DETAILED ECONOMIC AND FINANCIAL ANALYSIS

A. Introduction

1. The project will finance the upgrading and rehabilitation of the Chubek Irrigation System (CIS) including modernization of the two pump systems, i.e.: (i) Urtaboz 1, 2, 3, and 4 (complete) and (ii) Janubi consisting of Janubi 1 and 2, Perikachka, and Moskva 1 and 2. The objective of this project is to increase agricultural water productivity and, hence, agricultural production. The following project outputs are envisaged: (i) improved water resources management capacity in the Pyanj River Basin; (ii) modernized and climate-proofed irrigation and drainage infrastructures; and (iii) improved farm management and water use capacity. The economic and financial analysis of the project has been carried out based on Asian Development Bank (ADB) guidelines for economic analysis of the project interventions.

B. Macroeconomic Assessment

2. Agriculture in Tajikistan has gone through major transitions since its independence in 1991. Although some heavy industries were moved to the region during the Second World War, the Union of Soviet Socialist Republics (USSR) mainly dedicated the Tajik Soviet Socialist Republic (SSR) to growing cotton, which it had been doing since coming under Soviet control.[1] Throughout the first part of the 20th century, people were relocated to Tajikistan from other parts of the USSR, and a vast irrigation network in the two main river valleys of Tajikistan was set up to increase the yield and output of cotton. In the 1980s, the Tajik SSR boasted some of the world's highest-yielding cotton, which was noted also for its high quality. Tajikistan became so specialized that it grew almost nothing else, including food, thereby setting stage for later food shortages during the civil war and leaving food insecurity as one of the most pressing challenges that face the country today. Much of the infrastructure that survived the collapse of the USSR was devastated during the civil war of 1991–1997 period.[2]

3. The gross domestic product (GDP) of Tajikistan in 2014 (in current prices) is US$19.1 billion and average annual GDP growth rate is 7.5% during the 2004–2014 period. However, there is likely a declining trend during 2015 due to economic recession in the Russian Republic, weakening of the Russian ruble and tightening of migration regulations.[3] As of 2013, shares of value added to the GDP are as follows: industry 21.6%, agriculture 27.4%, and services 51%. The annual growth rate of the agriculture sector value added during the 2004–2013 is 7.5%. Employing 46.5% of the total work force (of 2.2 million people), the agriculture sector in Tajikistan remains a key engine for national economic development.

4. Tajikistan's average inflation rate as of September 2015 was 5.3%. During the 1999-2015 period, the inflation rate averaged 13.7%, reaching an all-time high of 61% in December 2000 and a record low of 1.8% in April 2004.[4] While the poverty rate remains high, Tajikistan has managed to remarkably reduce poverty from over 80% in 1999 to about 32% in 2014, the pace of which has been among the top 10% in the world.[5]

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1 USAID. 2012. *Feed the Future Initiative*. Dushanbe.
2 UNDP. 2012. *Energy for All, Gap Analysis.* Dushanbe.
3 The World Bank. 2015. *Global Overview Fact Sheet.* Dushanbe.
4 National Bank of Tajikistan. 2012. *Annual Report*. Dushanbe.
5 Worldmark encyclopedia. 2014. *Worldmark Encyclopedia of Nations*. www. Encyclopedia.com/topic/Tajikistan, 2014.

C. Demand Analysis

5. The country depends heavily on cereal imports, mainly wheat, which accounts for almost 98% of the total cereal import requirements. Wheat and barley are mainly imported from Kazakhstan, while rice is largely sourced from the Russian Federation. Wheat imports in the 2014–2015 marketing year (July/June) are forecast at 1.1 million tons, which is 4% above 2013–2014 marketing year's near-average level due to lower 2014 production outputs. In 2013–2014 marketing year, wheat imports reached 1.0 million tons with increased wheat grain and reduced flour imports.[6] The project area is water scarce and there is a strong demand by farmers for timely availability of the desired amount of irrigation water to improve agriculture production and livelihoods. Considering water as the key input to crop production, farmers' demand has strong relevance towards boosting commodity outputs to meet the domestic demand for staple foods.

D. Rationale for the Proposed Project Investment

6. Agriculture plays a crucial role in the economic growth of Tajikistan. The agricultural sector has undergone substantial changes since its independence. The international trade barriers were removed in 1991 and agricultural prices were liberalized. After years of deep decline, the sector has recovered and has become a backbone of the economy. As of 2014, the share of agricultural value added to the country's GDP is 20% and the share of the sector export, specifically for cotton lint, vegetables, and fruits, is 30%.

7. The growth of the agricultural sector in recent years is a result of land reforms. Although, land in Tajikistan remains exclusively under "state ownership",[7] land use-rights can be transferred to individuals. Peasant (*dehkan*) farms hold 98.5% of the total agricultural land. As of January 2013, the numbers of peasant (dehkan) farms reached 71,857 and the land held by dehkan farms was 98.5% of total agricultural land.[8] Nearly 90% of agricultural products are produced by the private sector: 63% by households' subsidiary plots (except cotton), and 29% by peasant (*dehkan*) farms.[9]

8. The project area has productive fertile land, gravity and pumped flow water resources, and a climate that is conducive to produce many types of food and non-food crops. In order to increase agricultural production and to improve the socio-economic conditions, there is dire need for making persistent efforts to maximize the irrigation potential of the project area through the rehabilitatation, improvement, and modernization of irrigation and drainage systems and provision of other relevant physical and non-physical facilities.

9. Agricultural studies and estimation of crop water requirements were carried out for the entire project area. Presently, the target command area is largely being cultivated with traditional crops having low yields and some of the areas is rain-fed. Regular and dependable irrigation water supply with the interventions proposed under the project will increase cropped area, crop yields, thereby expanding agriculture production.

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[6] FAO. 2013. *Country Brief Global Information and Early Warning System (GIEWS*). Dushanbe.
[7] Government of Republic of Tajikistan. *Article 13 of the Constitution of the Republic of Tajikistan.* Dushanbe.
[8] Government of the Republic of Tajikistan. 2013. *Committee on Land, Geodesy and Cartography.* Dushanbe.
[9] Government of the Republic of Tajikistan. 2010. *Agriculture Sector.* Dushanbe.

10. The present condition of low yields among traditional crops cannot be improved without providing reliable irrigation water supply in adequate amounts. The increase in cultivated area and cropping intensities in the command area is not possible without improved supply of irrigation water. Therefore, the existing level of agricultural production in the project areas is not going to improve without water resources/agriculture development projects. Without the project, it is expected that the existing cropping pattern, crop yields, and production may improve slightly. Therefore, to improve agricultural productivity to meet national agricultural production requirements, it is important for the public sector to invest in irrigation infrastructure, which is unlikely to be provided by the private sector given the magnitude of capital costs and limited potential financial or commercial returns.

E. Project Alternatives

11. Modernization and climate proofing of the gravity irrigation and drainage infrastructure in the whole project area of 50,163 ha will be carried out, including 6,953 ha which is presently being rain-fed. Regarding the pumped irrigation area, initially, all 20 pumping stations in the project area were selected for modernization. The least cost analysis was undertaken to select pump systems based on the pumping heads. The weighted average heads are 21 meters and 59 meters for Janubi pump system and for Urtaboz pump system respectively, while other pump systems have their heads over 94 meters. Based on current best practices, pump systems with lifts higher than 60 meters is not financially sustainable and hence economically unviable in pump-fed irrigation systems given existing command areas which they serve. Based on these analyses and keeping in view the available fund allocation, only two sets of pumping stations, i.e.,Janubi and Urtaboz, were prioritized and selected for modernization.

12. The project has been designed with the least operation and maintenance (O&M) cost principles, and various scenarios were examined for estimating the O&M costs. Based on the analysis, the project will finance the construction of the sediment excluding basin and the purchase of heavy machinery for sedimentation removal from the basin. This option ensures that the O&M costs for sediment handling is around $3.77/ha under with-project scenario from $36.5 per ha under the present and future without-project scenarios.

13. For the pumped irrigation, the present charges of electricity ($0.018 per KWh) remain far below the economic cost of electricity of $0.0238 per KWh. It is clear that large subsidies are required to maintain the electricity generating industry in Tajikistan or for the purchase of power during the irrigation season. With regard to the project's required O&M, the project's estimated operation and maintenance cost outlined in Table 5.1 will sufficiently cover the cost of electricity among other routine O&M and associated costs.

F. Major Assumptions

14. The major assumptions for projecting the stream of project costs and benefits are outlined below and detailed assumptions and estimation are in the MS-Excel model.

(i) General Assumptions

a. The project has two components: the pump and gravity irrigation components. These two components are inter-dependent in that: (i) the pump irrigation component is at the upstream portion of the project area, which is one of the significant sources of water for the gravity irrigated area, and (ii) the benefits obtained from the gravity component component include the increased cropping intensities and crop yields that also accrue to the pump component.

b. The financial and economic analysis compares two scenarios, i.e., “with project” and “without project” scenarios.
c. Yields are assumed to increase by 20% for all crops from year 1 to year 10 in the “with-project scenario,” while in the “without-project scenario,” the yields are assumed to be unchanged.

d. The cropping intensities, crop yields, and representative crop budget parameters were established based on the average and conservative estimates obtained from rapid field surveys, interviews with farmers, and professional judgements by the PPTA Agronomist (see section L. for data sources used to estimate crop yields and associated parameters).

e. The project economic life is assumed to be 30 years.

(ii) Project Investment

a. Project cost includes: (i) civil works, (ii) mechanical equipment, (iii) survey, study, and design, (iv) training and workshops, and (v) consulting services. Other costs include: (i) PMO and PIO salaries, (ii) office accommodation, (iii) operations and maintenance equipment, and (iv) office/vehicle for operation and maintenance activities. Detailed estimate of the project cost was based on the PPTA work conducted in 2015.

b. The share of the gravity irrigation improvement of the total investment cost is 68%. Meanwhile, the share of the modernization of selected pump stations out of the total investment cost is 32%. These proportions were based on the PPTA survey in 2015.

c. The total investment cost was assumed to phase over five years, starting year 1. The phasing of investment cost follows the schedule as shown in Table 1.

d. Replacement costs for both investment components (i.e. pump and gravity irrigation components) have been added for major repair and maintenance in years 10 and 20 at the rate of 5% of the respective capital costs.

Table 1: Phasing of Investment Cost (%)

	Year					Total
	1	2	3	4	5	
Share of total investment (%)	12.9%	27.0%	32.4%	24.7%	2.9%	100%

(iii) Operation and Maintenance Costs

a. The assumed O&M cost per hectare for the pump component is US$76.46 per ha; while US$26.77 per ha for the gravity component. These unit values were based on the detailed feasibility study accomplished through the PPTA in 2015.

b. The material component of the O&M cost is 60%, while that of labor is 40%.

c. In both the gravity and pump irrigation components, the annual O&M costs were assumed to be constant from year 6 as an effect of the replacement costs mentioned in the previous section.

(iv) Net Benefits

a. The main quantified benefit of the project is the net agricultural returns. In addition, the project would also result to savings in O&M cost due to the sediment exclusion investment.

b. The net agricultural returns were calculated based on the established gross margins for the following crops: (i) wheat, (ii) rainfed wheat, (iii) cotton, (iv) rice, (v) maize, (vi) melon, (vii) pulses, (viii) fodder, (ix) barley, (x) vegetables, (xi) oilseeds, and (xii) fruits. The respective gross magin estimates represent the net return for every unit of the output produced. The gross margins were multiplied by the estimated volume of production per year over the span of the project life for each crop under each scenario to obtain the respective flow of economic benefits.

(v) Assumptions Used in Converting Financial into Economic Values

a. The world price was used as numeraire for deriving the import and export parity prices, and that of the standard conversion factor (SCF).

b. Import and export parity prices have been derived for traded commodities. The export parity price was used for cotton; whereas import parity prices were used for wheat, maize, and paddy (rice) (see Annex Tables 21 to 24 for the detailed derivations). Meanwhile, the import parity prices for the nitrogenous, potash, and phosphoric fertilizers were derived as shown in Annex Table 25. Data used in the derivation were obtained from the PPTA surveys in 2015, the World Bank, and the Food and Agriculture Organization (FAO).

c. The financial and economic prices are shown in Annex Table 26. The economic prices were estimated based on the SCF and shadow wage rate factor (SWRF).

d. An SCF of 0.91 was used to convert a financial price into an economic value for non-tradable goods (see Annex Table 27 for the derivation). Data used in the derivation of the SCF were obtained from the Tajikistan Statistics Office and FAOSTAT.

e. An SWRF of 0.83 was used for unskilled labor (see Annex Table 28 for the derivation). Data used in the derivation of the SWRF were obtained from the World Bank and FAOSTAT.

f. A discount rate of 12% was considered as the opportunity cost of capital as the cut-off rate.

g. The cash flows have been drawn in the local currency Tajikistan Somoni (TJS) and TJS-US$ exchange rate of $1.0=TJS 6.734 was used in the economic analysis.

