ECONOMIC ANALYSIS

A. Macroeconomic and Sector Context

1. Tajikistan's economy has grown consistently since 1997, adding an average annual 7.2% to its real gross domestic product (GDP).[1] Robust growth was aided by significant increases in remittance inflows; a favorable external environment, particularly from rapid economic development in the Russian Federation; and public investment fueled by external borrowing. Macroeconomic stabilization and surging international prices of aluminum and cotton—the country's dominant exports—also contributed.

2. Between 1992 and 2016, economic losses from natural hazards in Tajikistan exceeded $1.8 billion and affected almost 7 million people.[2] Estimated average annual losses in Tajikistan could reach 1.4% of GDP in the case of floods and 5% of GDP in the case of earthquakes.[3] The probable maximum loss from earthquakes is estimated to range from $542 million (100–year return event) to $2 billion (1,500–year return event).[4]

B. Project Definition and Option Analysis

3. The proposed project focuses on pre-disaster risk management. Potential beneficiaries will include vulnerable communities living in disaster-prone areas of the country. The project will develop a comprehensive national risk profile, disaster analysis and hazard mapping, vulnerability and risk assessments, an inventory of assets at risk, as well as an integrated national early warning system.

4. Any speculation on the future entails considerable uncertainty, particularly in the early stages of a project like this. The present analysis explicitly acknowledges the uncertainty of many project variables; uncertainty that is magnified by the dearth of available data. The analysis thus relies on best available data, information, and estimates from Tajikistan's Committee of Emergency Situations and Civil Defense (CESCD), supplemented where appropriate with information from other government agencies as well as secondary material.

5. Currently, Tajikistan's socioeconomic vulnerability to natural hazards and the resulting economic losses are very high. The 10-year annual average of total economic losses from disasters in 2014 was equal to $111.9 million,[5] or 1.2% of GDP. The project is expected to reduce that annual average by 3.1%.

C. Frequency and Risk of Natural Disasters

6. Tajikistan's overall risk profile is rated medium (61st out of 191 countries) in the Inform 2016 Risk Index. Out of the 180 countries covered by the Notre Dame Global Adaptation Initiative, Tajikistan is the 79th least vulnerable and the 51st least ready country.[6]

7. Tajikistan faces significant exposure to earthquakes and floods. Floods affect an average annual population (2014) of about 100,000—or 15,900 households—and cause an average annual

---

[1] Asian Development Bank (ADB). 2018. *Asian Development Outlook 2018: How Technology Affects Jobs*. Manila (April).
[2] Centre for Research on the Epidemiology of Disasters, *International Disaster Database*: http://www.emdat.be
[3] World Bank. 2017. *Press Release – Tajikistan*. Washington, DC: http://www.worldbank.org/en/news/press-release/2017/07/10/tajikistan-aims-to-better-protect-people-and-property-from-natural-disasters-and-climate-change (last accessed on 26 August 2018)
[4] United Nations Office for Disaster Risk Reduction. 2015. *Global Assessment Report Tajikistan Risk Profile*. Geneva, Switzerland. https://www.preventionweb.net/english/hyogo/gar/2015/en/profiles/GAR_Profile_TJK.pdf
[5] https://www.preventionweb.net/english/hyogo/gar/2015/en/home/data.php?iso=TJK
[6] Notre Dame Global Adaptation Initiative Country Index (ND-GAIN Country Index): http://index.gain.org/country/tajikistan

loss of about $100 million. Earthquakes affect an annual average population of about 400,000 or 63,500 households. Critical assets such as transport infrastructure and hydropower plants are at risk.

8. Tajikistan is prone to recurrent natural disasters such as earthquakes and climate-related floods, mudflows, landslides, and avalanches. According to the CESCD, 1,372 natural disasters occurred in Tajikistan during 2007–2016 (Tables 1 and 2). Nearly a third of these (422 incidents) were related to mudflows. Other frequent disasters were earthquakes (20.8%), avalanches (20.8%), and rockfalls (7.8%). As regards frequency, fatalities, and economic losses, mudflows and floods are the most damaging natural disasters.

