5409582	
X= FOB value of exports					M+T _m =	3892981.1	
T _m = Net value of taxes on imports					X-T _x =	1922646.4	
T _x = Net value of taxes on exports					SCF=	0.93	
Sources:							
* Economic Survey 2014-15							
** Year Book, 2013-14, FBR Islamabad							
*** Ministry of Finance, Islamabad; (for 2012-13, the figure is estimated on the basis of average ratio of import subsidies to total imports due to its non-availability).							

Annex Table 3: Derivation of the Shadow Wage Rate Factor

I. Price Ratio of Domestic and Border Prices*						
Crop	Domestic Price (US\$/mt) **	Border Price (US\$/mt)	Price Ratio	Value of Production (2013) (in US\$ million)***	Weight (%)	Value
	(A)	(B)	(C) = (A) / (B)	(D)	(E)	(F) = (C) x (E)
1. Wheat	375.89	316.73	1.19	521.25	11.67	0.14
2. Maize	322.20	445.14	0.72	3,943.82	88.33	0.64
Total				4,465.07	100.00	
Weighted Average						0.78
II. Conversion factor to bring the value of foregone output (i.e. foregone output because labor is not put into productive use) to border prices						
Conversion factor (G) = 1/(F)						1.29
III. Reciprocal of the employment rate						
Labor force participation rate (%) (H)**						24.83
Employment in agriculture (%) (I)***						43.70
Under-employment in agriculture (%) (J)						-
Adjusted employment rate in agriculture (%) (K) = (I) - (J)						43.70
(L) = (H) / (K)						0.57
IV. Shadow Wage Rate Factor						
(M) = (G) x (L)						0.73
*Average from 2000 to 2013						
**Source: Pakistan Bureau of Statistics (2013-2014) (Labor force participation rate in the rural area of Khyber Pakhtunkhwa)						
*** Source: World Bank Pink Sheet and FAOSTAT						
Notes: The method used in calculating the SWRF was based on the estimated value of the direct opportunity cost of hiring unskilled labor for agricultural production (based on: Medalla, E.M.; Del Rosario, C.M.; Pineda, V.S.; Querubin, R.G.; and Tan, E.S. 1990. Re-estimation of Shadow Prices for the Philippines. Working Paper Series No. 90-16, Philippine Institute for Development Studies, 61p). The conversion factor based on the ratio of the border and domestic prices of major agricultural commodities represent the foregone value of output at border prices when labor is not used in productive use. This was multiplied by the ratio of the labor force (of the whole economy) to the employment in agriculture, which represents the number of responding migrants from the economy-at-large for each job created in the agriculture sector. In broad terms, this ratio also represents the marginal product of unskilled labor in agriculture (where the change in output in the agriculture sector is given by the additional labor flowing into the sector from the economy-at-large, and the change in the quantity of unskilled labor as the employment in agriculture).						

