ECONOMIC ANALYSIS

A. Introduction

1. The proposed project will support the development of the State Agency for Hydrometeorology (Hydromet) into a sustainable and well-resourced national institution that produces timely and accurate forecasting of extreme weather events, with a focus on the Pyanj River Basin (PRB) area. It will (i) help address key underlying institutional barriers and weaknesses of Hydromet that hamper its institutional capacity and development, and (ii) support improved capacity in the production and dissemination of forecasting services.

B. Context of Vulnerability

2. Tajikistan remains highly vulnerable to environmental hazards like floods, earthquakes, rock falls, landslides, mudslides, and droughts because of its topography, and hydrological and climatic variation. Tajikistan is among the most vulnerable countries in Central Asia to climate change and one of the least able to adapt. Natural disasters destroy infrastructure and livelihoods and kill or displace people. Climate change is expected to exacerbate these impacts.[1]

3. The mandate of Hydromet is to (i) protect people, society, and the state from natural hazards; (ii) provide hydrometeorological information on the state of the environment and pollution to satisfy the needs of the state and the population; and (iii) ensure the sustainability of the collection, processing, and dissemination of hydrometeorological data. However, lack of advanced infrastructure, inefficient organization, and poor staff retention and development hamper Hydromet's capacity to achieve this mandate.

C. Project Costs

4. The additional financing project cost is estimated at $12.8 million, comprising a $6.5 million grant from the Asian Development Fund and a $5 million grant from the Green Climate Fund. The government will contribute about $1.3 million in the form of taxes and duties. In line with the *Guidelines for the Economic Analysis of Projects* (2017) of the Asian Development Bank (ADB), the additional financing project financial costs are converted into economic costs (Table 1).

[1] ADB. 2016. *Economics of Climate Change in Central and West Asia – Adaptation Component*. Consultant's report.. Manila (RETA 8119-REG).

Table 1: Derivation of Economic Values of Total Project Cost ($)

	Description	Amount
	Total Project Cost	12,785,715
	Less: Interest cost	0
	Less: Price contingency	990,814
	Equals: Adjusted project cost	11,794,901
A.	**Less: Foreign component of adjusted project cost**	**6,112,493**
	Equals: Local component of adjusted project cost	5,682,408
	Less: Duties and taxes	571,700
	Equals: Net local component of adjusted project cost	5,110,707
	Multiplied by: the percentage of unskilled labor from the net local component	0.26
	Equals: Financial cost of unskilled labor	1,328,784
	Multiplied by: Shadow wage rate factor	0.83
B.	**Equals: Economic cost of unskilled labor**	**1,099,227**
	Net local component of adjusted project cost	5,110,707
	Less: Financial cost of unskilled labor	1,328,784
	Equals: Financial cost of remaining local cost items	3,781,924
	Multiplied by: Standard conversion factor	0.91
C.	**Equals: Economic cost of remaining local cost items**	**3,438,365**
	Economic equivalence of total project cost = A + B + C	**10,650,085**

Notes:
1. The shadow wage rate factor, standard conversion factor, and percentage of unskilled labor from the net local component are taken from Asian Development Bank. 2016. *Report and Recommendation of the President to the Board of Directors: Proposed Loan, Grant, and Administration of Grant and Technical Assistance Grant to the Republic of Tajikistan for the Water Resources Management in the Pyanj River Basin Project.* Economic Analysis (accessible from the list of linked documents in Appendix 2). Manila.
2. The world price numeraire was used for deriving the standard conversion factor.

Source: Asian Development Bank.

D. Monetized Project Benefits

5. Undertaking economic analysis of the costs and benefits of investments in meteorological services is challenging, with highly uncertain and in some cases unquantifiable (or difficult to quantify) benefits.[2] This economic analysis will focus on and monetize the benefit of avoided disaster impacts arising from improved forecasting and warning services.

6. Every year, natural hazards cause significant damage to infrastructure and property in Tajikistan. In the period 1990 to 2016, the country experienced about 45 significant climate-related natural disasters, of which 60% were floods. These disasters caused about 500 deaths and $1.5 billion in damages.[3] Climate-related losses can be reduced through better prediction of the weather, hydrological, and climatic events, which helps communities and the government to plan, adapt, and respond in a more efficient and timely manner.