G. Project Costs

1. Capital Costs

15. Total capital costs, based on the engineering designs, have been estimated at $33.7 million[10] including physical and price contingencies of $2.5 million (Table 2). Interest during implementation has be calculated to be $0.7 million (for the proposed ADB ADF loan of $19.2 million). Duties and taxes were estimated at $3.7 million. For the economic analysis, all costs were converted into their respective economic values. The total project capital cost in financial terms is $33.7 million, which is equivalent of TJS 227 million. In economic prices, the total capital cost is $26.5 million, or an equivalent of TJS 178.45 million. Table 3 shows how the economic cost of the project was derived, while Table 4 expresses the total investment cost by component (pump and gravity) in economic terms.[11]

Table 2: Project Cost (Financial) ($)

Item				Total Costs	Year 1	Year 2	Year 3	Year 4	Year 5
A.	Investment Cost								
	1	Civil Works		14,525,037	1,544,496	3,742,618	5,049,871	3,824,926	363,126
	2	Mechanical and Equipment							
		a	Vehicles	295,500	31,422	76,141	102,736	77,815	7,388
		b	Machinery	2,347,400	249,607	604,847	816,113	618,149	58,685
		c	Pumps, Motors and Auxiliaries	4,518,834	480,503	1,164,353	1,571,048	1,189,960	112,971
		d	Supplies, Others	922,000	98,039	237,569	320,549	242,793	23,050
	3	Survey, Study and Design		759,300	80,739	195,646	263,983	199,949	18,983
	4	Training and Workshops		256,102	27,232	65,989	89,038	67,440	6,403
	5	Consulting Services							
		a	Project Management	2,391,968	254,346	616,330	831,607	629,885	59,799
		b	Capacity Developemnt	1,013,500	107,769	261,145	352,360	266,888	25,338
			Subtotal	**27,029,641**	**2,874,152**	**6,964,637**	**9,397,305**	**7,117,805**	**675,741**
B.	Recurrent Costs								
	1	PMO and PIO Salaries		893,571	95,016	230,243	310,665	235,307	22,339
	2	Office Accommodation		274,000	29,135	70,601	95,261	72,153	6,850
	4	O&M Equipment		76,041	8,086	19,593	26,437	20,024	1,901
	5	Office/Vehicle O&M		202,458	21,528	52,167	70,388	53,314	5,061
			Subtotal	**1,446,069**	**153,765**	**372,604**	**502,750**	**380,798**	**36,152**
			Total Base Cost	**28,475,710**	**3,027,917**	**7,337,241**	**9,900,055**	**7,498,604**	**711,893**
C.	Contingencies								
	1	Physical		1,301,748	138,419	335,417	452,574	342,794	32,544
	2	Price		1,237,765	131,616	318,931	430,330	325,945	30,944
			Subtotal	**2,539,513**	**270,035**	**654,348**	**882,904**	**668,738**	**63,488**
D.	Financing Charges During Construction								
	1	Interest		699,000	62,910	111,840	146,790	174,750	202,710
	2	Commitment							
			Subtotal	**699,000**	**62,910**	**111,840**	**146,790**	**174,750**	**202,710**
E.	Technical Assistance (JFPR)			**2,000,000**	1,000,000	1,000,000	0	0	0
			TOTAL	**33,714,222**	**4,360,862**	**9,103,429**	**10,929,749**	**8,342,092**	**978,091**
			% Total Project Costs	**100.0%**	**12.9%**	**27.0%**	**32.4%**	**24.7%**	**2.9%**

Source: ADB estimates.

[10] Inclusive of JFPR TA of $2.0 million.

[11] The financial values corresponding to the investment cost were duly converted using an SCF equal to 0.91 and SWRF equal to 0.83. The respective derivations of the SCF and SWRF can be seen in Annex Tables 27 and 28, respectively.

Table 3: Derivation of Economic Values of Total Project Cost

Derivation of the economic value of the total project cost

	Item	Value ($)
	Total Project Cost	33,714,222.41
	Less: Interest Cost	699,000.00
	Less: Price Contingency	1,237,764.74
	Equals: Adjusted Project Cost	31,777,457.67
A	**Less: Foreign Component of Adjusted Project Cost**	**14,121,115.80**
	Equals: Local Component of Adjusted Project Cost	17,656,341.87
	Less: Duties and Taxes	3,714,223.00
	Equals: Net Local Component of Adjusted Project Cost	13,942,118.87
	Multiplied by: the Percentage of Unskilled Labor from the Net Local Component	26%
	Equals: Financial Cost of Unskilled Labor	3,624,950.91
	Multiply by: SWRF	0.83
B	**Equals: Economic Cost of Unskilled Labor**	**2,998,713.40**
	Net Local Component of Adjusted Project Cost	13,942,118.87
	Less: Financial Cost of Unskilled Labor	3,624,950.91
	Equals: Financial Cost of Remaining Local Cost Items	10,317,167.96
	Multiply by: SCF	0.91
C	**Equals: Economic Cost of Remaining Local Cost Items**	**9,379,934.32**
	Economic Equivalence of Total Project Cost = A + B + C	**26,499,763.52**
	Economic Equivalence of Total Project Cost (in USD million)	**26.50**
	Economic Equivalence of Total Project Cost (in TJS million)	**178.45**

Source: ADB estimates.

Table 4: Project Economic Cost by Component (in TJS million)

Year	Phasing of Project Investment Cost (%)	Economic Cost		
		Pump Component	Gravity Component	Total
1	12.93	7.37	15.71	23.08
2	27.00	15.38	32.80	48.18
3	32.42	18.47	39.39	57.85
4	24.74	14.09	30.06	44.15
5	2.90	1.65	3.52	5.18
Total	**100.00**	**56.96**	**121.49**	**178.45**

Source: ADB estimates.

2. Operation and Maintenance Costs

16. The projected financial O&M cost (expressed in $) is shown in Table 5.1, while the project O&M cost stream in terms of the local currency (TJS) is presented in Table 5.2. These estimates were based on calculated unit cost values as presented in the Operation and Maintenance Requirements and Sustainability Plan conducted during the PPTA Feasibility Study. This stream of cost accounts for material and labor costs associated with, among others, sediment removal, and repair and maintenance of structures and machines. The O&M cost for the gravity and pump irrigation components increase gradually from year 2 at a value of US$1.37 million; reaching US$1.57 million in year 5. From year 6 onwards, the total O&M cost is held constant at US$1.59 million as an effect of the capital replacement in years 10 and 20.

Table 5.1: Estimated Operation and Maintenance Cost ($ million)

Year	Incremental Area (ha)		TOTAL OM ($ million)		
	Gravity	Pump	Gravity[a]	Pump[b]	Total
1	31,247.00	6,923.93			
2	31,247.00	6,923.93	0.84	0.53	1.37
3	32,618.60	7,337.35	0.87	0.56	1.43
4	33,990.20	7,750.77	0.91	0.59	1.50
5	35,361.80	8,164.19	0.95	0.62	1.57
6	35,819.00	8,302.00	0.96	0.63	1.59
7	35,819.00	8,302.00	0.96	0.63	1.59
8	35,819.00	8,302.00	0.96	0.63	1.59
9	35,819.00	8,302.00	0.96	0.63	1.59
10[b]	35,819.00	8,302.00	0.96	0.63	1.59

[a] Unit O&M cost per hectare for the gravity irrigation component is equal to US$ 26.77 per ha.
[b] Unit O&M cost per hectare for the pump irrigation component is equal to US$ 76.46 per ha.
Source: PPTA Feasibility Study (2015).

Table 5.2: Estimated Operations and Maintenance Costs (TJS million)

Year	Incremental Area (ha)		TOTAL OM (TJS million)[a]		
	Gravity	Pump	Gravity[a]	Pump[b]	Total
1	31,247.00	6,923.93			
2	31,247.00	6,923.93	5.63	3.57	9.20
3	32,618.60	7,337.35	5.88	3.78	9.66
4	33,990.20	7,750.77	6.13	3.99	10.12
5	35,361.80	8,164.19	6.37	4.20	10.58
6	35,819.00	8,302.00	6.46	4.27	10.73
7	35,819.00	8,302.00	6.46	4.27	10.73
8	35,819.00	8,302.00	6.46	4.27	10.73
9	35,819.00	8,302.00	6.46	4.27	10.73
10[b]	35,819.00	8,302.00	6.46	4.27	10.73

[a] Unit O&M cost per hectare (gravity system) = TJS 180.27 per ha.
[b] Unit O&M cost per hectare (pump system) = TJS 514.88 per ha.
Source: PPTA Feasibility Study (2015)

17. Table 6 presents a breakdown of the financial and economic operation and maintenance costs.

Table 6: Breakdown of Financial and Economic Operation and Maintenance Costs (TJS million)

Breakdown of Financial O&M Cost

	TOTAL MATERIAL COST (TJS million)			TOTAL LABOR COST (TJS million)			FINANCIAL VALUE OF O&M COST		
Year	Gravity	Pump	Total	Gravity	Pump	Total	Gravity	Pump	Total
1									
2	3.38	2.14	5.52	2.25	1.43	3.68	5.63	3.57	9.20
3	3.53	2.27	5.79	2.35	1.51	3.86	5.88	3.78	9.66
4	3.68	2.39	6.07	2.45	1.60	4.05	6.13	3.99	10.12
5	3.82	2.52	6.35	2.55	1.68	4.23	6.37	4.20	10.58
6	3.87	2.56	6.44	2.58	1.71	4.29	6.46	4.27	10.73
7	3.87	2.56	6.44	2.58	1.71	4.29	6.46	4.27	10.73
8	3.87	2.56	6.44	2.58	1.71	4.29	6.46	4.27	10.73
9	3.87	2.56	6.44	2.58	1.71	4.29	6.46	4.27	10.73
10	3.87	2.56	6.44	2.58	1.71	4.29	6.46	4.27	10.73

Source: PPTA Feasibility Study (2015)

SCF	0.91
SWRF	0.83

Breakdown of Economic O&M Cost

	TOTAL MATERIAL COST (TJS million)			TOTAL LABOR COST (TJS million)			ECONOMIC O&M COST (TJS million)		
Year	Gravity	Pump	Total	Gravity	Pump	Total	Gravity	Pump	Total
1									
2	3.07	1.94	5.02	1.86	1.18	3.04	4.94	3.12	8.06
3	3.21	2.06	5.27	1.95	1.25	3.20	5.15	3.31	8.46
4	3.34	2.18	5.52	2.03	1.32	3.35	5.37	3.50	8.87
5	3.48	2.29	5.77	2.11	1.39	3.50	5.59	3.68	9.27
6	3.52	2.33	5.85	2.14	1.41	3.55	5.66	3.75	9.41
7	3.52	2.33	5.85	2.14	1.41	3.55	5.66	3.75	9.41
8	3.52	2.33	5.85	2.14	1.41	3.55	5.66	3.75	9.41
9	3.52	2.33	5.85	2.14	1.41	3.55	5.66	3.75	9.41
10	3.52	2.33	5.85	2.14	1.41	3.55	5.66	3.75	9.41

Source: PPTA Feasibility Study (2015)

H. Project Benefits

18. **Quantified benefits.** The quantified project benefits arise from higher cropping intensities, cropped area, and crop yields. In addition, the agricultural benefits are also due to improved farm and water management since in the longer run, improved and reliable irrigation water availability will lead to better management of water and other inputs and hence will enhance irrigated crop productivity.

19. The quantified benefits represent the gains from the maximization of the potential command area of the CIS which is at 50,163 ha. At present, however, the system is serving 43,210 ha only. In addition to the CIS command area, the project covers 6,953 ha of rain-fed areas, of which 2,381 ha also falls under command of the pump irrigation component (Table 7). The stream of project benefits for the gravity and pump irrigation components are shown in Annex Table 29.