Annex Table 4: Economic Cost of Resettlement and Land Acquisition

Item	Resettlement Activity	Unit	Quantity	Unit Rate (Rs.)	Total Financial Costs (Rs.)	Conversion Factor	Economic Values (Rs.)	Source
A	Land Acquisition							
i)	Agriculture land	Hectare	193.51	5,368,139	1,038,788,513			Unit price of the acquired agricultural land was calculated as the forgone net economic benefits 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 Tab: Land Opportunity Cost_193.51ha
	Barren land	Hectare	11.42	4,852,436	55,414,815	0.93	51,545,768	Barren land in the project area. (Annex 9.1 and 9.1 a) multiplied with SCF
	Residential land	Hectare	5.67	27,004,347	153,114,649	0.93	142,424,228	In case of residential land near Abadi at District Swabi and Nowshera (Annex 9.1 and 9.1 a) Multiplied with SCF
	Nullah land (non-perennial water stream)	Hectare	2.52	7,323,726	18,455,790	0.93	17,167,212	Barren Land
	Hilly land	Hectare	3.98	3,704,938	14,745,655	0.93	13,716,118	Do
	Govt. land (existing road/ track canal, irrigation & others)	Hectare	1.78	-		0.93	-	Unit rate consideres as of the Barren land
	Sub Total		218.88		1,280,519,422		224,853,326	
	Compulsory Acquisition Surcharge (15%)		15%	-	192,077,913	0.93	178,667,088	This is payment to the Affecttees
	Add 2% District Council Tax		2%	-	29,451,947	-	-	Considered as Taxes
	Sub Total Land (A)				1,502,049,282		403,520,413	
B	Crops Compensations	Hectare	193.5	35,000	6,772,850	0.93	6,299,972	At current cropping intensity of 52.4% crop compensation would be required to 193.5 hectares @ Rs 35,000 per hectare. (Crop budget analysis)
	Sub-Total Crops (B)				6,772,850		6,299,972	
C	Commercial/ Residential Structures							
	Pacca (179 Nos.)	Sq.m	7326	10,222	74,886,372	0.93	69,657,827	The unit rate of residential structure is Rs. 950/ s.ft. as per building Department, 2014 (Annex 9.2) ,multiplied with SCF
	Semi-Pacca (38 Nos)	Sq.m	2328	7,532	17,534,496	0.93	16,310,242	The unit rate of residential structure is Rs. 700/ s.ft. multiplied with SCF
	Sub-Total Structures (C)		9,654		92,420,868		85,968,069	
D	Others							
	Tubewells	No.	1	250,000	250,000	0.93	232,545	Do
	Sub-Total Other Structures (D)				250,000		232,545	

Continued.....

(Continued)

Annex Table 4: Economic Cost of Resettlement and Land Acquisition

Item	Resettlement Activity	Unit	Quantity	Unit Rate (Rs.)	Total Financial Costs (Rs.)	Conversion Factor	Economic Values (Rs.)	Source
E	Trees - Private Ownership							
	Timber/ Fuel	Nos.	1110	3,500	3,885,000	0.93	3,613,750	The average girth of wood trees along the project alignment is between 4-6 feet, the unit price as per Forest Department is Rs. 3500/ tree (Annex 9.3), unit rate multiplied with SCF
	Fruit	Nos.		-	-	0.93	-	
	Sub-Total Trees (E)				3,885,000		3,613,750	
F	Allowances/ Livelihood Restoration (Estimated)							
	Business interruption allowance (for 3 months based on the official wage rate at Rs. 13,000 per month).	Nos.	39	45,000	1,755,000	0.93	1,632,466	
	Severity allowance equal to 1 crop year	Hectare	193.51	44,980	8,704,080	0.93	8,096,363	
	Shifting/ transport assistance/ allowance Rs.5,000) - 179 house + 38 shops	Nos.	217	5,000	1,085,000	0.93	1,009,246	
	Livelihood assistance for the lost of 179 houses - (for 3 months based on the official wage rate at Rs. 13,000 per month).	Nos.	179	45,000	8,055,000	0.93	7,492,602	
	Vulnerability allowance (cash allowance for 3 months based on the Official Wage Rate Rs. 13000 per month as fixed). - 39 DPs are below poverty line	Nos.	39	45,000	1,755,000	0.93	1,632,466	
	Sub-Total Allowances (F)				21,354,080		19,863,144	
G	Monitoring & Capacity Building (intermittent input)	lumpsum			13,267,920	0.93	12,341,558	
	Sub-Total (G):				13,267,920		12,341,558	
	Grand Total (A to G):				1,640,000,000		531,839,452	
	Rs in Million):				1,640.000		531.839	This is one-off cost of land in economic terms to be phased during years 1, 2, and 3. However the cost stream will contain annual loss of agriculture over the period of analysis of 30 years.

Source: PPTA Survey (2015).

