ECONOMIC AND FINANCIAL ANALYSIS

A. Introduction

1. The proposed Jalalpur Irrigation Project will enhance irrigation water supplies through the right bank of the Rasul Barrage on the Jhelum River. It is proposed as a nonperennial irrigation system, which will provide irrigation supplies during *kharif* season[1] (i.e., from April to October). The project will bring areas of Tehsil Pind Dadan Khan of Jhelum district and Tehsil Khushab of Khushab district under the canal command. Without-project and with-project scenarios were compared to determine the economic net benefits of the project. The without-project scenario assumes a continuation of current agricultural practices which are largely *barani* agriculture[2] and intermittent irrigation of wheat in *rabi* season[3] 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, because of improved water availability from new irrigation infrastructure attributable to the project. It is expected that the project will lead to (i) greater area of irrigated production of *kharif* crops, (ii) higher crop yields of *kharif* crops and wheat (because of availability of adequate soil moisture in some areas), and (iii) a shift to the production of high-value crops.

B. Macroeconomic Assessments

2. Pakistan's agriculture sector experience modest growth during 1970–2016 when it grew by about 3.4% per annum.[4] The highest growth rates were achieved in 1985 (11%), 1992 (10%), and 1996 (12.0%). The agriculture sector experienced negative growth of –5% in 1984 and 1993, and –2% in 2001 because of severe droughts 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 milk, cows' milk, wheat, rice, and cotton. These products are mostly grown in the Indus River plain in the provinces of Punjab and Sindh. As of 2010 Punjab accounted for roughly 55% of the country's total agriculture production area, and Sindh 19%.[6] During 2000–2016, buffalo 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 was closely followed by wheat, which contributed $4.0 billion and 14.1% of the average annual agricultural GDP, and cows' milk, which contributed $3.1 billion and 10.8% of the average annual agricultural GDP. Other major agricultural products include rice, cotton lint, sugarcane, maize, and potato.

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 was 3.1 hectares (ha), which

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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 agriculture sector was 4% during 2000–2016.
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.

was a significant decrease from 1973 when the average farm size was 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 because of 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 the Agriculture Census Report (2010) with classification into five categories: very small (less than 2.02 ha), small (2.02–5.05 ha), medium (5.05–10.1 ha), large (10.1–20.2 ha), and very large (more than 20.2 ha). Of the 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%). This indicates that about 40,032 farming families would directly benefit 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 was about $179.30, increasing at an average annual rate of 0.5%. Despite the annual increase in food production value, the FAO reports that the average annual food deficit in the country was about 171.3 kilocalories per capita per day from 1990 to 2015. Undernourishment has remained high since at least 1990s at 20.0%.

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 was accompanied by volatility of domestic food prices, which was roughly 10% 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 in the national GDP has been declining, 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 especially the inadequacy of basic infrastructure such as for irrigation.

8. Water in the project area is scarce and there is strong demand by farmers for a sustainable supply of irrigation water to increase the efficiency with which farm resources are used. Having a sustainable supply of irrigation water could raise the cropping intensities and crop yields, and may provide farmers with incentives to venture into the production of high-value crops. These changes in the agricultural production landscape could result in better and more sustainable rural incomes.

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[7] M. Sial, S. Iqbal, and A. Sheikh. 2012. Farm Size-Productivity Relationship. *Pakistan Economic and Social Review.* Vol. 50, No. 2 (Winter 2012), pp. 139–62 (as reported by FAO [2001]).

[8] ADB. 2013. *Jalalpur Irrigation Project.* Consultant's 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 in the 80 target villages whose major source of income is farming.

[9] FAOSTAT. 2016. *Food Supply - Livestock and Fish Primary Equivalent.* FAO. http://faostat3.fao.org/download/FB/CL/E

9. The favorable climate and cheap labor for growing high-value crops will help to increase farm incomes in the project area. The project area is suitable for shifting towards and growing high-value crops such as 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 nearby urban centers such as 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 of these crops.