Table 7: Estimated Area Benefitted under the Project (ha)

Source of Water	Existing Situation			With-Project		
	Total Command Area	Irrigated Area	Rain-fed Area	Modernization of Irrigated area	Extension Irrigation to rain-fed area	Total Area Proposed for Modernization
Pump	14,344	11,963	2,381	6,924	1,378	8,302
Gravity	35,819	31,247	4,572	31,247	4,572	35,819
Total	**50,163**	**43,210**	**6,953**	**38,171**	**5,950**	**44,121**

Notes: The area of 44,121 ha was derived as follows: (i) total command area under the pumping schemes is 14,344 ha including 2,381 ha presently rainfed area; (ii) since not all the pumping schemes are being modernized, area where pumps will be modernized has been estimated as 8,302 ha, including rainfed area as 1,378 ha estimated on prorate basis; and (iii) however, the system under gravity irrigation will be fully modernized under the project, thus the all rainfed area (4,572 ha) falls under the gravity system will receive water for irrigation under the with-project scenario.
Source: Eptisa. 2015. *Feasibility Study for TA 8647-TAJ: Water Resources Management in Pyanj River Basin (Consultant Report).* Tajikistan.

20. **Unquantified benefits.** Improved and reliable supply of irrigation water will lead to better management of water and other inputs and hence will enhance the irrigated crop productivity. Additional agricultural benefits may be generated due to the "shift" in land use, which is unknown at the project design stage. In order to ensure that these benefits are properly captured, the terms of reference for the monitoring and evaluation (M&E) specialists of the project implementation consultants (PIC) have included the tasks of conducting field surveys to collect data and information. This would help ADB and the Government to conduct the project economic and financial re-evaluation during the project's mid-term review (see TOR for M&E specialists in PAM).

I. Economic Analysis and Estimated Results

21. **Approach and methodology.** A benefit-cost analysis has been undertaken to measure the key investment criteria of economic internal rate of return (EIRR) and economic net present value (ENPV). All costs and benefits have been quantified in economic terms. Financial values have been converted into their respective economic values by removing the effects of government interventions and market distortions.

22. Two scenarios have been compared to determine the economic net benefits: (i) the "without-project", and (ii) the "with-project" scenarios. The "without-project" scenario assumes a continuation of current agricultural practices, which is under rapid deterioration after the Soviet era and commenced due to lack of maintenance of the facilities. The "with-project" scenario assumes increased irrigated area, cropping intensities, and yields due to improved water availability from modernized irrigation and drainage infrastructure, and farm and water management comprising: (i) modernization of irrigation network under gravity flow; (ii) rehabilitation and modernizing two groups of pumping systems; and (iii) bringing a part of rain-fed agriculture area under gravity and pump irrigation. These interventions could lead to: (i) greater area of irrigated crops and reduced rain-fed crop production; (ii) higher irrigated cropping intensities and yields; and (iii) a shift to high value crops.

23. The project's benefits are assumed to increase gradually along their initial take-off development level during first five years, and area projected to be at their maximum at the project's full development at 10th year from the commencement of implementation. A number of key factors influencing the benefits were identified and sensitivity analyses have been conducted to test major risks to in the project benefits and costs.

24. **Economic returns and sensitivity analysis.** The project is expected to be economically viable in that the calculated economic internal rate of return (EIRR) is 16.3% and the economic net present value (ENPV) of the investment is TJS 105.7 million based on the discount rate of 12% (Table 8). These economic results are due to the substantial size of the economic benefit stream relative to the project's least cost engineering design. The consolidated cash flow is shown in Annex Table 29.

25. The reported economic returns of the project are based upon the assumption that costs and benefits over the life of the project will be as calculated. The future, however, may not perfectly follow that assumption. It is useful to examine particular risks and check the effects of these risks on the economic returns of the project. Some of the possible risks include: (i) increase in capital cost, (ii) increase in O&M cost, (iii) decrease in benefits, and (iv) delay in the realization of the benefits. The sensitivity analysis considers cases where each of these risks occur exclusively and where one risk scenario happens in conjuction with another. The effects of some of these risks on the economic viability of the project are shown in Table 8 and explained subsequently.

Table 8: Results of Economic Analysis and Sensitivity Analysis

Results of Evaluation	Change	ENPV (TJS mil)	EIRR	Sensitivity Indicator (SI)	Switching Value (SV)
Base Case		105.7	16.3%		
Sensitivity Scenarios					
Case 1 - Increase in Capital Costs	+10%	92.2	15.6%	1.28	78%
Case 2 - Increase in O&M Costs	+10%	99.2	16.1%	0.66	152%
Case 3 - Combined Case 1 and 2	as above	85.7	15.4%	n.a	n.a
Case 4 - Decrease in benefit	-10%	75.1	15.3%	4.07	25%
Case 5 - Benefit delay by 2 years	-2 yrs	38.5	13.6%	n.a	3 years
Case 6 - Combination of cases 3 and 4	as above	55.1	14.3%	n.a	n.a

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

Source: ADB estimates.

26. **Case 1 - Increase in Capital Costs -** Care has been taken to accurately estimate the project cost. Nevertheless it is possible that actual costs may be higher than the calculated amount. To see how vulnerable the economic returns may be to higher construction costs a ten percent increase in capital costs has been inserted into the calculations. This cost increase causes the EIRR to fall to 15.6%. The level of increase at which the EIRR would fall below the acceptable 12% level (the switching value)[12] is at a 78% increase in cost. **Case 2 - Increase in O&M Costs -** A 10% increase in O&M costs will cause the EIRR to fall to 16.1%. The level of increase at which the EIRR would fall below the acceptable of 12% level is at a 152% increase in cost. **Case 3 - Combination of Cases 1 and 2 -** Combination of Cases 1 and 2 will cause the EIRR to fall to 15.4%. **Case 4 - Decrease in Benefit -** A 10% decrease in benefit will cause the EIRR to fall to 15.3%. The level of decrease in project benefit at which the EIRR would fall below the acceptable level is at a 25%. **Case 5 - Two-year Benefit Delay -** If the benefits are

[12] Switching value refers to the percent change in the risk variable that will make the EIRR fall to the level of the opportunity cost of capital (which is assumed to be 12%).

delayed by 2 years, it will cause the EIRR to fall to 13.6%. The length of delay at which the EIRR would fall below the acceptable level is 3 years. **Case 6 - Combination of Cases 3 and 4 -** Combination of Cases 3 and 4 will cause the EIRR to fall to 14.3%. Annex Table 30 provides the details of the sensitivity tests.

27. Based on the sensitivity analysis, it is important to note that the economic viability of the project is most sensitive to benefits being delayed by 2 years. Therefore, it is essential that the project is implemented as scheduled. Furthermore, technical and extension support should be provided to project beneficiaries as proposed under Output 3 in order to ensure that project benefits are realized on schedule. It is also important to stress that system maintenance needs 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.

K. Project Benefit Distribution and Poverty Impact

28. **Household financial returns.** From the perspective of farm households, the incremental irrigated area resulting form the project investments would generate additional benefits of $212 per ha per annum (equivalent to TJS 1,426/year). With an average farm size of 0.5 ha in the command area, a farm household is expected to get an increase in his/her income by $106 per annum (equivalent to TJS 713/year).

29. **Distribution of project benefits and the estimated poverty impact ratio.** The project will directly affect over 85% of the project area's population which derives their main income from the production of wheat, cotton, and vegetable crops. 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 9 presents the result of the benefit distribution analysis. Economic benefits amounting to TJS 256 million would accrue to the farmers due to the project. The labor sector, on the other hand, would receive economic benefits valued at around TJS 15 million. These pattern of benefit distribution results to the project's poverty impact ratio of 42.8% (Table 10).

Table 9: Distribution of Economic Benefits

Unit: TJS million

	Financial Present Value	Economic Present Value	Economic less Financial	Distribution of Project Benefits			
				Government	Economy	Labor	Farmers
Total Benefits	49.8	305.9	256.1				256.1
Project Costs							
Traded	35.5	30.0	(5.5)		5.5		
Unskilled labor	94.7	80.1	(14.6)			14.6	
Non-traded	106.5	90.1	(16.5)		16.5		
Total Project Costs	236.8	200.2					
Net Benefits	(186.9)	105.7	292.6	(186.9)			
			Gains/Losses	**(186.9)**	**21.9**	**14.6**	**256.1**

Source: ADB estimates

Table 10: Poverty Impact Analysis

Unit: TJS million

Particulars	Gov't. / Economy	Labor	Farmers	Total
Benefits (Losses)	21.9	14.6	256.1	292.6
Financial Return to Government	(186.9)			(186.9)
Total Benefits (Losses)	(165.0)	14.6	256.1	105.7
Proportion of the Poor (%)	40%	60%	40%	
Benefits to Poor	(66.0)	8.8	102.4	45.2
Poverty Impact Ratio (%)				**42.8%**

Source: ADB estimates

L. Key Data Sources for Crop-Related Parameters

30. Estimation of existing cropping model/pattern, cropped area, and intensities in the Project command area was based on the data from the following sources:

- ADB Project TA8647-TAJ, Appendix-04, Draft Feasibility Report of Water Resources Management in Pyanj River Basin Tajikistan by EPTISA: June-2015, using past and projected crop yield data provided by Strategic Research Institute, Republic of Tajikistan.

- Remote Sensing data given in RESTEC Study, June 2015.

- The cropping pattern and cropped area by crops was derived from the district area, production and yield data provided in Agricultural Statistics by Districts, Republic of Tajikistan.

- Existing cropping intensity was derived from the cropped area by crop and the command area of the Chubek Irrigation System.

- Supplemented, validated, and crossed checked with (i) PPTA's consultations with 5 agriculture experts in the Department of Agriculture Tajikistan, 12 local agriculture officers associated with the Chubek Irrigation System; (ii) PPTA's farm household surveys in three districts in April 2015, 20 group discussions with farmers by crop practice; and 15 farmer discussions and site visits by ADB mission economist in November 2015; and (iii) professional jusdgements by the PPTA agronomist.

31. Existing crop yields in project command area were estimated on the bases of the data from the following sources:

- Annual Report of District Agriculture Unit within the Regional Reports of the Ministry of Agriculture, 2014 and 2015.

- Statistical Book of Tajikistan, Goskomstat, 2014. District Agriculture Management, Annual Report, 2014 and 2015.

- ADB Project TA8647-TAJ, Appendix-04, Draft Feasibility Report of Water Resources Management in Pyanj River Basin Tajikistan by EPTISA: June-2015, using past and projected crop yield data provided by Strategic Research Institute, Republic of Tajikistan.

- PPTA Agronomist's estimates from district level crop yield data using weighted average yields for the 2010-2015 period.

- ADB. 2013. Technical Assistance Consultants Report: Republic of Tajikistan: Developing Water Resources Sector Strategies in Central and West Asia. Manila Project No.45353-001 RETA 8015 June 2013 By AHT Group AG Management and Engineering UNICON.

- Supplemented, validated, and cross-checked with (i) PPTA's consultations with 5 agriculture experts in the Department of Agriculture Tajikistan, 12 local agriculture officers associated with the Chubek Irrigation System; (ii) PPTA's farm household surveys in three districts in April 2015, 20 group discussions with farmers by crop practice; and 15 farmer discussions and site visits by ADB mission economist in November 2015; and (iii) professional jusdgements by the PPTA agronomist.

32. Future cropping pattern and intensities with project interventions were based on data/information from the following sources:

- PPTA's consultations with 5 agriculture experts in the Department of Agriculture Tajikistan, 12 local agriculture officers associated with the Chubek Irrigation System.

- PPTA's farm household surveys in three districts in April 2015, 20 group discussions with farmers by crop practice; and 15 farmer discussions and site visits by ADB mission economist in November 2015.

- Professional jusdgements by the PPTA agronomist.

- Suplemented by: Uzbekistan: Grain Productivity Improvement Project, ADB Completion Report Project No.31527 March 2010.

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

- Draft Feasibility Report, June 2015 of Water Resources Management in Pyanj River Basin Tajikistan by EPTISA: ADB Project TA8647-TAJ, with details on expected effect on crop agronomy due to improved irrigation supplies with project interventions.

- Technical Assistance Consultants Report: Republic of Tajikistan: Developing Water Resources Sector Strategies in Central and West Asia. Manila Project No.45353-001 RETA 8015 June 2013 By AHT Group AG Management and Engineering UNICON.

- PPTA Agronomist's checking and comparing to yields under adequately irrigated areas in Tajikistan, Uzbekistan and Pakistan with improved irrigation water supply in the with-project interventions. For comparing with Uzbekistan, references were made to: Uzbekistan: Grain Productivity Improvement Project, ADB Completion Report Project No.31527 March 2010.