Annex Table 5. Estimation of the Opportunity Cost of Agricultural Land

Annex Table 5.1: Cropping Intensities (%) by Crop for the 193.51 ha of Agricultural Land Earmarked for Acquisition

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Maize	10.36	17.77	25.18	31.11	37.04	40.00	40.00	40.00	40.00	40.00	40.00
Kharif Fodders	0.00	1.21	2.42	3.39	4.36	4.85	4.85	4.85	4.85	4.85	4.85
Tomato	0.00	0.75	1.50	2.10	2.70	3.00	3.00	3.00	3.00	3.00	3.00
Melons	0.00	0.54	1.08	1.51	1.94	2.15	2.15	2.15	2.15	2.15	2.15
Kh Cauliflower	0.00	0.71	1.42	1.99	2.56	2.85	2.85	2.85	2.85	2.85	2.85
Kh. Oilseeds	3.72	3.85	3.98	4.09	4.19	4.25	4.25	4.25	4.25	4.25	4.25
Lady's Fingers	0.00	0.96	1.92	2.69	3.46	3.85	3.85	3.85	3.85	3.85	3.85
Sugarcane	0.00	2.34	4.68	6.55	8.42	9.36	9.36	9.36	9.36	9.36	9.36
Kh. Orchards (Plant)	0.00	0.46	0.92	1.29	1.66	1.85	1.40	0.95	0.59	0.23	0.05
Kh. Orchards (Fruit)	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.90	1.26	1.62	1.80
Kharif Total	14.08	28.60	43.12	54.73	66.34	72.15	72.15	72.15	72.15	72.15	72.15
Wheat	36.92	39.40	41.88	43.87	45.86	46.85	46.85	46.85	46.85	46.85	46.85
R.Fodders	0.00	1.67	3.35	4.69	6.03	6.70	6.70	6.70	6.70	6.70	6.70
Sugarbeet	0.00	1.00	2.00	2.80	3.60	4.00	4.00	4.00	4.00	4.00	4.00
R.Oilseeds	1.40	1.77	2.13	2.42	2.70	2.85	2.85	2.85	2.85	2.85	2.85
Potatoes	0.00	1.04	2.08	2.91	3.74	4.15	4.15	4.15	4.15	4.15	4.15
R. Vegetables	0.00	1.79	3.58	5.01	6.44	7.15	7.15	7.15	7.15	7.15	7.15
Garlic	0.00	0.64	1.27	1.78	2.29	2.55	2.55	2.55	2.55	2.55	2.55
R. Orchards (Plant)	0.00	1.04	2.08	2.91	3.74	4.15	3.14	2.13	1.32	0.51	0.11
R. Orchards (Fruit)	0.00	0.00	0.00	0.00	0.00	0.00	1.01	2.02	2.83	3.64	4.04
Rabi Total	38.32	48.34	58.36	66.37	74.39	78.40	78.40	78.40	78.40	78.40	78.40
Grand Total	52.40	76.94	101.48	121.10	140.73	150.55	150.55	150.55	150.55	150.55	150.55

Source: PPTA Survey (2015).

Annex Table 5.2: Cropped Area (ha) by Crop for the 193.51 ha of Agricultural Land Earmarked for Acquisition