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

Table 1: Production Profile

	Production 2014–2015			**Project Area in 2014–2015**		**Project Area in 2025–2026**	
Major Crops	**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	6.480	0.16	194.84	4.85
Cotton	2,374	1,747.0	73.59	0.183	0.01	14.34	0.82
Rice	7,003	3,648.0	52.09	0.608	0.02	12.65	0.35
Bajra	295	267.4	90.64	1.230	0.46	1.74	0.65
Kharif Oilseeds (Sesamum)	34	25.8	75.22	0.086	0.33	0.48	1.86
Wheat	25,086	19,282.0	76.86	25.940	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 nonavailability of adequate and quality irrigation water. 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 nonfood crops. 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) is 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 do not have the incentive to invest in 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 in irrigation development can only succeed 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 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% (13.00% 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 because of erratic and inadequate rainfall resulting in shortage of required moisture.

16. **With-project scenario.** With provision of irrigation water supply to the existing unirrigated command area, there would be improvement in the cropping pattern, cropping intensity, and crop yields. In this scenario, an area of 68,263 ha where rain-fed agriculture is being practiced will be brought under canal irrigation during *kharif* season. A 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 132.60% (90.00% in *kharif* and 42.50% in *rab*i 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 will also contribute to improved environmental health of households in the beneficiary villages.

F. Major Assumptions

17. The assumptions used in converting financial into economic values and estimating economic parameters include the following: (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 nontradable goods; (iii) a shadow wage rate factor of 0.76 was used for unskilled labor; (iv) specific conversion factors for cement, steel, petroleum products, and insecticides have also been derived for converting the values into economic terms; (v) export parity prices have been derived for rice and cotton, which are the major export commodities of Pakistan; (vi) a discount rate of 9% was considered as the opportunity cost of capital; and (vii) the cash flows have been drawn in the local currency (Pakistan rupees). The exchange rate of $1.0 = PRs105 was used in the economic analysis.

18. **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 costs associated with the rebuilding of the residential and commercial areas. 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.

19. Detailed assumptions, costs, and benefit estimations and data sources used in the economic analysis are in supplementary document 17 (Detailed Economic and Financial Analysis, supported by a Microsoft Excel estimation model), available upon request.

G. Project Costs

20. **Capital costs.** The total capital costs, based on engineering designs, have been estimated at PRs32,722 million, which includes a physical contingency of PRs953 million. Duties and taxes were estimated at PRs3,602 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 PRs21,928 million, exclusive of taxes and duties.

21. **Operation and maintenance costs.** The annual incremental operation and maintenance (O&M) cost in financial terms for the irrigation system is PRs370 million, which is equivalent to $3.52 million. A 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 PRs330.70 million ($3.15 million). The O&M is assumed after hiring the operational staff and will start 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.

H. Project Benefits

22. **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 because of 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 because of improved long-run farm and water management, and availability of reliable irrigation water supply. 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.

23. **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 because of 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

24. **Approach and methodology.** A benefit–cost analysis was undertaken to measure the economic internal rate of return (EIRR) and the economic net present value (ENPV) as economic viability criteria. All costs and benefits have been valued in economic terms by converting the financial values by appropriately using the SCF for nontradable goods. For major tradable goods,

export and import parity prices were derived separately. 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.

25. **Economic returns and sensitivity analysis.** Construction of the project envisages developing irrigated agriculture in the currently unirrigated below-subsistence farming land 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 can only be grown with regulated irrigation supply. All these development interventions will enhance productivity and increase farm incomes. Thus, the project is deemed economically viable given the calculated overall EIRR of 15.2% and the overall ENPV of PRs16,563 million. Table 2 outlines the results of economic analysis and sensitivity analysis and Table 3 presents the estimated streams of costs and benefits. 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.

Table 2: Results of Economic Analysis and Sensitivity Analysis

Results of Evaluation	Change	ENPV (PRs million)	EIRR (%)	Sensitivity Indicator [a]	Switching Value[b] (%)
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		14,579	14.1	1.1	74
Case 4 - Decrease in overall benefit	–10%	12,922	13.9	2.8	36
Case 5 - Benefit delay by 2 years	–2 years	10,720	12.5	5.4	18
Case 6 - Combination of cases 3 and 4		10,939	12.9	5.1	19

EIRR = economic internal rate of return, ENPV = economic net present value,
[a] The ratio that compares percentage change in ENPV with percentage change in a variable.
[b] The percentage change in a variable sufficient to reduce the ENPV to zero.
Source: Asian Development Bank estimates.

26. 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 2 and explained as follows:

(i) **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%.