- PPTA's consultations with 5 agriculture experts in the Department of Agriculture Tajikistan, 12 local agriculture officers associated with the Chubek Irrigation System.
- PPTA's farm household surveys in three districts in April 2015, 20 group discussions with farmers by crop practice; and 15 farmer discussions and site visits by ADB mission economist in November 2015.

- Professional jusdgements by the PPTA agronomist.

ANNEX TABLES

A. GRAVITY SYSTEM

TABLE 1: DEVELOPMENT OF INTENSITIES WITH PROJECT

Chubek Irrigation System - Gravity Irrigation Command Area 35,819 hectares

Unit: %

	Crops	Baseline	Year of Development									
			1	2	3	4	5	6	7	8	9	10
1	Wheat (Rainfed)	8.30	6.64	4.98	3.32	1.66	0.00	0.00	0.00	0.00	0.00	0.00
2	Wheat	42.97	42.97	42.97	42.97	43.40	43.82	44.24	44.67	45.09	45.09	45.09
3	Potato	2.14	2.14	2.14	2.14	2.52	2.91	3.30	3.69	4.07	4.07	4.07
4	Carrot	0.00	0.00	0.00	0.00	0.60	1.20	1.80	2.40	3.00	3.00	3.00
5	Onion	0.00	0.00	0.00	0.00	1.01	2.01	3.02	4.03	5.04	5.04	5.04
6	Barley	0.00	0.00	0.00	0.00	0.59	1.19	1.78	2.37	2.96	2.96	2.96
7	Fodder	0.00	0.00	0.00	0.00	0.49	0.98	1.47	1.95	2.44	2.44	2.44
8	Pulses	0.34	0.34	0.34	0.34	1.06	1.79	2.52	3.25	3.98	3.98	3.98
9	Paddy	3.85	3.85	3.85	3.85	3.68	3.51	3.35	3.18	3.02	3.02	3.02
10	Cotton	39.57	39.57	39.57	39.57	41.63	43.69	45.74	47.80	49.86	49.86	49.86
11	Melon	2.02	2.02	2.02	2.02	2.62	3.21	3.81	4.40	5.00	5.00	5.00
12	Vegatables	5.96	5.96	5.96	5.96	5.38	4.79	4.21	3.62	3.03	3.03	3.03
13	Maize	0.71	0.71	0.71	0.71	1.96	3.20	4.45	5.70	6.94	6.94	6.94
14	Oilseeds	0.00	0.00	0.00	0.00	0.99	1.99	2.98	3.97	4.96	4.96	4.96
15	Fodder Maize	5.83	5.83	5.83	5.83	5.40	4.96	4.53	4.10	3.67	3.67	3.67
16	Soya bean	0.00	0.00	0.00	0.00	0.41	0.82	1.22	1.63	2.04	2.04	2.04
17	Alfalfa	0.00	0.00	0.00	0.00	0.59	1.19	1.78	2.37	2.96	2.96	2.96
18	Orchard	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89
19	New Orchard	0.00	0.00	0.00	0.00	1.03	2.06	3.10	4.13	5.16	5.16	5.16
	Total	**118.58**	**116.92**	**115.26**	**113.60**	**121.91**	**130.22**	**140.19**	**150.15**	**160.12**	**160.12**	**160.12**
	Total with Double for Crops 17-19	**125.47**	**123.81**	**122.15**	**120.50**	**130.43**	**140.36**	**151.95**	**163.55**	**175.14**	**175.14**	**175.14**

Source: PPTA Feasibility (2015)

TABLE 2: CROPPING PATTERN AND INTENSITIES WITHOUT PROJECT

Chubek Irrigation System - Gravity Irrigation Command Area 35819 hectares

Unit: %

	Crops	Baseline	Index Year									
			1	2	3	4	5	6	7	8	9	10
1	Wheat (Rainfed)	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30	8.30
2	Wheat	42.97	42.97	42.97	42.97	42.97	42.97	42.97	42.97	42.97	42.97	42.97
3	Potato	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14
4	Carrot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Onion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Barley	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Fodder	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Pulses	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
9	Paddy	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85	3.85
10	Cotton	39.57	39.57	39.57	39.57	39.57	39.57	39.57	39.57	39.57	39.57	39.57
11	Melon	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02	2.02
12	Vegatables	5.96	5.96	5.96	5.96	5.96	5.96	5.96	5.96	5.96	5.96	5.96
13	Maize	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
14	Oilseeds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	Fodder Maize	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83
16	Soya bean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Alfalfa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	Orchard	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89
19	New Orchard	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**118.6**	**118.6**	**118.6**	**118.6**	**118.6**	**118.6**	**118.6**	**118.6**	**118.6**	**118.6**	**118.6**

Source: PPTA Feasibility (2015)

TABLE 3: AREA BUILD UP "WITH" PROJECT

Unit: hectares

	Crops	Baseline	Year of Development									
			1	2	3	4	5	6	7	8	9	10
1	Wheat (Rainfed)	2,972	2,377	1,783	1,189	594	0	0	0	0	0	0
2	Wheat	15,392	15,392	15,392	15,392	15,544	15,696	15,696	15,696	15,696	15,696	15,696
3	Potato	765	765	765	765	904	1,043	1,043	1,043	1,043	1,043	1,043
4	Carrot	0	0	0	0	215	430	430	430	430	430	430
5	Onion	0	0	0	0	361	722	722	722	722	722	722
6	Barley	0	0	0	0	212	425	425	425	425	425	425
7	Fodder	0	0	0	0	175	350	350	350	350	350	350
8	Pulses	120	120	120	120	381	642	642	642	642	642	642
9	Paddy	1,378	1,378	1,378	1,378	1,318	1,259	1,259	1,259	1,259	1,259	1,259
10	Cotton	14,175	14,175	14,175	14,175	14,912	15,648	15,648	15,648	15,648	15,648	15,648
11	Melon	724	724	724	724	937	1,151	1,151	1,151	1,151	1,151	1,151
12	Vegatables	2,136	2,136	2,136	2,136	1,926	1,716	1,716	1,716	1,716	1,716	1,716
13	Maize	255	255	255	255	702	1,148	1,148	1,148	1,148	1,148	1,148
14	Oilseeds	0	0	0	0	356	711	711	711	711	711	711
15	Fodder Maize	2,089	2,089	2,089	2,089	1,933	1,778	1,778	1,778	1,778	1,778	1,778
16	Soya bean	0	0	0	0	146	292	292	292	292	292	292
17	Alfalfa	0	0	0	0	212	425	425	425	425	425	425
18	Orchard	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468
19	New Orchard	0	0	0	0	370	740	740	740	740	740	740
	Total	**42,475**	**41,880**	**41,286**	**40,692**	**43,668**	**46,643**	**46,643**	**46,643**	**46,643**	**46,643**	**46,643**

Source: PPTA Feasibility (2015)

TABLE 4: CROPPED AREA "WITHOUT" PROJECT

Unit: hectares

	Crops	Baseline	Index Year									
			1	2	3	4	5	6	7	8	9	10
1	Wheat -Rainfed	2,972	2,972	2,972	2,972	2,972	2,972	2,972	2,972	2,972	2,972	2,972
2	Wheat	15,392	15,392	15,392	15,392	15,392	15,392	15,392	15,392	15,392	15,392	15,392
3	Potato	765	765	765	765	765	765	765	765	765	765	765
4	Carrot	0	0	0	0	0	0	0	0	0	0	0
5	Onion	0	0	0	0	0	0	0	0	0	0	0
6	Barley	0	0	0	0	0	0	0	0	0	0	0
7	Fodder	0	0	0	0	0	0	0	0	0	0	0
8	Pulses	120	120	120	120	120	120	120	120	120	120	120
9	Paddy	1,378	1,378	1,378	1,378	1,378	1,378	1,378	1,378	1,378	1,378	1,378
10	Cotton	14,175	14,175	14,175	14,175	14,175	14,175	14,175	14,175	14,175	14,175	14,175
11	Melon	724	724	724	724	724	724	724	724	724	724	724
12	Vegatables	2,136	2,136	2,136	2,136	2,136	2,136	2,136	2,136	2,136	2,136	2,136
13	Maize	255	255	255	255	255	255	255	255	255	255	255
14	Oilseeds	0	0	0	0	0	0	0	0	0	0	0
15	Fodder Maize	2,089	2,089	2,089	2,089	2,089	2,089	2,089	2,089	2,089	2,089	2,089
16	Soya bean	0	0	0	0	0	0	0	0	0	0	0
17	Alfalfa	0	0	0	0	0	0	0	0	0	0	0
18	Orchard	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468	2,468
19	New Orchard	0	0	0	0	0	0	0	0	0	0	0
	Total	**42,475**	**42,475**	**42,475**	**42,475**	**42,475**	**42,475**	**42,475**	**42,475**	**42,475**	**42,475**	**42,475**

Source: PPTA Feasibility (2015)

TABLE 5: CROP YIELDS PROJECTED FOR "WITH" PROJECT

Unit: ton/ha

	Crops	Baseline	Year of Development									
			1	2	3	4	5	6	7	8	9	10
1	Wheat -R	1.54	1.56	1.58	1.60	1.62	1.64					
2	Wheat	2.96	2.97	2.99	3.00	3.08	3.16	3.24	3.32	3.40	3.47	3.55
3	Potato	23.73	23.85	23.97	24.09	24.71	25.34	25.97	26.60	27.22	27.85	28.48
4	Carrot	22.50	22.61	22.73	22.84	23.43	24.03	24.62	25.22	25.81	26.41	27.00
5	Onion	22.40	22.51	22.62	22.74	23.33	23.92	24.51	25.10	25.70	26.29	26.88
6	Barley	2.40	2.41	2.42	2.44	2.50	2.56	2.63	2.69	2.75	2.82	2.88
7	Fodder	12.50	12.56	12.63	12.69	13.02	13.35	13.68	14.01	14.34	14.67	15.00
8	Pulses	1.40	1.41	1.41	1.42	1.46	1.50	1.53	1.57	1.61	1.64	1.68
9	Paddy	3.30	3.32	3.33	3.35	3.44	3.52	3.61	3.70	3.79	3.87	3.96
10	Cotton	2.05	2.06	2.07	2.08	2.14	2.19	2.24	2.30	2.35	2.41	2.46
11	Melon	24.86	24.98	25.11	25.23	25.89	26.55	27.21	27.86	28.52	29.18	29.83
12	Vegatables	21.00	21.11	21.21	21.32	21.87	22.43	22.98	23.54	24.09	24.65	25.20
13	Maize	4.10	4.12	4.14	4.16	4.27	4.38	4.49	4.60	4.70	4.81	4.92
14	Oilseeds	2.00	2.01	2.02	2.03	2.08	2.14	2.19	2.24	2.29	2.35	2.40
15	Fodder Maize	18.00	18.09	18.18	18.27	18.75	19.22	19.70	20.17	20.65	21.12	21.60
16	Soya bean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Alfalfa	8.50	8.54	8.59	8.63	8.85	9.08	9.30	9.53	9.75	9.98	10.20
18	Orchard	8.93	8.97	9.02	9.06	9.30	9.54	9.77	10.01	10.24	10.48	10.72
19	New Orchard	0.00	0.00	0.00	0.00	0.00	9.29	9.73	10.18	10.63	10.72	10.72

Source: PPTA Feasibility (2015)

TABLE 6: CROP YIELDS "WITHOUT" PROJECT

Unit: ton/ha

	Crops	Baseline	Index Year									
			1	2	3	4	5	6	7	8	9	10
1	Wheat -Rainfed	1.54	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55	1.55
2	Wheat	2.96	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97	2.97
3	Potato	23.73	23.85	23.85	23.85	23.85	23.85	23.85	23.85	23.85	23.85	23.85
4	Carrot	22.50	22.61	22.61	22.61	22.61	22.61	22.61	22.61	22.61	22.61	22.61
5	Onion	22.40	22.51	22.51	22.51	22.51	22.51	22.51	22.51	22.51	22.51	22.51
6	Barley	2.40	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41	2.41
7	Fodder	12.50	12.56	12.56	12.56	12.56	12.56	12.56	12.56	12.56	12.56	12.56
8	Pulses	1.40	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41
9	Paddy	3.30	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32
10	Cotton	2.05	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06	2.06
11	Melon	24.86	24.98	24.98	24.98	24.98	24.98	24.98	24.98	24.98	24.98	24.98
12	Vegatables	21.00	21.11	21.11	21.11	21.11	21.11	21.11	21.11	21.11	21.11	21.11
13	Maize	4.10	4.12	4.12	4.12	4.12	4.12	4.12	4.12	4.12	4.12	4.12
14	Oilseeds	2.00	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01	2.01
15	Fodder Maize	18.00	18.09	18.09	18.09	18.09	18.09	18.09	18.09	18.09	18.09	18.09
16	Soya bean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Alfalfa	8.50	8.54	8.54	8.54	8.54	8.54	8.54	8.54	8.54	8.54	8.54
18	Orchard	8.93	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97	8.97
19	New Orchard	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: PPTA Feasibility (2015)