7. The project will support improved flood forecasting and warning to pilot districts in the PRB,

[2] World Meteorological Organization. 2015. *Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services*. WMO Report No. 1153. Geneva.

[3] Centre for Research on the Epidemiology of Disasters. The International Disaster Database (accessed17 April 2018).

which will have a direct benefit to the settlements and key vulnerable sectors including agriculture, water resources, and transport in the target areas. The project also supports improved facilities, increased staff retention, and additional sources of entrepreneurial revenue for Hydromet, thereby strengthening its institutional and financial conditions. This will indirectly help the sustainability and quality of Hydromet's ongoing national extreme weather monitoring, forecasting, and alerts activities currently being supported by the World Bank, and thereby provide additional incremental benefits of avoided impacts at the national level.

8. The starting point for the economic analysis is the projected long-term national average annual losses associated with floods (Table 2). This average annual loss (AAL) is the average expected loss annualized over a long time horiozon and is therefore considered as the without-project baseline.[4]

Table 2: Monetized Projected National Flood Damage in Tajikistan

Hazard	Average Annual Loss ($ million)
Flood	48

Source: United Nations Office for Disaster Risk Reduction. 2015. *Global Assessment Report on Disaster Risk Reduction*. Geneva.

9. The project benefits arise from additional (incremental) avoidance of these impacts for the project target area, the PRB.[5] This incremental project benefit (B_{inc}) in million United States dollars ($ million) per year is calculated with the following formula:

$$B_{inc} = AAL_N \times D_{PRB} \times A_{proj} \times R$$

(i) AAL_N is the projected national flood damage, which is the without-project baseline of $48 million per year (Table 2).

(ii) D_{PRB} is the share (%) of the national-level flood damage that is projected to occur in the PRB area. In the absence of subnational estimates of AAL, it is assumed this will follow the historical share. Statistics for 1998–2011 indicate the PRB area experienced about 35% of the country's flood events and incurred about 45% of the country's flood damage.[6] For the economic analysis, D_{PRB} is assumed at 40%.

(iii) A_{proj} is the share (%) of the PRB area covered by the project. The project will install monitoring and warning equipment in at least six pilot areas for the flood forecasting and warning system. The system will also integrate data from the existing monitoring system currently being upgraded by the World Bank Central Asian Hydrometeorology Modernization Project.[7] For the economic analysis, A_{proj} is assumed at 33%.

(iv) R is the flood damage avoidance rate (%) arising from the flood forecasting and warning system. The avoidance rates reported in the literature suggest a maximum avoidance rate of about 35%–40%.[8] For the economic analysis, a conservative value of R is assumed at 25%.

[4] United Nations Office for Disaster Risk Reduction. 2015. *Global Assessment Report on Disaster Risk Reduction*. Geneva.

[5] This area comprises about 15 districts in Tajikistan bordering or near the Pyanj River.

[6] Statistics from the Committee on Emergency Situations of Tajikistan (personal communication). 2018.

[7] World Bank. 2011. *Central Asia Hydromet Modernization Project*. Project appraisal document. Washington, DC.

[8] K. Carsell, N. Pingel, and D. Ford. 2004. Quantifying the Benefit of a Flood Warning System. *Natural Hazards Review*. 5 (3). pp. 131–140; United Nations. 2004. *Guidelines for Reducing Flood Losses*. Geneva; and J. Thielen-del Pozo

10. The key modeling parameters and the estimated incremental project benefit (B_{inc}) are in Table 3.

Table 3: Incremental Project Benefit Calculation

Variable	Description	Value	Source
AAL_N	National flood damage ($ million per year)	48	Footnote 4
D_{PRB}	Share of national flood damage occurring in PRB (%)	40%	Footnote 6
A_{proj}	Share of PRB area covered by project (%)	33%	See para. 9
R	Flood damage avoidance rate (%)	25%	Footnote 8
B_{inc}	**Initial incremental project benefit** ($ million per year)	**1.6**	

PRB = Pyanj River Basin.