(ii) **Case 2: Increase in operation and maintenance costs.** A 10% increase in O&M costs causes a small change in the EIRR. The level of increase in the total O&M cost at which the EIRR would be equal to the hurdle is 929%.

(iii) **Case 3: Combination of cases 1 and 2:** A combination of cases 1 and 2 will cause the EIRR to fall to 14.1%.

(iv) **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%.

(v) **Case 5: Two-year benefit delay.** A 2-year delay in the realization of project benefits will cause the EIRR to fall to 12.5%.

(vi) **Case 6: Combination of cases 3 and 4.** A combination of cases 3 and 4 will cause the EIRR to fall to 12.9%.

27. The sensitivity analysis indicates that the economic viability of the project is most sensitive to a 2-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.

Table 3: Estimated Stream of Cost and Benefits

(PRs million)

Year	Investment Costs	Opportunity Cost of Land	Operation and Maintenance	Total Costs	Agriculture Benefits			Net Incremental Benefits
					Without Project	With Project	Incremental Benefits	
1	6,101	0	0	6,101	492	492	0	-6,101
2	5,323	33	0	5,356	492	492	0	-5,356
3	5,536	34	0	5,570	492	492	0	-5,570
4	3,111	34	0	3,145	492	492	0	-3,145
5	1,076	35	155	1,266	500	2,153	1,653	388
6	781	35	159	976	502	3,592	3,090	2,114
7		35	164	199	511	5,230	4,719	4,520
8		35	169	204	519	5,430	4,911	4,707
9		35	175	210	521	5,711	5,189	4,979
10		35	182	217	521	5,711	5,189	4,973
11		35	189	224	521	5,711	5,189	4,966
12		35	197	231	521	5,711	5,189	4,958
13		35	205	240	521	5,711	5,189	4,949
14		35	215	249	521	5,711	5,189	4,940
15		35	225	260	521	5,711	5,189	4,930
16		35	236	271	521	5,711	5,189	4,918
17		35	249	284	521	5,711	5,189	4,906
18		35	263	298	521	5,711	5,189	4,892
19		35	278	313	521	5,711	5,189	4,877
20		35	295	329	521	5,711	5,189	4,860
21		35	313	348	521	5,711	5,189	4,842
22		35	331	366	521	5,711	5,189	4,824
23		35	331	366	521	5,711	5,189	4,824
24		35	331	366	521	5,711	5,189	4,824
25		35	331	366	521	5,711	5,189	4,824
26		35	331	366	521	5,711	5,189	4,824
27		35	331	366	521	5,711	5,189	4,824
28		35	331	366	521	5,711	5,189	4,824
29		35	331	366	521	5,711	5,189	4,824
30		35	331	366	521	5,711	5,189	4,824
ENPV	**17,721**	**349**	**1,923**	**19,834**	**5,614**	**42,011**	**36,397**	**16,563**
EIRR								**15.2%**

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

J. Project Benefit Distribution and Poverty Impact

28. From the perspective of farm households, the incremental irrigated area would generate an average annual benefit of around $688 per ha because of project investments in irrigation (nonperennial). 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 $694.88 per annum, whereas per capita income in the project beneficiary household will increase by about $115.80 per annum. The distribution of economic benefits and costs over and above financial revenues and expenses is estimated to determine the extent to which public investment policy can affect the share that the various sectors derive from the project. Table 4 presents the result of the benefit distribution analysis. The project poverty impact ratio is estimated at 48.0% (Table 5).

Table 4: Distribution of Economic Benefits
(PRs 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	
Nontraded	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**

( ) = negative, O&M = operation and maintenance.
Source: Asian Development Bank estimates.

Table 5: Poverty Impact Analysis
(PRs million)

Particulars	Gov't/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%	75.17%	29.2%	
Benefits to the poor	(5,133.3)	2,493.9	10,589.1	7,949.7
Poverty impact ratio (%)				**48.0%**

Sources: Asian Development Bank estimates; Govt'/Economy: World Bank. 2014. *World Development Indicators. http://data.worldbank.org/data-catalog/world-development-indicators;* Labor: Z. M. Nasir. 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; Farmers: United National Development Programme. 2011. *Khyber Pakhtunkhwa Millennium Development Goals*. Peshawar.