TABLE 7: CROP PRODUCTION PROJECTED FOR "WITH" PROJECT

Unit: tons

	Crops	Baseline	Year of Development									
			1	2	3	4	5	6	7	8	9	10
1	Wheat (Rainfed)	4,577	3,709	2,817	1,902	963	0	0	0	0	0	0
2	Wheat	45,561	45,788	46,017	46,247	47,919	49,614	50,842	52,069	53,296	54,524	55,751
3	Potato	18,164	18,255	18,347	18,438	22,346	26,428	27,082	27,736	28,389	29,043	29,697
4	Carrot	0	0	0	0	5,038	10,332	10,588	10,843	11,099	11,354	11,610
5	Onion	0	0	0	0	8,417	17,262	17,689	18,116	18,543	18,970	19,397
6	Barley	0	0	0	0	531	1,089	1,116	1,143	1,170	1,196	1,223
7	Fodder	0	0	0	0	2,278	4,672	4,788	4,903	5,019	5,134	5,250
8	Pulses	168	169	170	171	556	960	984	1,007	1,031	1,055	1,079
9	Paddy	4,547	4,570	4,593	4,616	4,531	4,436	4,546	4,656	4,765	4,875	4,985
10	Cotton	29,059	29,205	29,351	29,498	31,838	34,258	35,105	35,953	36,800	37,648	38,495
11	Melon	17,999	18,089	18,179	18,270	24,271	30,552	31,308	32,063	32,819	33,575	34,331
12	Vegatables	44,850	45,075	45,300	45,526	42,124	38,489	39,441	40,393	41,345	42,297	43,249
13	Maize	1,046	1,052	1,057	1,062	2,996	5,026	5,150	5,275	5,399	5,523	5,648
14	Oilseeds	0	0	0	0	741	1,519	1,557	1,594	1,632	1,669	1,707
15	Fodder Maize	37,595	37,783	37,972	38,162	36,247	34,184	35,030	35,876	36,721	37,567	38,413
16	Soya bean	0	0	0	0	0	0	0	0	0	0	0
17	Alfalfa	0	0	0	0	1,880	3,856	3,951	4,047	4,142	4,238	4,333
18	Orchard	22,044	22,154	22,264	22,376	22,957	23,539	24,121	24,703	25,286	25,868	26,450
19	New Orchard	0	0	0	0	0	6,869	7,199	7,529	7,860	7,926	7,926
	Total	**225,610**	**225,848**	**226,067**	**226,268**	**255,633**	**293,084**	**300,494**	**307,905**	**315,316**	**322,462**	**329,542**

Source: Estimated based on cropped areas and yields from PPTA Feasibility (2015)

TABLE 8: CROP PRODUCTION PROJECTED FOR "WITHOUT" PROJECT

Unit: tons

	Crops	Baseline	Index Year									
			1	2	3	4	5	6	7	8	9	10
1	Wheat Rainfed	4,577	4,636	4,695	4,755	4,814	4,874	4,716	4,739	4,763	4,787	4,811
2	Wheat	45,561	46,176	46,946	47,716	48,485	49,255	46,945	47,179	47,415	47,652	47,891
3	Potato	18,164	18,440	18,716	18,999	19,282	19,573	18,716	18,810	18,904	18,998	19,093
4	Carrot	0	0	0	0	0	0	0	0	0	0	0
5	Onion	0	0	0	0	0	0	0	0	0	0	0
6	Barley	0	0	0	0	0	0	0	0	0	0	0
7	Fodder	0	0	0	0	0	0	0	0	0	0	0
8	Pulses	168	170	173	175	178	180	173	174	175	176	177
9	Paddy	4,547	4,616	4,685	4,754	4,823	4,892	4,686	4,709	4,733	4,756	4,780
10	Cotton	29,059	29,485	29,910	30,335	30,761	31,186	29,942	30,092	30,242	30,394	30,546
11	Melon	17,999	18,267	18,542	18,817	19,099	19,389	18,545	18,638	18,731	18,825	18,919
12	Vegatables	44,850	45,534	46,217	46,901	47,605	48,310	46,213	46,444	46,676	46,909	47,144
13	Maize	1,046	1,062	1,077	1,092	1,108	1,125	1,078	1,084	1,089	1,094	1,100
14	Oilseeds	0	0	0	0	0	0	0	0	0	0	0
15	Fodder Maize	37,595	38,159	38,723	39,308	39,892	40,498	38,737	38,931	39,125	39,321	39,517
16	Soya bean	0	0	0	0	0	0	0	0	0	0	0
17	Alfalfa	0	0	0	0	0	0	0	0	0	0	0
18	Orchard	22,044	22,364	22,710	23,056	23,401	23,747	22,713	22,827	22,941	23,056	23,171
19	New Orchard	0	0	0	0	0	0	0	0	0	0	0
	Total	**225,610**	**228,909**	**232,394**	**235,907**	**239,448**	**243,028**	**232,464**	**233,626**	**234,794**	**235,968**	**237,148**

Source: Estimated based on cropped areas and yields from PPTA Feasibility (2015)

TABLE 9: ECONOMIC VALUE OF PRODUCTION PROJECTED FOR "WITH" PROJECT

Unit: TJS

	Crops	Baseline	Year of Development									
			1	2	3	4	5	6	7	8	9	10
1	Wheat (Rainfed)		4,144,617	3,148,315	2,125,445	1,076,006	0	0	0	0	0	0
2	Wheat		56,572,561	56,855,424	57,139,701	59,204,896	61,299,419	62,815,836	64,332,254	65,848,671	67,365,088	68,881,505
3	Potato		0	0	0	0	0	0	0	0	0	0
4	Carrot		0	0	0	0	0	0	0	0	0	0
5	Onion		0	0	0	0	0	0	0	0	0	0
6	Barley		0	0	0	300,173	615,574	630,802	646,030	661,258	676,486	691,714
7	Fodder		0	0	0	513,169	1,052,371	1,078,404	1,104,438	1,130,471	1,156,505	1,182,538
8	Pulses		207,152	208,187	209,228	681,588	1,177,635	1,206,768	1,235,900	1,265,032	1,294,164	1,323,296
9	Paddy		10,504,015	10,556,535	10,609,317	10,414,623	10,196,045	10,448,274	10,700,502	10,952,731	11,204,959	11,457,187
10	Cotton		66,277,397	66,608,783	66,941,827	72,252,724	77,744,663	79,667,901	81,591,138	83,514,376	85,437,613	87,360,851
11	Melon		3,415,829	3,432,908	3,450,072	4,583,241	5,769,342	5,912,063	6,054,784	6,197,506	6,340,227	6,482,948
12	Vegatables		10,054,397	10,104,669	10,155,192	9,396,208	8,585,312	8,797,695	9,010,077	9,222,459	9,434,842	9,647,224
13	Maize		1,297,099	1,303,585	1,310,103	3,695,169	6,199,503	6,352,865	6,506,228	6,659,590	6,812,953	6,966,315
14	Oilseeds		0	0	0	2,063,121	4,230,906	4,335,570	4,440,233	4,544,897	4,649,561	4,754,224
15	Fodder Maize		0	0	0	0	0	0	0	0	0	0
16	Soya bean		0	0	0	0	0	0	0	0	0	0
17	Alfalfa		0	0	0	0	0	0	0	0	0	0
18	Orchard		25,161,605	25,287,413	25,413,850	26,074,247	26,734,593	27,395,950	28,057,307	28,718,664	29,380,021	30,041,378
19	New Orchard		0	0	0	0	7,801,411	8,176,479	8,551,547	8,926,615	9,001,629	9,001,629
	Total	**0**	**177,634,670**	**177,505,818**	**177,354,735**	**190,255,168**	**211,406,776**	**216,818,607**	**222,230,438**	**227,642,269**	**232,754,046**	**237,790,809**

Source: Estimated based on the individual crop gross margin and production volume

TABLE 10: ECONOMIC VALUE OF PRODUCTION PROJECTED FOR "WITHOUT" PROJECT

Unit: TJS

	Crops	Baseline	Index Year									
			1	2	3	4	5	6	7	8	9	10
1	Wheat Rainfed		0	0	0	0	0	0	0	0	0	0
2	Wheat		57,051,796	58,002,659	58,953,523	59,904,386	60,855,249	56,572,561	56,572,561	56,572,561	56,572,561	56,572,561
3	Potato		0	0	0	0	0	0	0	0	0	0
4	Carrot		0	0	0	0	0	0	0	0	0	0
5	Onion		0	0	0	0	0	0	0	0	0	0
6	Barley		0	0	0	0	0	0	0	0	0	0
7	Fodder		0	0	0	0	0	0	0	0	0	0
8	Pulses		209,066	212,010	214,955	217,899	220,844	207,152	207,152	207,152	207,152	207,152
9	Paddy		10,610,116	10,768,476	10,926,836	11,085,196	11,243,555	10,504,015	10,504,015	10,504,015	10,504,015	10,504,015
10	Cotton		66,912,746	67,877,834	68,842,921	69,808,009	70,773,097	66,277,397	66,277,397	66,277,397	66,277,397	66,277,397
11	Melon		3,449,420	3,501,374	3,553,327	3,606,647	3,661,335	3,415,829	3,415,829	3,415,829	3,415,829	3,415,829
12	Vegatables		10,156,823	10,309,270	10,461,718	10,618,929	10,776,141	10,054,397	10,054,397	10,054,397	10,054,397	10,054,397
13	Maize		1,309,533	1,328,421	1,347,308	1,366,196	1,388,231	1,297,099	1,297,099	1,297,099	1,297,099	1,297,099
14	Oilseeds		0	0	0	0	0	0	0	0	0	0
15	Fodder Maize		0	0	0	0	0	0	0	0	0	0
16	Soya bean		0	0	0	0	0	0	0	0	0	0
17	Alfalfa		0	0	0	0	0	0	0	0	0	0
18	Orchard		25,400,894	25,793,403	26,185,911	26,578,419	26,970,928	25,161,605	25,161,605	25,161,605	25,161,605	25,161,605
19	New Orchard		0	0	0	0	0	0	0	0	0	0
	Total	**0**	**175,100,394**	**177,793,446**	**180,486,499**	**183,185,682**	**185,889,380**	**173,490,053**	**173,490,053**	**173,490,053**	**173,490,053**	**173,490,053**

Source: Estimated based on the individual crop gross margin and production volume

B. PUMP SYSTEM

TABLE 11: DEVELOPMENT OF INTENSITIES WITH PROJECT

PUMP IRRIGATION CCA = **8,302** Hectares

Unit: %

	Crops	Baseline	Year of Development									
			1	2	3	4	5	6	7	8	9	10
1	Wheat (Rainfed)	10.79	9.71	8.63	7.55	6.47	0.00	0.00	0.00	0.00	0.00	0.00
2	Wheat	42.97	43.19	43.40	43.62	43.83	45.13	45.13	45.13	45.13	45.13	45.13
3	Potato	2.14	2.43	2.72	3.01	3.30	5.03	5.03	5.03	5.03	5.03	5.03
4	Carrot	0.00	0.40	0.80	1.20	1.61	4.02	4.02	4.02	4.02	4.02	4.02
5	Onion	0.00	0.61	1.21	1.82	2.42	6.05	6.05	6.05	6.05	6.05	6.05
6	Barley	0.00	0.30	0.59	0.89	1.19	2.96	2.96	2.96	2.96	2.96	2.96
7	Fodder	0.00	0.28	0.56	0.84	1.13	2.82	2.82	2.82	2.82	2.82	2.82
8	Pulses	0.00	0.47	0.93	1.40	1.87	4.67	4.67	4.67	4.67	4.67	4.67
9	Paddy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Cotton	39.57	40.10	40.63	41.16	41.68	44.85	44.85	44.85	44.85	44.85	44.85
11	Melon	2.03	2.33	2.63	2.94	3.24	5.05	5.05	5.05	5.05	5.05	5.05
12	Vegatables	5.96	5.87	5.78	5.69	5.60	5.05	5.05	5.05	5.05	5.05	5.05
13	Maize	0.71	1.43	2.16	2.88	3.61	7.95	7.95	7.95	7.95	7.95	7.95
14	Oilseeds	0.00	0.50	1.00	1.51	2.01	5.02	5.02	5.02	5.02	5.02	5.02
15	Fodder Maize	5.83	5.67	5.52	5.36	5.21	4.27	4.27	4.27	4.27	4.27	4.27
16	Soya bean	0.00	0.24	0.47	0.71	0.95	2.37	2.37	2.37	2.37	2.37	2.37
17	Alfalfa	0.00	0.30	0.59	0.89	1.19	2.96	2.96	2.96	2.96	2.96	2.96
18	Orchard	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89
19	New Orchard	0.00	0.52	1.03	1.55	2.06	2.58	3.10	3.61	4.13	4.64	5.16
	Total	**116.89**	**121.23**	**125.57**	**129.90**	**134.24**	**157.69**	**158.21**	**158.72**	**159.24**	**159.75**	**160.27**
	Total with Double for Crops 17-19	**123.78**	**128.93**	**134.08**	**139.23**	**144.38**	**170.13**	**171.16**	**172.19**	**173.22**	**174.25**	**175.29**