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Maize	20.1	34.4	48.7	60.2	71.7	77.4	77.4	77.4	77.4	77.4	77.4
Kharif Fodders	0.0	2.3	4.7	6.6	8.4	9.4	9.4	9.4	9.4	9.4	9.4
Tomato	0.0	1.5	2.9	4.1	5.2	5.8	5.8	5.8	5.8	5.8	5.8
Melons	0.0	1.0	2.1	2.9	3.7	4.2	4.2	4.2	4.2	4.2	4.2
Kh Cauliflower	0.0	1.4	2.8	3.9	5.0	5.5	5.5	5.5	5.5	5.5	5.5
Kh. Oilseeds	7.2	7.5	7.7	7.9	8.1	8.2	8.2	8.2	8.2	8.2	8.2
Lady's Fingers	0.0	1.9	3.7	5.2	6.7	7.4	7.4	7.4	7.4	7.4	7.4
Sugarcane	0.0	4.5	9.1	12.7	16.3	18.1	18.1	18.1	18.1	18.1	18.1
Kh. Orchards (Plant)	0.0	0.9	1.8	2.5	3.2	3.6	2.7	1.8	1.1	0.4	0.1
Kh. Orchards (Fruit)	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.7	2.4	3.1	3.5
Kharif Total	27	55	83	106	128	140	140	140	140	140	140
Wheat	71.4	76.2	81.1	84.9	88.7	90.7	90.7	90.7	90.7	90.7	90.7
R.Fodders	0.0	3.2	6.5	9.1	11.7	13.0	13.0	13.0	13.0	13.0	13.0
Sugarbeet	0.0	1.9	3.9	5.4	7.0	7.7	7.7	7.7	7.7	7.7	7.7
R.Oilseeds	2.7	3.4	4.1	4.7	5.2	5.5	5.5	5.5	5.5	5.5	5.5
Potatoes	0.0	2.0	4.0	5.6	7.2	8.0	8.0	8.0	8.0	8.0	8.0
R. Vegetables	0.0	3.5	6.9	9.7	12.5	13.8	13.8	13.8	13.8	13.8	13.8
Garlic	0.0	1.2	2.5	3.5	4.4	4.9	4.9	4.9	4.9	4.9	4.9
R. Orchards (Plant)	0.0	2.0	4.0	5.6	7.2	8.0	6.1	4.1	2.6	1.0	0.2
R. Orchards (Fruit)	0.0	0.0	0.0	0.0	0.0	0.0	2.0	3.9	5.5	7.0	7.8
Rabi Total	74	94	113	128	144	152	152	152	152	152	152
Grand Total	101	149	196	234	272	291	291	291	291	291	291

Source: PPTA Survey (2015).

**Annex Table 5.3: Per Hectare Net Value of Crops - Economic Terms
(PRs)**

Crops	Base Year	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Kharif Crops											
Maize	28,534	50,520	62,063	71,160	75,366	77,674	77,674	77,674	77,674	77,674	77,674
Kharif Fodders	-	20,081	36,267	49,131	55,353	58,590	58,590	58,590	58,590	58,590	58,590
Tomato	-	150,927	274,801	365,376	409,624	431,567	431,567	431,567	431,567	431,567	431,567
Melons	-	98,508	170,232	224,591	251,286	264,924	264,924	264,924	264,924	264,924	264,924
Kh Cauliflower	-	172,240	303,477	400,641	448,573	472,042	472,042	472,042	472,042	472,042	472,042
Kh. Oilseeds	50,344	50,344	50,344	50,344	50,344	50,344	50,344	50,344	50,344	50,344	50,344
Lady's Fingers	-	101,988	172,324	228,936	256,921	271,106	271,106	271,106	271,106	271,106	271,106
Sugarcane	-	34,662	74,071	96,138	102,111	109,743	109,743	109,743	109,743	109,743	109,743
Kh. Orchards (Plant)											
Kh. Orchards (Fruit)	-	(42,711)	(25,508)	(28,099)	(33,363)	(37,998)	135,587	240,225	324,497	365,994	387,381
Rabi Crops											
Wheat	29,268	38,060	45,541	50,109	51,837	53,018	53,018	53,018	53,018	53,018	53,018
R.Fodders	-	19,654	35,636	48,222	54,018	57,214	57,214	57,214	57,214	57,214	57,214
Sugarbeet	-	21,489	39,332	53,271	59,401	62,969	62,969	62,969	62,969	62,969	62,969
R.Oilseeds	21,806	27,469	30,686	33,141	34,074	34,718	34,718	34,718	34,718	34,718	34,718
Potatoes	-	19,345	99,392	174,584	208,278	227,134	227,134	227,134	227,134	227,134	227,134
R. Vegetables	-	77,682	145,285	196,550	221,128	232,702	232,702	232,702	232,702	232,702	232,702
Garlic	-	275,969	500,496	678,044	762,785	807,548	807,548	807,548	807,548	807,548	807,548
R. Orchards (Plant)											
R. Orchards (Fruit)	-	(42,334)	(25,760)	(28,099)	(33,363)	(37,998)	112,361	202,482	275,141	310,832	329,316

Source: PPTA Survey (2015).

