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 following two pump systems: (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 infrastructure; 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 project interventions. Detailed economic and financial analysis is available as a supplementary appendix.[1]

B. Macroeconomic Assessment

2. Agriculture in Tajikistan has gone through major transitions since the country's 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 to growing cotton, which it had been doing since it came under Soviet control.[2] 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 Soviet Socialist Republic 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 the stage for later food shortages during the civil war of 1991–1997 and leaving food insecurity as one of the most pressing challenges that faces the country today. Much of the infrastructure that survived the collapse of the USSR was devastated during the civil war.[3]

3. The gross domestic product (GDP) of Tajikistan in 2014 (in current prices) was $19.1 billion and the average annual GDP growth rate was 7.5% during 2004–2014. However, there is likely a declining trend during 2015 because of economic recession in the Russian Federation, weakening of the Russian ruble, and tightening of migration regulations.[4] As of 2013, shares of value added to the GDP were as follows: industry 21.6%, agriculture 27.4%, and services 51.0%. The annual growth rate of the agriculture sector value added during 2004–2013 was 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 1999–2015, the inflation rate averaged 13.7%, reaching an all-time high of 61.0% in December 2000 and a record low of 1.8% in April 2004.[5] While the poverty rate remains high, Tajikistan has managed

[1] Detailed Economic and Financial Analysis (accessible from the list of linked documents in Appendix 2 of the report and recommendation of the President).
[2] United States Agency for International Development. 2012. *Feed the Future Initiative*. Dushanbe.
[3] United National Development Programme. 2012. *Energy for All, Gap Analysis*. Dushanbe.
[4] World Bank. 2015. *Global Overview Fact Sheet.* Dushanbe.
[5] National Bank of Tajikistan. 2012. *Annual Report.* Dushanbe.

to dramatically 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.[6]

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) were forecast at 1.1 million tons, which is 4% above 2013–2014 marketing year's near-average level because of lower 2014 production. In the 2013–2014 marketing year, wheat imports reached 1.0 million tons with increased wheat grain and reduced flour imports.[7] Water is scarce in the project area 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 is 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 agriculture sector has undergone substantial changes since the country's independence. International trade barriers were removed in 1991 and agriculture prices were liberalized. After years of deep decline, the sector has recovered to become a backbone of the economy. As of 2014, the share of agricultural value added to the country's GDP was 20% and the share of the sector's exports, specifically for cotton lint, vegetables, and fruit, was 30%.

7. The growth of the agriculture sector in recent years has been a result of land reforms. Although land in Tajikistan remains exclusively under state ownership,[8] land-use rights can be transferred to individuals. *Dehkan* (peasant) farms account for 98.5% of the total agricultural land, and as of January 2013 there were 71,857 *dehkan* farms.[9] Nearly 90% of agricultural products are produced by the private sector: 63% by households' subsidiary plots (except cotton), and 29% by *dehkan* farms.[10]

8. The project area has productive fertile land, gravity- and pumped-flow water resources, and a climate that is conducive to producing many types of food and nonfood crops. To increase agricultural production and improve socioeconomic conditions, there is dire need to maximize the irrigation potential of the project area through the rehabilitation, improvement, and modernization of irrigation and drainage systems and provision of other physical and nonphysical facilities.

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

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[6] Worldmark Encyclopedia. 2014. *Worldmark Encyclopedia of Nations*. http://www.encyclopedia.com/topic/Tajikistan

[7] FAO. 2013. Country Brief Global Information and Early Warning System (GIEWS). Dushanbe.

[8] Government of Tajikistan. 1994. Article 13 of the Constitution of the Republic of Tajikistan. Dushanbe.

[9] Government of Tajikistan. 2013. Committee on Land, Geodesy and Cartography. Dushanbe.

[10] Government of Tajikistan. 2010. *Agriculture Sector.* Dushanbe.

10. The present 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 and 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 that the public sector invests in irrigation infrastructure as it 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 hectares (ha) will be carried out, including 6,953 ha which is presently rain fed. Of the pumped irrigation area, initially all 20 pumping stations in the project area were selected for modernization. Least-cost analysis was undertaken to select pump systems based on the pumping heads. The weighted average heads are 21 meters (m) for the Janubi pump system and 59 m for the Urtaboz pump system, while for other pump systems it is over 94 m. Based on current best practices, pump systems with lifts higher than 60 m are not financially sustainable and, hence, economically unviable in pump-fed irrigation systems given the 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 sediment removal from the basin. This option ensures that the O&M costs for sediment handling is around $3.77/ha under the with-project scenario, compared to $36.5/ha under the present and future without-project scenarios.