Source: PPTA Feasibility (2015)

TABLE 12: CROPPING PATTERN AND INTENSITIES WITHOUT PROJECT

8,302 Hectares

Unit: %

	Crops	Baseline	Index Year									
			1	2	3	4	5	6	7	8	9	10
1	Wheat Rainfed	10.79	10.79	10.79	10.79	10.79	10.79	10.79	0.00	0.00	0.00	0.00
2	Wheat	42.97	42.97	42.97	42.97	42.97	42.97	42.97	42.97	42.97	42.97	42.97
3	Potato	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14
4	Carrot	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Onion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	Barley	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	Fodder	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Pulses	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	Paddy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	Cotton	39.57	39.57	39.57	39.57	39.57	39.57	39.57	39.57	39.57	39.57	39.57
11	Melon	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03	2.03
12	Vegatables	5.96	5.96	5.96	5.96	5.96	5.96	5.96	5.96	5.96	5.96	5.96
13	Maize	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
14	Oilseeds	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	Fodder Maize	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83	5.83
16	Soya bean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Alfalfa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	Orchard	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89	6.89
19	New Orchard	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total	**116.89**	**116.90**	**116.90**	**116.90**	**116.90**	**116.90**	**116.90**	**106.11**	**106.11**	**106.11**	**106.11**

Source: PPTA Feasibility (2015)

TABLE 13: AREA BUILD UP "WITH" PROJECT

Unit: ha

	Crops	Baseline	Year of Development									
			1	2	3	4	5	6	7	8	9	10
1	Wheat (Rainfed)	896	806	717	627	537	0	0	0	0	0	0
2	Wheat	3,567	3,585	3,603	3,621	3,639	3,746	3,746	3,746	3,746	3,746	3,746
3	Potato	178	202	226	250	274	418	418	418	418	418	418
4	Carrot	0	33	67	100	133	333	333	333	333	333	333
5	Onion	0	50	100	151	201	502	502	502	502	502	502
6	Barley	0	25	49	74	98	246	246	246	246	246	246
7	Fodder	0	23	47	70	94	234	234	234	234	234	234
8	Pulses	0	39	78	116	155	388	388	388	388	388	388
9	Paddy	0	0	0	0	0	0	0	0	0	0	0
10	Cotton	3,285	3,329	3,373	3,417	3,461	3,724	3,724	3,724	3,724	3,724	3,724
11	Melon	169	194	219	244	269	420	420	420	420	420	420
12	Vegatables	495	487	480	472	465	420	420	420	420	420	420
13	Maize	59	119	179	239	299	660	660	660	660	660	660
14	Oilseeds	0	42	83	125	167	417	417	417	417	417	417
15	Fodder Maize	484	471	458	445	432	355	355	355	355	355	355
16	Soya bean	0	20	39	59	79	197	197	197	197	197	197
17	Alfalfa	0	25	49	74	98	246	246	246	246	246	246
18	Orchard	572	572	572	572	572	572	572	572	572	572	572
19	New Orchard	0	43	86	128	171	214	257	300	343	385	428
	Total	**9,704**	**10,064**	**10,424**	**10,785**	**11,145**	**13,091**	**13,134**	**13,177**	**13,220**	**13,263**	**13,306**

Source: PPTA Feasibility (2015)

TABLE 14: CROPPED AREA "WITHOUT" PROJECT

Unit: ha

	Crops	Baseline	Index Year									
			1	2	3	4	5	6	7	8	9	10
1	Wheat (Rainfed)	896	896	896	896	896	896	896	0	0	0	0
2	Wheat	3,567	3,568	3,568	3,568	3,568	3,568	3,568	3,568	3,568	3,568	3,568
3	Potato	178	177	177	177	177	177	177	177	177	177	177
4	Carrot	0	0	0	0	0	0	0	0	0	0	0
5	Onion	0	0	0	0	0	0	0	0	0	0	0
6	Barley	0	0	0	0	0	0	0	0	0	0	0
7	Fodder	0	0	0	0	0	0	0	0	0	0	0
8	Pulses	0	0	0	0	0	0	0	0	0	0	0
9	Paddy	0	0	0	0	0	0	0	0	0	0	0
10	Cotton	3,285	3,286	3,286	3,286	3,286	3,286	3,286	3,286	3,286	3,286	3,286
11	Melon	169	168	168	168	168	168	168	168	168	168	168
12	Vegatables	495	495	495	495	495	495	495	495	495	495	495
13	Maize	59	59	59	59	59	59	59	59	59	59	59
14	Oilseeds	0	0	0	0	0	0	0	0	0	0	0
15	Fodder Maize	484	484	484	484	484	484	484	484	484	484	484
16	Soya bean	0	0	0	0	0	0	0	0	0	0	0
17	Alfalfa	0	0	0	0	0	0	0	0	0	0	0
18	Orchard	572	572	572	572	572	572	572	572	572	572	572
19	New Orchard	0	0	0	0	0	0	0	0	0	0	0
	Total	**9,704**	**9,705**	**9,705**	**9,705**	**9,705**	**9,705**	**9,705**	**8,809**	**8,809**	**8,809**	**8,809**

Source: PPTA Feasibility (2015)

TABLE 15: CROP YIELDS PROJECTED FOR "WITH" PROJECT

Unit: ton/ha

	Crops	Baseline	Year of Development									
			1	2	3	4	5	6	7	8	9	10
1	Wheat (Rainfed)	1.54	1.56	1.58	1.60	1.62	1.64	0.00	0.00	0.00	0.00	0.00
2	Wheat	2.96	2.97	2.99	3.00	3.08	3.16	3.24	3.32	3.40	3.47	3.55
3	Potato	23.73	23.85	23.97	24.09	24.71	25.34	25.97	26.60	27.22	27.85	28.48
4	Carrot	22.50	22.61	22.73	22.84	23.43	24.03	24.62	25.22	25.81	26.41	27.00
5	Onion	22.40	22.51	22.62	22.74	23.33	23.92	24.51	25.10	25.70	26.29	26.88
6	Barley	2.40	2.41	2.42	2.44	2.50	2.56	2.63	2.69	2.75	2.82	2.88
7	Fodder	12.50	12.56	12.63	12.69	13.02	13.35	13.68	14.01	14.34	14.67	15.00
8	Pulses	1.40	1.41	1.41	1.42	1.46	1.50	1.53	1.57	1.61	1.64	1.68
9	Paddy	3.30	3.32	3.33	3.35	3.44	3.52	3.61	3.70	3.79	3.87	3.96
10	Cotton	2.05	2.06	2.07	2.08	2.14	2.19	2.24	2.30	2.35	2.41	2.46
11	Melon	24.86	24.98	25.11	25.23	25.89	26.55	27.21	27.86	28.52	29.18	29.83
12	Vegatables	21.00	21.11	21.21	21.32	21.87	22.43	22.98	23.54	24.09	24.65	25.20
13	Maize	4.10	4.12	4.14	4.16	4.27	4.38	4.49	4.60	4.70	4.81	4.92
14	Oilseeds	2.00	2.01	2.02	2.03	2.08	2.14	2.19	2.24	2.29	2.35	2.40
15	Fodder Maize	18.00	18.09	18.18	18.27	18.75	19.22	19.70	20.17	20.65	21.12	21.60
16	Soya bean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Alfalfa	8.50	8.54	8.59	8.63	8.85	9.08	9.30	9.53	9.75	9.98	10.20
18	Orchard	8.93	8.97	9.02	9.06	9.30	9.54	9.77	10.01	10.24	10.48	10.72
19	New Orchard	0.00	0.00	0.00	0.00	0.00	9.29	9.73	10.18	10.63	10.72	10.72

Source: PPTA Feasibility (2015)

TABLE 16: CROP YIELDS "WITHOUT" PROJECT

Unit: ton/ha

	Crops	Baseline	Index Year									
			1	2	3	4	5	6	7	8	9	10
1	Wheat (Rainfed)	1.54	1.56	1.58	1.58	1.58	1.58	0.00	0.00	0.00	0.00	0.00
2	Wheat	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96	2.96
3	Potato	23.73	23.73	23.73	23.73	23.73	23.73	23.73	23.73	23.73	23.73	23.73
4	Carrot	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50	22.50
5	Onion	22.40	22.40	22.40	22.40	22.40	22.40	22.40	22.40	22.40	22.40	22.40
6	Barley	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40	2.40
7	Fodder	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50	12.50
8	Pulses	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
9	Paddy	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30	3.30
10	Cotton	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05	2.05
11	Melon	24.86	24.86	24.86	24.86	24.86	24.86	24.86	24.86	24.86	24.86	24.86
12	Vegatables	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
13	Maize	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10	4.10
14	Oilseeds	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
15	Fodder Maize	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
16	Soya bean	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	Alfalfa	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50	8.50
18	Orchard	8.93	8.93	8.93	8.93	8.93	8.93	8.93	8.93	8.93	8.93	8.93
19	New Orchard	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: PPTA Feasibility (2015)

TABLE 17: CROP PRODUCTION PROJECTED FOR "WITH" PROJECT

Unit: tons

	Crops	Baseline	Year of Development									
			1	2	3	4	5	6	7	8	9	10
1	Wheat Rainfed	1,380	1,258	1,132	1,003	871	0	0	0	0	0	0
2	Wheat	10,559	10,665	10,772	10,880	11,218	11,843	12,135	12,428	12,721	13,014	13,307
3	Potato	4,216	4,810	5,410	6,015	6,766	10,590	10,852	11,114	11,376	11,638	11,899
4	Carrot	0	754	1,515	2,284	3,125	8,010	8,209	8,407	8,605	8,803	9,001
5	Onion	0	1,131	2,273	3,427	4,688	12,018	12,315	12,612	12,909	13,207	13,504
6	Barley	0	59	119	180	246	630	646	662	677	693	708
7	Fodder	0	294	590	890	1,218	3,121	3,199	3,276	3,353	3,430	3,507
8	Pulses	0	55	110	165	226	580	594	608	623	637	651
9	Paddy	0	0	0	0	0	0	0	0	0	0	0
10	Cotton	6,734	6,859	6,984	7,110	7,389	8,152	8,354	8,556	8,757	8,959	9,161
11	Melon	4,190	4,838	5,493	6,154	6,964	11,140	11,416	11,691	11,967	12,242	12,518
12	Vegatables	10,391	10,284	10,176	10,067	10,164	9,410	9,643	9,876	10,109	10,341	10,574
13	Maize	242	490	742	996	1,278	2,889	2,960	3,032	3,103	3,175	3,246
14	Oilseeds	0	84	168	254	347	890	912	934	956	978	1,000
15	Fodder Maize	8,712	8,522	8,330	8,135	8,105	6,820	6,989	7,157	7,326	7,495	7,663
16	Soya bean	0	0	0	0	0	0	0	0	0	0	0
17	Alfalfa	0	210	422	637	871	2,233	2,288	2,343	2,399	2,454	2,509
18	Orchard	5,108	5,134	5,160	5,186	5,321	5,459	5,594	5,729	5,864	5,999	6,134
19	New Orchard	0	0	0	0	0	1,989	2,501	3,052	3,641	4,131	4,590
	Total	**51,532**	**55,446**	**59,396**	**63,382**	**68,796**	**95,774**	**98,606**	**101,477**	**104,386**	**107,196**	**109,975**

Source: Estimated based on cropped areas and yields from PPTA Feasibility (2015)