Annex Table 5.4: Economic Value by Crop for the 193.51 ha of Agricultural Land Earmarked for the Project's Acquisition (PRs million)

Year	Maize	Kharif Fodders	Tomato	Melons	Kh Cauliflower	Kh. Oilseeds	Lady's Fingers	Sugarcane	Wheat	R.Fodders	Sugarbeet	R.Oilseeds	Potatoes	R. Vegetables	Garlic	Kh. Orchards (Fruit)	R. Orchards (Fruit)	Total Forgone (Rs million)
1	0.57	-	-	-	-	0.36	-	-	2.09	-	-	0.06	-	-	-	-	-	3.08
2	1.74	0.05	0.22	0.10	0.24	0.38	0.19	0.16	2.90	0.06	0.04	0.09	0.04	0.27	0.34	(0.04)	(0.09)	6.69
3	3.02	0.17	0.80	0.35	0.84	0.39	0.64	0.67	3.69	0.23	0.15	0.13	0.40	1.01	1.23	(0.05)	(0.10)	13.57
4	4.28	0.32	1.48	0.65	1.55	0.40	1.19	1.22	4.25	0.44	0.29	0.15	0.98	1.90	2.34	(0.07)	(0.16)	21.23
5	5.40	0.47	2.14	0.94	2.23	0.41	1.72	1.66	4.60	0.63	0.41	0.18	1.51	2.75	3.38	(0.11)	(0.24)	28.09
6	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	(0.14)	(0.31)	32.00
7	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	0.49	0.90	33.83
8	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	0.12	1.63	34.19
9	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	0.43	2.21	35.09
10	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	0.81	2.50	35.76
11	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.18	2.65	36.27
12	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
13	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
14	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
15	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
16	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
17	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
18	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
19	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
20	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
21	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
22	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
23	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
24	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
25	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
26	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
27	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
28	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
29	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48
30	6.01	0.55	2.51	1.10	2.60	0.41	2.02	1.99	4.81	0.74	0.49	0.19	1.82	3.22	3.98	1.39	2.65	36.48

Source: PPTA Survey (2015).

