CLIMATE CHANGE ASSESSMENT

I. BASIC PROJECT INFORMATION

Project Title:	Landslide Risk Management Sector Project
Project Cost ($ million)**:**	39.0
Location:	Kyrgyz Republic
Sector:	Agriculture, Natural Resources, and Rural Development
Theme:	Disaster Risk Management
Brief Description:	The Landslide Risk Management Sector Project aims to reduce the vulnerability and exposure of infrastructure, community assets, livelihoods, and human life in the Kyrgyz Republic to landslide hazards. The project will take a comprehensive approach to risk reduction combining structural (including civil works and equipment) and non-structural (including risk information platforms and institutional capacity building) interventions. Project outputs are: (i) landslide mitigation engineering measures implemented; (ii) systems for on-site and national landslide monitoring improved; and (iii) capacity for landslide risk management strengthened.

II. SUMMARY OF CLIMATE CHANGE FINANCE

Project Financing		**Climate Finance**	
Source	**Amount** ($ million)	**Adaptation** ($ million)	**Mitigation** ($ million)
Asian Development Bank			
ADF grant[a]	23.50	11.75	
Concessional ordinary concessional resources loan	11.50	5.75	
Cofinancing			
Government	4.0	2.0	
Total	39.0	19.5	

ADF = Asian Development Fund.

[a] The grant is provided under the ADF-13 Climate Change Adaptation/Disaster Risk Reduction Thematic Pool.

III. SUMMARY OF CLIMATE RISK SCREENING AND ASSESSMENT

A. Sensitivity of Project Component(s) to Climate or Weather Conditions

Landslide risk is associated with soil water content and therefore sensitive to infiltration rate and depth as well as runoff of surface water. The effectiveness and maintenance requirements of the project's stabilization measures and installations (e.g., drainage infrastructure, hydraulic protections, and other slope stabilization measures) may be negatively affected by increased winter precipitation and higher temperatures that result in deeper snowpack and less soil frost that thaw earlier in the year. This could include changes in the underlying spatiotemporal landslide risk pattern of the region, increased risks during works, damage to surface installations, and increased maintenance requirements.

B. Climate Risk Screening

Kyrgyz Republic is a country vulnerable to extreme weather events exacerbated by climate change, which may further increase the risks of landslide. According to the Second and Third National Communications of the Kyrgyz Republic to the United Nations Framework Convention on Climate Change submitted in 2009 and 2017 respectively, average annual temperature in the Kyrgyz Republic is reported to have risen by 0.8°C since the 20th century, and the average annual precipitation has increased by 6% over the same period.[1] In many instances, rainfall intensity has also increased. Future projections in the Kyrgyz Republic, indicate a 2°C increase in annual temperature by 2050 compared to the baseline period of 1961–1990.[2] Changes in annual precipitation show a less clear trend, with likely increase in precipitation in the northern part of the country and decrease in the southern part of the country.

As a result of the increase in temperature, more precipitation will fall as rain and glaciers and snowfields will shrink. On the other hand, precipitation is projected to increase in winter and decrease in summer, leading to more precipitation falling as snow and being stored as snowpack or ice over the winter. Given the effect that climate change can have on landslide risk (e.g., change in soil freeze/thawing, infiltration, runoff), the design and implementation of project components (both structural and non-structural) will need to consider climate change futures for landslide risk management and mitigation. The impact to the project may be both direct and indirect: climate changes may negatively impact performance of investments and affect optimal landslide risk management through changes in the spatiotemporal risk pattern in the region.

Climate Risk Classification: Medium

C. Climate Risk and Adaptation Assessment

Climate Change Risks

A detailed climate change risk assessment has been performed for the prospective sites to be implemented as subprojects.[3] The assessment focuses on future changes in soil water content, a major factor for landslide risk. For areas where infiltration of surface water during spring is projected to increase, landslide risk is expected to potentially increase.

A GIS based approach has been applied to assess climate change impacts on water balances for the subproject sites proposed for the investment project. Specifically, the changes between baseline year (2019) and future projected conditions (2050 under RCP 4.5 and 8.5 conditions) were compared. Water balance components were then assessed considering precipitation, evapotranspiration, sublimation, snowpack accumulation/thawing, runoff, and infiltration as well as the effects of changing temperature (at different altitudes) on these components.

Monthly climate data values were used to allow for sufficient temporal resolution to capture the varying processes over the year. Historical climate data for 1970-2000 from the WorldClim dataset[4] was used as the baseline period data. Similarly, future climate data for 2050 (average for 2041-2060) was obtained from the WorldClim dataset.[5] The future climate data of 4.5 and 8.5 representative concentration pathways (RCPs) from 7 GCMs was taken into consideration for the analysis. After the adjustments made to the historical and future projected climate data, the water balance calculations were performed for each subproject site separately. An assessment of the combined effect of temperature and precipitation change was then conducted by analyzing the effects on snow accumulation and thawing

[1] Government of the Kyrgyz Republic, 2009 and 2017. *Second and Third National Communications of the Kyrgyz Republic to the United Nations Framework Convention on Climate Change*. Bishkek.
[2] State Agency on the Environment al Protection and Forestry. 2014. *Climate Risk and Food Security in the Kyrgyz Republic. An overview of climate trends and the impact on Food Security*. Bishkek.
[3] ADB. 2021. *Landslide Risk Management Sector Project: Detailed Climate Change Assessment.* Consultant's report. Manila (TA 9726-KGZ).
[4] WorldClim version 2.1 climate data for 1970-2000: https://worldclim.org/data/worldclim21.html.
[5] Downscaled CMIP5 data, 2.5-minute spatial resolution: https://worldclim.org/data/v1.4/cmip5_2.5m.html.

leading to respective change in runoff and potential infiltration both with regards to timing and intensity, leading to changes in soil water content.