TABLE 18: CROP PRODUCTION EXPECTED "WITHOUT" PROJECT

Unit: tons

	Crops	Baseline	Index Year									
			1	2	3	4	5	6	7	8	9	10
1	Wheat Rainfed	2,383	2,414	2,445	2,476	2,507	2,538	0	0	0	0	0
2	Wheat	18,245	18,492	18,800	19,108	19,416	19,724	10,560	10,560	10,560	10,560	10,560
3	Potato	7,274	7,384	7,495	7,608	7,722	7,838	4,210	4,210	4,210	4,210	4,210
4	Carrot	0	0	0	0	0	0	0	0	0	0	0
5	Onion	0	0	0	0	0	0	0	0	0	0	0
6	Barley	0	0	0	0	0	0	0	0	0	0	0
7	Fodder	0	0	0	0	0	0	0	0	0	0	0
8	Pulses	0	0	0	0	0	0	0	0	0	0	0
9	Paddy	0	0	0	0	0	0	0	0	0	0	0
10	Cotton	11,637	11,807	11,978	12,148	12,318	12,489	6,735	6,735	6,735	6,735	6,735
11	Melon	7,230	7,337	7,448	7,558	7,672	7,788	4,184	4,184	4,184	4,184	4,184
12	Vegatables	17,961	18,234	18,508	18,782	19,064	19,346	10,395	10,395	10,395	10,395	10,395
13	Maize	419	425	431	437	444	451	243	243	243	243	243
14	Oilseeds	0	0	0	0	0	0	0	0	0	0	0
15	Fodder Maize	15,055	15,281	15,507	15,741	15,975	16,218	8,714	8,714	8,714	8,714	8,714
16	Soya bean	0	0	0	0	0	0	0	0	0	0	0
17	Alfalfa	0	0	0	0	0	0	0	0	0	0	0
18	Orchard	8,832	8,960	9,099	9,237	9,376	9,514	5,112	5,112	5,112	5,112	5,112
19	New Orchard	0	0	0	0	0	0	0	0	0	0	0
	Total	**89,036**	**90,336**	**91,710**	**93,096**	**94,493**	**95,906**	**50,153**	**50,153**	**50,153**	**50,153**	**50,153**

Source: Estimated based on cropped areas and yields from PPTA Feasibility (2015)

TABLE 19: ECONOMIC VALUE OF PRODUCTION PROJECTED FOR "WITH" PROJECT

Unit: TJS

	Crops	Baseline	Year of Development									
			1	2	3	4	5	6	7	8	9	10
1	Wheat (Rainfed)		1,405,470	1,265,323	1,121,173	973,018	0	0	0	0	0	0
2	Wheat		13,177,417	13,309,447	13,442,468	13,860,518	14,631,697	14,993,654	15,355,611	15,717,568	16,079,525	16,441,482
3	Potato		0	0	0	0	0	0	0	0	0	0
4	Carrot		0	0	0	0	0	0	0	0	0	0
5	Onion		0	0	0	0	0	0	0	0	0	0
6	Barley		33,545	67,425	101,644	139,052	356,449	365,266	374,084	382,902	391,720	400,538
7	Fodder		66,165	132,991	200,484	274,269	703,064	720,456	737,848	755,241	772,633	790,025
8	Pulses		66,941	134,552	202,837	277,488	711,317	728,913	746,510	764,106	781,703	799,299
9	Paddy		0	0	0	0	0	0	0	0	0	0
10	Cotton		15,564,747	15,848,740	16,135,184	16,767,703	18,500,934	18,958,607	19,416,281	19,873,955	20,331,628	20,789,302
11	Melon		913,588	1,037,209	1,162,044	1,315,050	2,103,666	2,155,707	2,207,747	2,259,787	2,311,827	2,363,868
12	Vegatables		2,293,976	2,269,874	2,245,474	2,267,234	2,099,080	2,151,007	2,202,934	2,254,861	2,306,787	2,358,714
13	Maize		604,968	914,906	1,227,928	1,576,361	3,563,363	3,651,513	3,739,663	3,827,813	3,915,963	4,004,113
14	Oilseeds		233,302	468,936	706,921	967,092	2,479,058	2,540,384	2,601,711	2,663,037	2,724,364	2,785,691
15	Fodder Maize		0	0	0	0	0	0	0	0	0	0
16	Soya bean		0	0	0	0	0	0	0	0	0	0
17	Alfalfa		0	0	0	0	0	0	0	0	0	0
18	Orchard		5,830,981	5,860,550	5,890,269	6,043,993	6,199,928	6,353,301	6,506,674	6,660,047	6,813,420	6,966,793
19	New Orchard		0	0	0	0	2,258,866	2,840,958	3,466,490	4,135,462	4,691,491	5,212,768
	Total	**0**	**40,191,099**	**41,309,954**	**42,436,426**	**44,461,778**	**53,607,421**	**55,459,767**	**57,355,553**	**59,294,779**	**61,121,061**	**62,912,592**

Source: Estimated based on the individual crop gross margin and production volume

TABLE 20: ECONOMIC VALUE OF PRODUCTION PROJECTED FOR "WITHOUT" PROJECT

Unit: TJS

	Crops	Baseline	Index Year									
			1	2	3	4	5	6	7	8	9	10
1	Wheat Rainfed		2,698,035	2,732,625	2,767,216	2,801,806	2,836,396	0	0	0	0	0
2	Wheat		22,846,840	23,227,621	23,608,401	23,989,182	24,369,963	13,046,952	13,046,952	13,046,952	13,046,952	13,046,952
3	Potato		0	0	0	0	0	0	0	0	0	0
4	Carrot		0	0	0	0	0	0	0	0	0	0
5	Onion		0	0	0	0	0	0	0	0	0	0
6	Barley		0	0	0	0	0	0	0	0	0	0
7	Fodder		0	0	0	0	0	0	0	0	0	0
8	Pulses		0	0	0	0	0	0	0	0	0	0
9	Paddy		0	0	0	0	0	0	0	0	0	0
10	Cotton		26,795,735	27,182,212	27,568,689	27,955,166	28,341,643	15,285,113	15,285,113	15,285,113	15,285,113	15,285,113
11	Melon		1,385,528	1,406,396	1,427,264	1,448,681	1,470,648	790,154	790,154	790,154	790,154	790,154
12	Vegatables		4,067,379	4,128,428	4,189,477	4,252,434	4,315,390	2,318,778	2,318,778	2,318,778	2,318,778	2,318,778
13	Maize		524,413	531,977	539,540	547,104	555,928	299,141	299,141	299,141	299,141	299,141
14	Oilseeds		0	0	0	0	0	0	0	0	0	0
15	Fodder Maize		0	0	0	0	0	0	0	0	0	0
16	Soya bean		0	0	0	0	0	0	0	0	0	0
17	Alfalfa		0	0	0	0	0	0	0	0	0	0
18	Orchard		10,176,911	10,334,170	10,491,429	10,648,688	10,805,947	5,805,661	5,805,661	5,805,661	5,805,661	5,805,661
19	New Orchard		0	0	0	0	0	0	0	0	0	0
	Total	**0**	**68,494,841**	**69,543,429**	**70,592,016**	**71,643,061**	**72,695,915**	**37,545,799**	**37,545,799**	**37,545,799**	**37,545,799**	**37,545,799**

Source: Estimated based on the individual crop gross margin and production volume

C. OTHER ANNEXES

Table 21 : Economic Price Derivation for Wheat Import Parity Basis

Item	Unit	Value
FOB, port of origin	$/ton	245
FOB, port of origin	$/ton	245
Freight & insurance to St. Petersburg, Russia	$/ton	30
CIF price at St. Petersburg, Russia	$/ton	275
Port handling charges and storage costs at St. Petersburg	$/ton	7.0
Transport, loading, unloading and insurance costs to Moscow	$/ton	29.0
Landed price of American wheat in Moscow	$/ton	311.2
Quality Adjustment factor	%	0.85
Kazakhstan's wheat - average grades, in Moscow Region	$/ton	264.52
Less transport, handling and insurance: Kazakhstan - Moscow	$/ton	52.0
Kazakhstan Parity border price	$/ton	212.5
Transport, handling and insurance to Tajikistan	$/ton	33.0
Landed price of wheat at Tajikistan's border	$/ton	245.5
Importer's costs, handling and margin	10%	24.6
Wholesale price, equivalent to price at elevators	$/ton	270.1
Less Storage, losses, milling and drying costs	7.50%	20.3
Transport, loading and unloading -- farms to elevator	$/ton	27.0
Parity Price at farm gate	$/ton	276.8
Parity Price at farm gate - Local Currency	TJS/ton	1,864
Financial Prices		
Open Merket Price	TJS/ton	1,150
Less handling, transport and margin	5%	57.50
Wholesale price, equivalent to price at elevators	TJS/ton	1,093
Ratio of border to local farmgate price	Factor	1.71

CIF = cost, insurance and freight, FOB = free on board, MUV = manufactures unit value, SERF = shadow exchange rate factor.

Based on PPTA (2015) and World Bank Pink Sheet

Table 22: Financial and Economic Farmgate Prices for Cotton

Item	Unit	Values
World price	$/ton	1,830
Quality adjustment factor (92%)	92.00%	1,684
Less international shipping freight and insurance	$/ton	351
At port price	$/ton	1,333
Exchange rate: TJS/$		6.73
At port price	TJS/ton	8,974
Adjustment for shadow exchange rate (x1.11)		9,961
Less transport and handling gin to port (2.5%)		249
Less ginning costs (per mt of fiber)	TJS/ton	1,192
Ex-ginnery price of cotton fiber	TJS/ton	8,520
Processing ratio (30%)		
Cotton fiber value per metric ton of seed cotton	TJS/ton	2,556
Value of linters per ton of seed cotton (1.4%)	TJS/ton	35.8
Value of cotton seeds per ton of seed cotton	TJS/ton	118
Ginnery door value of seed cotton	TJS/ton	2,710
Wholesale price at Farmgate	TJS/ton	1,580
Ratio of border to local farmgate price	Factor	1.72

a/ Eastern Europe

b/ Source: Shipping Corporation Office Karachi Port July 2010 Quote

Based on PPTA (2015) and World Bank Pink Sheet

Table 23 : Economic Price Derivation for Maize Import Parity Basis

Item	Unit	Import
FOB, port of origin	$/ton	193
FOB, port of origin	$/ton	193
Freight & insurance to St. Petersburg, Russia	$/ton	30
CIF price at St. Petersburg, Russia	$/ton	223
Port handling charges and storage costs at St. Petersburg	$/ton	7.0
Transport, loading, unloading and insurance costs to Moscow	$/ton	29.0
Landed price of American wheat in Moscow	$/ton	258.9
Quality Adjustment factor	%	0.85
Khazakistan Maize - average grades, in Moscow Region	$/ton	220.065
Less transport, handling and insurance: Kazakhstan - Moscow	$/ton	52.0
Kazakhstan Parity border price	$/ton	168.1
Transport, handling and insurance to Tajikistan	$/ton	33.0
Landed price of Maize at Tajikistan's border	$/ton	201.1
Importer's costs, handling and margin	10%	20.1
Wholesale price, equivalent to price at elevators	$/ton	221.2
Less Storage, losses, and drying costs	7.50%	16.6
Transport, loading and unloading -- farms to elevator	$/ton	27.0
Parity Price at farm gate	$/ton	231.6
Parity Price at farm gate - Local Currency	TJS/ton	1,559
Financial Prices		
Open Merket Price	TJS/ton	750
Less handling, transport and margin	5%	37.50
Wholesale price, equivalent to price at elevators	TJS/ton	713
Ratio of border to local farmgate price	Factor	2.19

Based on PPTA (2015) and World Bank Pink Sheet

Table 24 : Economic Price Derivation for Rice Import Parity Basis

Item	Unit	Import
FOB, port of origin	$/ton	423
FOB, port of origin	$/ton	423
Freight & insurance to St. Petersburg, Russia	$/ton	30
CIF price at St. Petersburg, Russia	$/ton	453
Port handling charges and storage costs at St. Petersburg	$/ton	7.0
Transport, loading, unloading and insurance costs to Moscow	$/ton	29.0
Landed price of Thai Rice in Moscow	$/ton	488.8
Quality Adjustment factor	%	0.90
Thai Rice - average grades, in Moscow Region	$/ton	439.92
Less transport, handling and insurance: Kazakhstan - Moscow	$/ton	52.0
Parity border price	$/ton	387.9
Transport, handling and insurance to Tajikistan	$/ton	33.0
Landed price of Rice at Tajikistan's border	$/ton	420.9
Importer's costs, handling and margin	10%	42.1
Wholesale price, equivalent to price at elevators	$/ton	463.0
Ratio Formation Rice and husk 67:33	$/ton	310.2
Less Storage, losses, milling and drying costs	7.50%	23.3
Processed Value		287.0
Transport, loading and unloading -- farms to elevator	$/ton	27.0
Parity Price at farm gate	$/ton	314.0
Parity Price at farm gate - Local Currency	TJS/ton	2,114
Financial Prices		
Open Merket Price	TJS/ton	3,226
Less handling, transport and margin	5%	161.29
Wholesale price, equivalent to price at elevators	TJS/ton	3,065
Ratio of border to local farmgate price	Factor	0.69

CIF = cost, insurance and freight, FOB = free on board, MUV = manufactures unit value, SERF = shadow exchange rate factor.