F. Major Assumptions

13. **General assumptions.** The following are general project assumptions:

(i) The project has two interdependent components—the pump and gravity irrigation components.
(ii) The financial and economic analysis compares two scenarios, i.e., with-project and without-project scenarios.
(iii) 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.
(iv) The project economic life is assumed to be 30 years.

14. **Project investment assumptions.** Project investment assumptions are as follows:

(i) The project cost includes civil works, mechanical equipment, survey, study, design, training, and workshops, and consulting services. Other costs include staff salaries of project management office and project management office, office accommodation, O&M equipment, and office and vehicles for O&M activities.

(ii) The share of the gravity irrigation improvement of the total investment cost is 68%, and modernization of selected pump stations 32%.
(iii) The total investment cost is assumed to be phased over 5 years.
(iv) Replacement costs for both components have been added for major repair and maintenance in years 10 and 20 at the rate of 5% of the respective capital costs.

15. **Operation and maintenance cost assumptions.** O&M cost assumptions are as follows:
(i) The assumed O&M cost for the pump component is $76.46/ha and for the gravity component $26.77/ha.
(ii) The materials component of the O&M cost is 60%, while that of labor is 40%.
(iii) 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.

16. **Net benefit assumptions.** Net benefit assumptions are as follows:
(i) The main quantified benefit of the project is the net agricultural returns and, in addition, the project would result in O&M cost savings because of the sediment-exclusion investment.
(ii) The net agricultural returns were calculated based on the established gross margins for the following crops: wheat, rain-fed wheat, cotton, rice, maize, melons, pulses, fodder, barley, vegetables, oilseeds, and fruits.

17. **Assumptions used in converting financial into economic values.** The following assumptions were used in converting financial into economic values:
(i) The world price numeraire was used for deriving the import and export parity prices and the standard conversion factor.
(ii) Import and export parity prices have been derived for traded commodities.
(iii) A standard conversion factor of 0.91 was used to convert a financial price into an economic value for nontradable goods.
(iv) A shadow wage rate factor of 0.83 was used for unskilled labor.
(v) A discount rate of 12% was considered as the opportunity cost of capital as the cut-off rate.
(vi) The cash flows have been drawn in the local currency (somoni) and an exchange rate of $1 =TJS6.734 was used in the economic analysis.

G. Project Costs

1. Capital Costs

18. Total capital costs, based on the engineering designs, have been estimated at $33.7 millio[11] including physical and price contingencies of $2.5 million. Interest during implementation was calculated at $0.7 million (for the proposed ADB Asian Development Fund 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 TJS227.0 million. In economic prices, the total capital cost is $26.50 million, or the equivalent of TJS178.45 million.

[11] Inclusive of Japan Fund for Poverty Reduction technical assistance of $2 million.

2. Operation and Maintenance Costs

19. The O&M cost for the gravity and pump irrigation components increase gradually from $1.37 million in year 2 to $1.57 million in year 5. From year 6 onwards, the total O&M cost is held constant at $1.59 million as an effect of the capital replacement in years 10 and 20. These estimates were based on calculated unit cost values as presented in the O&M requirements and sustainability plan conducted during the project preparatory technical assistance 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.

H. Project Benefits

20. **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.

21. The quantified benefits represent the gains from the maximization of the potential command area of the CIS, which is 50,163 ha. At present, however, the system is only serving 43,210 ha. In addition to the CIS command area, the project covers 6,953 ha of rain-fed areas, of which 2,381 ha also fall under command of the pump irrigation component (Table 1).

Table 1: Estimated Area to Benefit under the Project
(hectares)

	Existing Situation			With Project		
Source of Water	**Total Command Area**	**Irrigated Area**	**Rain-Fed Area**	**Modernization of Irrigated Area**	**Extension of 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 hectares (ha) was derived as follows: (i) total command area under the pumping schemes is 14,344 ha including 2,381 ha presently rain fed; (ii) since not all the pumping schemes are being modernized, the area where pumps will be modernized has been estimated as 8,302 ha, including rain-fed area of 1,378 ha estimated on prorated basis; and (iii) the system under gravity irrigation will be fully modernized under the project, thus all the rain-fed area (4,572 ha) under the gravity system will receive water for irrigation under the with-project scenario.
Source: ADB. 2014. *Project Preparatory Technical Assistance for Proposed Grant Republic of Tajikistan: Water Resources Management in Pyanj River Basin*. Manila (Consultant Final Report).