Table 1: Number of Natural Disasters in Tajikistan, 2007–2016

Type of disaster	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	Total
Earthquake	50	38	41	26	47	31	25	11	15	2	286
Mudflow & flood	40	19	44	99	41	97	26	20	51	34	471
Avalanche	4	28	38	62	4	114	14	15	6	1	286
Rockfall	4	4	17	20	6	28	8	8	5	7	107
Epidemy	-	-	2	2	-	-	-	-	-	-	4
Strong wind	4	10	5	2	14	6	4	9	3	8	65
Underground water increase	-	-	1	-	-	7	-	-	-	-	8
Heavy snow	4	16	10	6	4	23	2	-	2	-	67
Hail, thunderstorm	3	-	27	15	3	-	2	3	7	3	63
Hydrodynamic accident	-	-	-	-	-	-	-	-	1	-	1
Biological case	1	2	2	2	2	2	2	1	-	-	14
Total	**110**	**117**	**187**	**234**	**121**	**308**	**83**	**67**	**90**	**55**	**1,372**

"-" not applicable
Source: Tajikistan's Committee of Emergency Situations and Civil Defense.

Table 2: Relative Share of Types of Disaster in Economic Losses in Tajikistan, 2007–2016

Type of disaster	**Share** (%)
Mudflow & flood	73.7
Heavy snow	16.7
Earthquake	5.5
Other	4.1
Total	**100.0**

Source: Tajikistan's Committee of Emergency Situations and Civil Defense.

D. Monetized Project Benefits

9. Undertaking economic analysis of the costs and benefits of investments under a disaster risk management project is inherently challenging, with highly uncertain and in some cases unquantifiable (or difficult to quantify) benefits.[7] This economic analysis will focus on and monetize the benefit of avoided disaster impacts arising from greater capacity at the CESCD, preventive disaster risk reduction, and improved early warning services. All assumptions are set to be conservative and were checked against available information and literature on the matter.

10. The starting point for the economic analysis is the country's projected long-term average annual loss associated with natural disasters (Table 3). This average annual loss is the average expected loss annualized over a long-time horizon and is therefore considered to be the without-project baseline.

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

Table 3: Monetized Projected National Disaster Damage in Tajikistan

Natural Disaster	**Share** (%)	**Average Annual Loss (**$ million)
Mudflow & flood	73.7	82.5
Heavy snow	16.7	18.7
Earthquake	5.5	6.1
Other	4.1	4.6
Total	**100.0**	**111.9**

Note: The average annual loss for mudflows and floods is taken at a more conservative value than the United Nations estimates reported in para. 9 of this document. The discrepancy reflects different time periods underlying the respective data.
Source: Tajikistan's Committee of Emergency Situations and Civil Defense.

11. The project benefits arise from additional (incremental) avoidance of these impacts throughout Tajikistan. In the face of inherent uncertainties about modeling benefits, the analysis conservatively focuses on two major types of disasters where the benefits of improved early warning would be most direct—mudflows and floods, and heavy snowfall. As noted already, these accounted for nearly 90% of average annual losses during 2007-2016. Thus, the incremental project benefit (B_{inc}) in million United States dollars ($ million) per year is calculated with the following formula:

$$B_{inc} = M\&F_{ben} + HS_{ben} + Oth_{ben}$$

(i) $M\&F_{ben}$ is the amount of losses saved nationally from mudflow and flood damage that is projected to occur in Tajikistan. In the absence of national estimates of *M&F*, it is assumed that this will follow the historical share.
(ii) HS_{ben} is the saved losses from heavy snows throughout the country.
(iii) Oth_{ben} is the saved economic losses from other natural hazards thanks to the flood forecasting and warning system.

12. Table 4 summarizes these parameters and the estimated incremental project benefits.

Table 4: Incremental Project Benefit Calculation
($ million per year)

Variable	**Description**	**Value**	**Source**
$M\&F_{ben}$	Amount of losses saved nationally from mudflows and floods	2.4	Paras. 14–15
HS_{ben}	Saved losses from heavy snows	0.56	Para. 16
Oth_{ben}	Saved damages from other natural hazards	0.5	Para. 18
B_{inc}	**Initial incremental project benefit**	**3.34**	

Source: Asian Development Bank estimates.