Based on PPTA (2015) and World Bank Pink Sheet

Table 25: Import Parity Prices of Fertilizers

Item	Commodities		
	Nitrogenous Fertilizer	Potash	Phosphoric Fertilizer
World Commodity Prices (US $/ tonne) : 5-year Average 2011-15	352.55	375.06	509.54
Adjustment factor	1.00	1.20	1.00
Adjusted price US $ /tonne	352.55	450.07	509.54
Freight charges US $ /tonne	55.00	55.00	55.00
C&F price at Dushanbe US $ /tonne	407.55	505.07	564.54
US Dollar conversion rate	6.73	6.73	6.73
C&F price at Dushanbe TJS /tonne	2,742.79	3,399.13	3,799.35
Marine Insurance @ 0.23% of C&F price	6.31	7.82	8.74
CIF Dushanbe Price TJS /tonne	2,749.10	3,406.95	3,808.09
Port Handling cost TJS /tonne	22.04	22.04	22.04
Bank Mark up @ 1% for one month	27.49	34.07	38.08
TCP Commission @ 2% of C&F value	54.98	68.14	76.16
Upcountry Expenses to the Project Area TJS /tonne	256.38	256.38	256.38
Parity Price in the Project Area TJS/ tonne	3,109.99	3,787.58	4,200.75
Transport from farm to market TJS/ tonne	29.00	29.00	29.00
Parity Price at Farmgate TJS /tonne	3,138.99	3,816.58	4,229.75
Parity Price at Farmgate TJS/ Kg	3.14	3.82	4.23
Import Parity Price Ratio	1.29	0.82	0.68

Sources:

1. Commodity Markets Outlook - World Bank Quarterly Reports, October, 2013 & October, 2015
2. Food Outlook, Global Market Analysis, 2011 to 2015, FAO

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 TJS was 6.73 as of December 2015.

Table 26. Prices used in financial and economic analysis

Description	Unit	Financial	Economic
Outputs			
Yields			
Wheat	TJS/Kg	1.15	1.96
Cotton	TJS/Kg	1.58	2.71
Paddy	TJS/Kg	3.23	2.23
Maize	TJS/Kg	0.75	1.64
Melon	TJS/Kg	0.30	0.27
Pulses	TJS/Kg	2.85	2.59
Fodders	TJS/Kg	0.30	0.27
Barley	TJS/Kg	1.25	1.14
Vegetables	TJS/Kg	0.53	0.48
Oilseeds	TJS/Kg	4.75	4.32
Orchards	TJS/Kg	1.63	1.48
By-Products			
Wheat Straws	TJS/Kg	0.23	0.21
Cotton Sticks	TJS/Kg	0.20	0.18
Husk	TJS/Kg	0.25	0.23
Inputs			
Seed			
Wheat	TJS/Kg	2.75	2.50
Cotton	TJS/Kg	1.58	1.44
Paddy	TJS/Kg	3.23	2.93
Maize	TJS/Kg	4.50	4.09
Melon	TJS/Kg	0.50	0.45
Pulses	TJS/Kg	9.50	8.64
Fodders	TJS/Kg	0.30	0.27
Barley	TJS/Kg	1.25	1.14
Vegetables	TJS/Kg	53.82	48.93
Oilseeds	TJS/Kg	9.50	8.64
Orchards	TJS/Plant	11.56	10.51
Fertilizers			
Nitrogenous fertilizer	TJS/Bag	60	77.61
Potash fertilizer	TJS/Bag	58	47.32
Phosphoric fertilizer	TJS/Bag	78	53.36
Farm Yard Manure	1000 Kg	40	36.37
Sprays			
Weedicide/Pesticide	TJS/Liter	96	87.28
Mechanical Labour	TJS/Hour	70	70.00
Hired Labour	TJS/Day	9	7.45

Source: PPTA survey and the World Bank Pink Sheet

Table 27: Derivation of Standard Conversion Factor

Item	Value (TJS)
Total Agricultural Imports	3,618,000,000.00
Total Agricultural Exports	1,190,220,000.00
Import Duty	204,055,200.00
Sales Tax on Imports	321,278,400.00
Subsidy on Imports	47,757,600.00
Net Value of Taxes on Imports	477,576,000.00
Export Duty	3,213,594.00
Export Rebates	6,070,122.00
Net Value of Taxes on Exports	- 2,856,528.00
Exports + Imports	4,808,220,000.00
Imports + NVTM	4,095,576,000.00
Exports - NVTX	1,193,076,528.00
Standard Conversion Factor	**0.91**

Standard Conversion Factor [M+X / (M+Tm)+(X-Tx)]

Source: FAO and Tajikistan Statistics Office

Table 28: Derivation of the Shadow Wage Rate Factor

I. Price Ratio of Domestic and Border Prices

	(A)	(B)	(C) = (A) / (B)	(D)	(E)	(F) = (C) x (E)
Crop	Domestic Price (US$/m	Border Price (US$/mt	Price Ratio	Value of Production (2013) (	Weight (%)	
1. Wheat	276.82	245.20	1.13	123,069.96	28.27	0.32
2. Cotton	2,476.34	1,830.00	1.35	257,196.21	59.08	0.80
3. Maize	231.58	192.90	1.20	27,766.34	6.38	0.08
4. Rice	313.95	422.80	0.74	27,308.68	6.27	0.05
Total				**435,341.19**	**100.00**	
Weighted Average						**1.24**

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)	**0.81**

III. Reciprocal of the employment rate

Labor force participation rate (%) (H)	67.90
Employment in agriculture (%) (I)	66.10
Under-employment in agriculture (%) (J)	-
Adjusted employment rate in agriculture (%) (K) = (I) - (J	66.10
(L) = (H) / (K)	**1.03**

IV. Shadow Wage Rate Factor

(M) = (G) x (L)	**0.83**

Source: World Bank Pink Sheet and FAOSTAT

Note:

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).

Table 29: Cash Flow of Costs and Benefits - Economic Analysis (TJS million)

Year	Capital Costs			O&M Costs			Total Costs			Benefits Without Project			Benefits With Project				Incremental Benefits			Net Cash Flow
	Pump	Gravity	Total	Pump	Gravity	Total	Pump	Gravity	Total	Pump	Gravity	Total	Pump	Gravity	O&M Savings	Total	Pump	Gravity	Total	
1	7.39	15.70	23.08	-	-	-	7.39	15.70	23.08	68.49	175.10	243.60	40.19	177.63	-	217.83	(28.30)	2.53	(25.77)	(48.85)
2	15.42	32.77	48.18	3.12	4.94	8.06	18.54	37.70	56.25	69.54	177.79	247.34	41.31	177.51	3.27	222.09	(28.23)	(0.29)	(25.25)	(81.50)
3	18.51	39.34	57.85	3.31	5.15	8.46	21.82	44.49	66.32	70.59	180.49	251.08	42.44	177.35	2.87	222.66	(28.16)	(3.13)	(28.42)	(94.74)
4	14.13	30.03	44.15	3.50	5.37	8.87	17.63	35.40	53.02	71.64	183.19	254.83	44.46	190.26	2.46	237.18	(27.18)	7.07	(17.65)	(70.67)
5	1.66	3.52	5.18	3.68	5.59	9.27	5.34	9.11	14.45	72.70	185.89	258.59	53.61	211.41	2.06	267.08	(19.09)	25.52	8.49	(5.96)
6	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	55.46	216.82	1.93	274.21	17.91	43.33	63.17	53.76
7	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	57.36	222.23	1.93	281.51	19.81	48.74	70.48	61.07
8	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	59.29	227.64	1.93	288.86	21.75	54.15	77.83	68.42
9	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	61.12	232.75	1.93	295.80	23.58	59.26	84.77	75.36
10	2.86	6.07	8.92	3.75	5.66	9.41	6.60	11.73	18.33	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	73.27
11	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
12	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
13	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
14	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
15	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
16	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
17	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
18	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
19	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
20	2.86	6.07	8.92	3.75	5.66	9.41	6.60	11.73	18.33	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	73.27
21	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
22	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
23	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
24	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
25	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
26	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
27	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
28	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
29	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
30	-	-	-	3.75	5.66	9.41	3.75	5.66	9.41	37.55	173.49	211.04	62.91	237.79	1.93	302.63	25.37	64.30	91.59	82.19
																			Base-case ENPV	105.69
																			Base-case EIRR	16.3%

Source: ADB estimates

Table 30: Sensitivity Analysis (TJS million)

Year	Case 1		Case 2		Case 3		Case 4		Case 5		Case 6	
	VAR	NCF	VAR	NCF	VAR	NCF	VAR	NCF	VAR	NCF	VAR	NCF
1	25.39	(51.16)	23.08	(48.85)	25.39	(51.16)	(23.19)	(46.27)	-	(23.08)	(23.19)	(48.58)
2	61.06	(86.31)	57.05	(82.30)	61.87	(87.12)	(22.73)	(78.97)	-	(56.25)	(22.73)	(84.60)
3	72.10	(100.52)	67.16	(95.58)	72.95	(101.37)	(25.58)	(91.89)	(25.77)	(92.08)	(25.58)	(98.52)
4	57.44	(75.08)	53.91	(71.56)	58.32	(75.97)	(15.88)	(68.90)	(25.25)	(78.27)	(15.88)	(74.21)
5	14.97	(6.48)	15.37	(6.88)	15.89	(7.40)	7.64	(6.81)	(28.42)	(42.87)	7.64	(8.25)
6	9.41	53.76	10.35	52.82	10.35	52.82	56.85	47.45	(17.65)	(27.05)	56.85	46.51
7	9.41	61.07	10.35	60.13	10.35	60.13	63.43	54.02	8.49	(0.91)	63.43	53.08
8	9.41	68.42	10.35	67.48	10.35	67.48	70.05	60.64	63.17	53.76	70.05	59.70
9	9.41	75.36	10.35	74.42	10.35	74.42	76.29	66.88	70.48	61.07	76.29	65.94
10	19.22	72.37	19.27	72.33	20.16	71.43	82.43	64.11	77.83	59.50	82.43	62.27
11	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	84.77	75.36	82.43	72.09
12	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
13	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
14	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
15	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
16	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
17	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
18	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
19	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
20	19.22	72.37	19.27	72.33	20.16	71.43	82.43	64.11	91.59	73.27	82.43	62.27
21	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
22	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
23	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
24	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
25	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
26	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
27	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
28	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
29	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
30	9.41	82.19	10.35	81.25	10.35	81.25	82.43	73.03	91.59	82.19	82.43	72.09
	ENPV	**92.19**	**ENPV**	**99.17**	**ENPV**	**85.67**	**ENPV**	**75.10**	**ENPV**	**38.49**	**ENPV**	**55.09**
	EIRR	**15.6%**	**EIRR**	**16.1%**	**EIRR**	**15.4%**	**EIRR**	**15.3%**	**EIRR**	**13.6%**	**EIRR**	**14.3%**
	SI	1.28	SI	0.66	SI	n.a	SI	4.07	SI	n.a	SI	n.a
	SV	78%	SV	152%	SV	n.a	SV	25%	SV	3 years	SV	n.a

Case 1 - Increase in Capital Costs	10%
Case 2 - Increase in O&M Costs	10%
Case 3 - Combined Case 1 and 2	as above

Case 4 - Decrease in overall benefit	-10%
Case 5 - Benefit delay by 3 years	-3 years
Case 6 - Combination of cases 3 and 4	as above

EIRR - economic internal rate of return; ENPV - economic net present value; NFC - Net cash flow; SI - sensitivity indicator; SV - switching value; and VAR - sensitivity variable

Source: ADB estimates