**Annex Table 6: Consolidated Cash Flow – Base Case
(PRs Million)**

YEAR	Investment Costs	Opportunity Cost of Land Acquisition & Resettlement	O&M	Total Costs	Agriculture Benefits			Net Incremental Benefits
					Without Project	With Project	Incremental Benefits	
1	74.70	-	-	74.70	139.11	139.11	-	(74.70)
2	808.02	109.45	-	917.47	139.11	139.11	-	(917.47)
3	1,626.13	219.43	-	1,845.56	139.11	139.11	-	(1,845.56)
4	1,332.40	226.31	-	1,558.71	139.11	185.28	46.17	(1,512.54)
5	805.50	21.23	22.04	848.77	139.11	307.81	168.70	(680.07)
6	478.96	28.09	22.94	529.98	139.11	625.10	485.99	(44.00)
7		32.00	23.93	55.93	139.11	981.99	842.87	786.94
8		33.83	25.01	58.85	139.11	1,301.82	1,162.70	1,103.86
9		34.19	26.21	60.40	139.11	1,485.68	1,346.56	1,286.16
10		35.09	27.52	62.61	139.11	1,499.56	1,360.45	1,297.84
11		35.76	28.97	64.73	139.11	1,536.37	1,397.25	1,332.53
12		36.27	30.56	66.83	139.11	1,584.19	1,445.08	1,378.25
13		36.48	32.31	68.79	139.11	1,630.20	1,491.09	1,422.30
14		36.48	34.24	70.72	139.11	1,654.50	1,515.39	1,444.67
15		36.48	36.36	72.84	139.11	1,654.50	1,515.39	1,442.55
16		36.48	38.69	75.17	139.11	1,654.50	1,515.39	1,440.22
17		36.48	41.25	77.73	139.11	1,654.50	1,515.39	1,437.66
18		36.48	44.08	80.55	139.11	1,654.50	1,515.39	1,434.84
19		36.48	47.18	83.65	139.11	1,654.50	1,515.39	1,431.73
20		36.48	50.59	87.07	139.11	1,654.50	1,515.39	1,428.32
21		36.48	54.34	90.82	139.11	1,654.50	1,515.39	1,424.57
22		36.48	57.98	94.46	139.11	1,654.50	1,515.39	1,420.93
23		36.48	57.98	94.46	139.11	1,654.50	1,515.39	1,420.93
24		36.48	57.98	94.46	139.11	1,654.50	1,515.39	1,420.93
25		36.48	57.98	94.46	139.11	1,654.50	1,515.39	1,420.93
26		36.48	57.98	94.46	139.11	1,654.50	1,515.39	1,420.93
27		36.48	57.98	94.46	139.11	1,654.50	1,515.39	1,420.93
28		36.48	57.98	94.46	139.11	1,654.50	1,515.39	1,420.93
29		36.48	57.98	94.46	139.11	1,654.50	1,515.39	1,420.93
30		36.48	57.98	94.46	139.11	1,654.50	1,515.39	1,420.93
ENPV	3,414.77	552.77	182.55	4,130.54	1,120.58	6,853.22	5,732.64	1,602.10
EIRR								16.1%
Total								5,125.70
ENPV								1,602.100
BC Ratio								1.66