E. Economic Costs and Benefits

13. The economic evaluation is based on the comparison of two scenarios—without project and with project—and was conducted in line with Asian Development Bank (ADB) guidelines.[8] The economic analysis was carried out by comparing economic costs and benefits with and without the project to generate the standard decision criteria for the project, notably the net present value and the economic internal rate of return. The evaluation period for the cost–benefit analysis is 20 years, including the project implementation period of 5 years, (2019–2023). Maintenance expenditures will be incurred during the remaining 15 years of the evaluation period. Because of the project, overall average annual economic losses from natural disasters will be reduced by 3.1%.

Table 5: Estimated Economic Losses by Type of Natural Disasters in 2014

Type of disaster	**Economic loss** ($ million)	**Reduction in losses** (%)	**Economic benefits** ($ million)
Mudflow & flood	82.5	2.9	2.4
Heavy snow	18.7	3.0	0.56

[8] ADB. 2017. *Guidelines for the Economic Analysis of Projects*. Manila.

Earthquake	6.1	0.0	0.0
Other	4.6	10.9	0.5
Total	**111.9**	**3.1**[a]	**3.46**

[a] Computed based on the weighted average of each disaster observed.
Source: Tajikistan's Committee of Emergency Situation and Civil Defense.

14. **Mudflows and floods.** An important benefit of the project would be an increased ability of households to minimize losses from floods and mudflows thanks to an improved early warning system. Based on discussions with the CESCD, almost 70% of economic losses from natural disasters relate to household assets (both movable and immovable); the other 30% are associated with damage to public infrastructure (e.g., bridges, roads, schools). The average wealth of Tajik households is estimated at $23,436, of which $5,126 can be classified as easily movable assets (e.g., cattle, poultry, vehicles, some home appliances, cash, jewelry). In the absence of disaggregated data by regions and households, the number of households affected on average by both mudflows and floods is assumed at 16,000 annually, which is more conservative than the United Nations estimates (para. 9). Total losses from mudflows and floods were divided into public infrastructure and household losses[9] using a 30:70 ratio based on estimates from the CESCD, putting total household losses at $57.8 million (70% of $82.5 million). This gives an average loss per household of both movable and immovable assets of $3,609, or 15.4% of total household assets, on average. Assuming that 80% of the household loss concerns immovable assets, the average household loss of movable assets is $772, or 14% of estimated household movable assets. It is assumed that the improved early warning system from the project would translate into savings for a household of an additional $250, or 4.8% of their total movable assets of $5,126. Although this is a very conservative estimate, in simulation carried out later in the analysis, the additional household loss reduction is assumed even lower, at $180 per household.

15. Multiplying the number of affected households with the average value of a household's movable assets saved, i.e., $250, the value of private assets saved from mudflows and floods is estimated at $4.0 million per year on average, given the average annual loss observed. Subtracting incremental benefits of $1.6 million owing to the Water Resources Management in Pyanj River Basin Project, the net benefits of the National Disaster Risk Management Project from avoided mudflows and floods will be $2.4 million per year. The proposed project will be strengthening the early warning system in the basin and also extending it across the nation. We therefore conservatively reduced the total expected benefits per year ($4.0 million) by the annual benefits calculated for the Pyanj River Basin project ($1.6 million) to arrive at $2.4 million per year.

16. **Heavy snow.** This natural phenomenon mainly affects agricultural outputs. Climate change has brought unusually cold weather—snowfalls are now being observed throughout the country in late April and early May (summer usually begins in mid-May). As a result, flowering gardens froze and a significant part of future fruit harvests were lost. In our analysis, the conservative assumption is that the project's outputs will reduce the total average annual economic losses related to heavy snows (i.e., $18.7 million) by at least 3% (or $0.56 million).