E. Economic Analysis

11. The economic analysis compares the costs and incremental benefits of the project. Key general assumptions are as follows: (i) benefits are assessed for 30 years; (ii) benefits are assumed to accrue from 2022; and (iii) incremental operation and maintenance costs are 1% of the annual project costs, in line with the financial analysis.

12. The results of the economic analysis in Table 4 indicate that the economic internal rate of return (EIRR) of the project is 11%, above the 6% threshold level required for flood protection and disaster risk reduction projects. Sensitivity analysis of possible variations from the base case outcomes indicates that the project economic viability is generally robust to uncertainties in costs and benefits (Table 4). The project will mitigate the risk of reduced benefits through (i) appropriate site selection of pilot districts based on flood risk vulnerability and exposure, (ii) integration of the existing hydro- and weather-station network into flood forecasting system, and (iii) support for disaster preparedness at the community level to supplement the flood warning systems. The calculated EIRR is conservative, as it does not capture the significant intangible and nonquantifiable benefits from the broader institutional strengthening of Hydromet.

Table 4: Results of Economic Analysis and Sensitivity Analysis

Results of Evaluation	Change	ENPV[a] ($ million)	EIRR (%)	Switching Value[b]
Project Case		6.5	11%	
Sensitivity Scenarios				
Case 1 - Increase in capital costs	+20%	4.5	9%	66%
Case 2 - Decrease in annual benefit	(25%)	2.4	8%	(40%)
Case 3 - Benefit delay (in years)	(2)	4.2	9%	(7)
Case 4 - Combination of cases 2 and 3		0.7	7%	

EIRR = economic internal rate of return, ENPV = economic net present value.
[a] At 6% discount rate for flood protection and disaster risk reduction projects.
[b] Level of sensitivity scenario at which ENPV = 0.
Source: Asian Development Bank.

13. The summary cash flow is in Table 5.

et al. 2015. The benefit of continental flood early warning systems to reduce the impact of flood disasters. *Joint Research Centre Science for Policy Report.* Brussels: European Commission.

Table 5: Summary Cash Flow ($ million per year)

Calendar Year	Total Costs	Without-Project Disaster Losses	With-Project Incremental Avoided Losses	Net Project Benefit
2018	0.00	(48)	0.00	0.00
2019	(1.22)	(48)	0.00	(1.22)
2020	(3.84)	(48)	0.00	(3.84)
2021	(3.62)	(48)	0.00	(3.62)
2022	(1.86)	(48)	0.00	(1.86)
2023	(0.19)	(48)	1.59	1.40
2024	(0.07)	(48)	1.59	1.53
2025	(0.07)	(48)	1.59	1.52
2026	(0.07)	(48)	1.59	1.52
2027	(0.07)	(48)	1.59	1.52
2028	(0.07)	(48)	1.59	1.52
2033	(0.07)	(48)	1.59	1.52
2038	(0.07)	(48)	1.59	1.52
2043	(0.07)	(48)	1.59	1.52
2048	(0.07)	(48)	1.59	1.52
			EIRR (%)	11%
			ENPV[a] ($ million)	6.5

( ) = negative, EIRR = economic internal rate of return, ENPV = economic net present value.
[a] At 6% discount rate for flood protection and disaster risk reduction projects.
Source: Asian Development Bank.

F. Non-Quantified Project Benefits

14. While not included in the economic analysis above, the additional nonquantifiable project benefits are worth noting. Disasters in Tajikistan cause loss of life, injury, and displacement of citizens, many of whom are among the most vulnerable to climate change. By supporting incremental avoided flood damage, the project will also reduce the number of deaths, injuries, and homeless. More broadly, the project supports the provision of weather information products to be made available through widely-used communication media including email, SMS, and the web. The project will also indirectly support the sustainability and quality of Hydromet's ongoing weather forecasting and environmental monitoring activities, which are made publicly available, and thereby provide additional incremental impacts nationally. The use of such improved services among the population and the government may support more efficient and more climate-resilient decision making—including planning, investment, and operation and maintenance—with associated economic benefits, including increased income and land values. These improved services may also increase the comfort, convenience, health, and safety of the population, including vulnerable communities (footnote 2).

G. Conclusion

15. The economic analysis, which incorporates conservative assumptions about the project benefits, has indicated that the project is economically viable and robust to key cost and benefit sensitivities.