**Annex Table 7: Sensitivity Analysis
(PRs Million)**

Case 1 - Increase in Capital Costs		Case 2 - Increase in O&M Costs		Case 3 - Combined Cases 1 and 2		Case 4 - Decrease in Overall Benefit		Case 5 - Benefit delay by 2 Years		Case 6 - Combination of Cases 3 and 4	
VAR	NCF	VAR	NCF	VAR	NCF	VAR	NCF	VAR	NCF	VAR	NCF
82.16	(82.16)	74.70	(74.70)	82.16	(82.16)	-	(74.70)	-	(74.70)	-	(82.16)
998.27	(998.27)	917.47	(917.47)	1,009.22	(1,009.22)	-	(917.47)	-	(917.47)	-	(1,009.22)
2,008.17	(2,008.17)	1,845.56	(1,845.56)	2,030.12	(2,030.12)	-	(1,845.56)	-	(1,845.56)	-	(2,030.12)
1,691.95	(1,645.78)	1,558.71	(1,512.54)	1,714.58	(1,668.41)	41.55	(1,517.15)	-	(1,558.71)	41.55	(1,673.03)
929.32	(760.62)	850.97	(682.28)	933.65	(764.95)	151.83	(696.94)	-	(848.77)	151.83	(781.82)
577.88	(91.89)	532.28	(46.29)	582.98	(96.99)	437.39	(92.59)	46.17	(483.81)	437.39	(145.59)
55.93	786.94	58.32	784.55	61.52	781.35	758.59	702.66	168.70	112.77	758.59	697.06
58.85	1,103.86	61.35	1,101.36	64.73	1,097.97	1,046.43	987.59	485.99	427.14	1,046.43	981.70
60.40	1,286.16	63.02	1,283.54	66.44	1,280.12	1,211.91	1,151.51	842.87	782.47	1,211.91	1,145.47
62.61	1,297.84	65.36	1,295.09	68.87	1,291.58	1,224.41	1,161.80	1,162.70	1,100.09	1,224.41	1,155.53
64.73	1,332.53	67.62	1,329.63	71.20	1,326.05	1,257.53	1,192.80	1,346.56	1,281.84	1,257.53	1,186.33
66.83	1,378.25	69.89	1,375.19	73.52	1,371.56	1,300.57	1,233.74	1,360.45	1,293.62	1,300.57	1,227.06
68.79	1,422.30	72.02	1,419.07	75.67	1,415.42	1,341.98	1,273.19	1,397.25	1,328.46	1,341.98	1,266.31
70.72	1,444.67	74.14	1,441.24	77.79	1,437.60	1,363.85	1,293.13	1,445.08	1,374.36	1,363.85	1,286.06
72.84	1,442.55	76.47	1,438.91	80.12	1,435.27	1,363.85	1,291.01	1,491.09	1,418.25	1,363.85	1,283.73
75.17	1,440.22	79.04	1,436.35	82.68	1,432.70	1,363.85	1,288.68	1,515.39	1,440.22	1,363.85	1,281.16
77.73	1,437.66	81.86	1,433.53	85.50	1,429.88	1,363.85	1,286.12	1,515.39	1,437.66	1,363.85	1,278.34
80.55	1,434.84	84.96	1,430.43	88.61	1,426.78	1,363.85	1,283.30	1,515.39	1,434.84	1,363.85	1,275.24
83.65	1,431.73	88.37	1,427.02	92.02	1,423.37	1,363.85	1,280.19	1,515.39	1,431.73	1,363.85	1,271.83
87.07	1,428.32	92.13	1,423.26	95.77	1,419.61	1,363.85	1,276.78	1,515.39	1,428.32	1,363.85	1,268.07
90.82	1,424.57	96.25	1,419.13	99.90	1,415.48	1,363.85	1,273.03	1,515.39	1,424.57	1,363.85	1,263.95
94.46	1,420.93	100.26	1,415.13	103.91	1,411.48	1,363.85	1,269.39	1,515.39	1,420.93	1,363.85	1,259.94
94.46	1,420.93	100.26	1,415.13	103.91	1,411.48	1,363.85	1,269.39	1,515.39	1,420.93	1,363.85	1,259.94
94.46	1,420.93	100.26	1,415.13	103.91	1,411.48	1,363.85	1,269.39	1,515.39	1,420.93	1,363.85	1,259.94
94.46	1,420.93	100.26	1,415.13	103.91	1,411.48	1,363.85	1,269.39	1,515.39	1,420.93	1,363.85	1,259.94
94.46	1,420.93	100.26	1,415.13	103.91	1,411.48	1,363.85	1,269.39	1,515.39	1,420.93	1,363.85	1,259.94
94.46	1,420.93	100.26	1,415.13	103.91	1,411.48	1,363.85	1,269.39	1,515.39	1,420.93	1,363.85	1,259.94
94.46	1,420.93	100.26	1,415.13	103.91	1,411.48	1,363.85	1,269.39	1,515.39	1,420.93	1,363.85	1,259.94
94.46	1,420.93	100.26	1,415.13	103.91	1,411.48	1,363.85	1,269.39	1,515.39	1,420.93	1,363.85	1,259.94
94.46	1,420.93	100.26	1,415.13	103.91	1,411.48	1,363.85	1,269.39	1,515.39	1,420.93	1,363.85	1,259.94
ENPV	1,260.62	ENPV	1,585.80	ENPV	1,189.05	ENPV	1,028.84	ENPV	354.00	ENPV	615.78
EIRR	15.1%	EIRR	16.1%	EIRR	14.9%	EIRR	14.7%	EIRR	12.8%	EIRR	13.5%
SI	2.13	SI	0.10	SI	3.47	SI	5.57	SI	n.a	SI	n.a
SV	47%	SV	973%	SV	29%	SV	18%	SV	6 yrs	SV	n.a