17. **Earthquakes.** Given that earthquakes are the natural phenomenon least subject to accurate forecasting and early warnings, it is conservatively assumed that economic losses will remain unchanged despite the project.

18. **Other hazards.** Other hazards include avalanches, rockfalls, strong winds, hail and thunderstorms, droughts, and hydrodynamic accidents. The average annual cumulative losses from these hazards are estimated at about $4.6 million (4.1% of total average economic losses per year), of which damages from hail and thunderstorms are calculated at $1.67 million, or 36.3% of all damages caused by this group of hazards. Given that one of the project's outputs is procurement of radars for the anti-hail unit of the CESCD, which will double the operational capacity and extend

[9] Industry and commercial entities are concentrated in urban areas; rural commercial entities are primarily informal or unincorporated households.

the areas for cloud monitoring from the current 250 kilometers to 500 kilometers, it is assumed that at least 30% of losses from hail and thunderstorms will be reduced. Since mitigation of other hazards in this group is reportedly impossible because of the relatively insignificant economic losses they cause, we conservatively factored in only the potential benefits from the upgrade of the anti-hail unit, i.e., $0.5 million (30% of $1.67 million).

19. Thus, on average, the potential total benefit of the project for the country is $3.46 million ($2.4 million + $0.56 million + 0.5 million) per year.

20. **Project costs.** The economic costs of capital expenditures financed under the project are $9.3 million. For the purpose of modeling, annual maintenance expenditures related to the project's capital investments are carried out over a period of 15 years (2024–2038). Project capital costs include the costs of contracts and consulting services, equipment, machinery, office establishment, and staff expenditures. The economic analysis was conducted using the United States dollar (US$) as the unit of currency and the domestic price numeraire. Most equipment and machinery inputs are internationally traded. Financial project costs were converted to economic costs by (i) excluding financial charges, taxes, and price contingencies; (ii) using a shadow exchange rate factor of 1.02, calculated based on Tajikistan's import and export trade data and related taxes; and (iii) using a shadow wage rate factor of 1.0 because of the project's high demand for skills and low demand for unskilled labor.

21. **Machinery and equipment maintenance.** For machinery and equipment procured under the project, a budget allocation from the beneficiary (CESCD) will be used for maintenance expenditures after project implementation. The annual maintenance budget was calculated based on 7% of the purchase price of equipment and machinery, based on government cost norms.

22. **Reduced losses from natural disasters**. The economic benefits of the project, based on a comparison of the with-project and without-project scenarios, were calculated as the reduction of economic losses from natural disasters thanks to the project's outputs. The benefits are expected to be realized after project completion, i.e., from 2024 onward. Based on an expected 3.1% reduction in the 10-year annual average of total economic losses from disasters from 2024 onward, the with-project scenario translates into annual savings of $3.46 million on average.

F. Results of the Economic Analysis

Economic rate of return. The economic internal rate of return of the project is computed at 20.5%, with a net present value of $9.52 million at a discount rate of 9%. The National Disaster Risk Management Project is therefore economically viable.

23. **Sensitivity analysis.** The outcome of the sensitivity analysis shows that the project's rate of return and economic viability is robust in the case of (i) an increase in capital costs of 10%, (ii) a decrease of benefits by 10%, and (iii) the combination of both scenarios unlikely combination of the two scenarios reduces the economic internal rate of return to 17.1%, which is well above the 9% threshold and remains high.

24. **Sustainability analysis**. The outputs achieved under the project will be maintained through ongoing annual state budget allocation following the project's completion. This will include maintenance costs of equipment and machinery procured under the project. The current budget allocations for the CESCD have increased in line with the increase in the overall state budget, which was driven by robust annual growth rates of 7.2% on average. For 2018, the budget allocation for the CESCD is TJS29.8 million ($3.3 million), out of which TJS12.8 million ($1.42 million) is earmarked for salaries and the remaining TJS17.0 million ($1.89 million) for post-disaster recovery, which includes maintenance of machinery and equipment. The expected $220,000 in annual maintenance cost included in the economic analysis for the project is deemed feasible given the overall budget allocation, and thus ensures the sustainability of project outputs.