22. **Unquantified benefits.** Improved and reliable supply of irrigation water will lead to better management of water and other inputs and hence enhance the irrigated crop productivity. Additional agricultural benefits may be generated as a result of the shift in land use, which is unknown at the project design stage. To ensure that these benefits are properly captured, the terms of reference for the monitoring and evaluation specialists of the project implementation consultants have included the tasks of conducting field surveys to collect data and information. This will help ADB and the government to conduct the project economic and financial reevaluation during the project's midterm review (see terms of reference for monitoring and evaluation specialists in the Project Administration Manual[12]).

[12] Project Administration Manual (accessible from the list of linked documents in Appendix 2 of the Report and Recommendation of the President to the Board of Directors).

I. Economic Analysis and Estimated Results

23. **Approach and methodology.** A benefit–cost analysis was 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.

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

25. The project's benefits are assumed to increase gradually during the first 5 years, and the area is projected to be at its maximum by the 10th year from the commencement of implementation. A number of key factors influencing the benefits were identified and sensitivity analyses has been conducted to test major risks to the project benefits and costs.

26. **Economic returns and sensitivity analysis.** The project is expected to be economically viable in that the calculated EIRR is 16.3% and the ENPV of the investment is TJS105.7 million based on the discount rate of 12.0% (Table 2). These economic results are due to the substantial size of the economic benefit stream relative to the project's least-cost engineering design.

27. 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 increase in capital cost, increase in O&M cost, decrease in benefits, and 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 conjunction with another. The effects of some of these risks on the economic viability of the project are shown in Table 2 and explained subsequently.

Table 2: Results of Economic Analysis and Sensitivity Analysis

Results of Evaluation	Change	ENPV (TJS million)	EIRR (%)	Sensitivity Indicator[a]	Switching Value[b]
Base Case		105.7	16.3		
Sensitivity Scenarios					
Case 1 - Increase in capital costs	+10%	92.9	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	+10%	85.7	15.4		
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		3 years
Case 6 - Combination of cases 3 and 4	as above[c]	55.1	14.3		

EIRR = economic internal rate of return, ENPV = economic net present value, n.a = not applicable, O&M = operation and maintenance.
[a] Sensitivity indicator is the ratio that compares percentage change in the ENPV with percentage change in a variable.
[b] Switching value is the percentage change in a variable sufficient to reduce the ENPV to zero.
[c] 10% increase in capital costs, 10% increase in O&M costs, and 10% decrease in benefit.
Source: Asian Development Bank estimates.

28. 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 10% increase in capital costs has been inserted into the calculations. This cost increase causes the EIRR to fall to 15.6%. A 78% increase in cost would cause the EIRR to fall below the acceptable 12% level (the switching value).[13] A 10.0% increase in O&M costs would cause the EIRR to fall to 16.1%, while a 152.0% increase in cost would cause the EIRR to fall below the acceptable level of 12.0%. A combination of cases 1 and 2 would cause the EIRR to fall to 15.4%, while a 10% decrease in benefit would 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 25%. If the benefits are delayed by 2 years, it would 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. A combination of cases 3 and 4 would cause the EIRR to fall to 14.3%.

29. 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 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.

J. Project Benefit Distribution and Poverty Impact

30. **Household financial returns.** From the perspective of farm households, the incremental irrigated area resulting form the project investments would generate additional benefits of $212/ha/year (equivalent to TJS1,426/year). With an average farm size of 0.5 ha in the command area, farm household income is expected to increase by $106/year (equivalent to TJS713/year).

31. **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 3 presents the result of the benefit distribution analysis. Economic benefits amounting to TJS256 million would accrue to the farmers as a result of the project. The labor force would receive economic benefits valued at around TJS15 million. This pattern of benefit distribution results in the project's poverty impact ratio of 42.8% (Table 4).

[13] 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%).

Table 3: Distribution of Economic Benefits
(TJS million)

Item	Financial Present Value	Economic Present Value	Economic Less Financial	Distribution of Project Benefits			
				Gov't	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	
Nontraded	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**

( ) = negative.
Source: Asian Development Bank estimates.

Table 4: Poverty Impact Analysis
(TJS million)

Item	Government/ Economy	Labor	Farmers	Total
Benefits	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**

( ) = negative.
Source: Asian Development Bank estimates.