Potential spring infiltration mainly takes place in March/April under baseline conditions and shifts to February/March under 2050 conditions. Under RCP4.5 conditions we see a decline in potential spring infiltration by an average 32 percent, under RCP8.5 conditions by an average 46 percent. The changes are significantly variable across individual sites, ranging from total disappearance to more than doubling of potential infiltration. Overall analysis for the subproject sites is as follows:

(i) Sites with strong *decrease* of potential infiltration (more than -30%) under RCP 4.5: 25 (out of 46 sites).
(ii) Sites with strong *increase* of potential infiltration (more than +30%) under RCP 4.5: 13.
(iii) Sites with strong *decrease* of potential infiltration (more than -30%) under RCP 8.5: 28.
(iv) Sites with strong *increase* of potential infiltration (more than +30%) under RCP 8.5: 9.

Additionally, soil frost is an important aspect that would need to be considered when converting potential infiltration to actual infiltration. More than half of the subproject sites considered in the investment project will reach mean above zero winter conditions (currently only one site has above zero average winter temperature conditions) suggesting risk of increased infiltration and landslide risks under future climate. Frost is an important factor for slope stabilization and restricts infiltration. Between baseline and 2050 conditions we see a significant temperature increase, moving temperatures closer to the zero mark at the subproject sites, and respectively reducing soil frost. The increasing temperatures between baseline conditions and 2050 conditions may therefore lead to a significant increase in infiltration of melting waters that previously had to run off on frozen ground, leading to a potential increase in future landslide risk as compared to baseline conditions. An analysis of the change in winter/spring temperature also reveals that between the baseline year (2019) and 2050, conditions a significant number of locations reaches temperatures that elevate the average winter temperature to above zero, which will lead to a significant reduction in frost and respectively a significant increase in infiltration.

Climate Change Adaptation

There is a strong theoretical basis for increased landslide activity because of predicted climate change. However, there remains a high level of uncertainty resulting from the margins of error inherent in scenario-driven global predictions, and the lack of spatial resolution of currently available downscaled projections. For the investment subprojects, more subproject site-specific surveys are required, but we can assume the following potential impacts from projected changes in climate:

(i) Increasing temperatures will lead to a general increase in snowline elevation over the different seasons, as well as a change in the thawing period, which, depending on the on-ground conditions (e.g. soils, slopes) may lead to a spatiotemporal change in the distribution of landslide risk;
(ii) Changes in annual rainfall quantity are less pronounced, so the potential impact on landslide risk from change in rainfall quantity may be marginal; and
(iii) The projected increase in short-term rainfall intensity may lead to increased runoff and less infiltration.[6] This increased runoff generally could generally increase erosion risk, with gully erosion potentially contributing to landslides, while, on the other hand, reduced infiltration generally lowers landslide risk.

The following adjustments have been made to the investment project design to consider the above findings from the climate risk assessment:

(i) Design of all landslide risk engineering measures (including for soil disposal sites) consider climate risks, with detailed design including analysis of climate data and recommendations to address future climate changes at the site acknowledging high uncertainties.

[6] In general conditions, increased rainfall intensity can be expected to lead to increased infiltration. However, in steeper slope areas with less vegetation such as those covered under the project, it can be expected to increase runoff and reduce infiltration.

(ii) Improved landslide monitoring system (including on-site systems) integrates monitoring of hydro-meteorological parameters.
(iii) Improved landslide risk database and GIS platform integrates hydro-meteorological parameters, climate change projections and other information on climate risks (including on vulnerability).
(iv) Updated landslide risk assessments (national, oblast and site-specific) integrate climate change and its impact on landslides, especially considering soil freezing/ thawing.
(v) Community risk assessment sessions integrate information sharing and discussion on how climate change risks, impacts and adaptation options.
(vi) Standard procedures and associated training materials (and all capacity building activities) on landslide risk mitigation integrate knowledge and skills on climate risks and adaptation.

Adaptation Finance

The project aligns with the Kyrgyz Republic Nationally Determined Contribution under the Paris Agreement of the United National Framework Convention on Climate Change to prevent climate change-related damage and losses including disasters.[7] The national development program for 2018–2022 includes proactive management of disaster and climate change risks and reduction of geophysical risks.[8] The Strategy for the Comprehensive Protection of the Population and the Territory of the Kyrgyz Republic from Emergency Situations for 2018–2030 seeks to reduce overall disaster losses through, among other measures, improved monitoring, forecasting, and construction of protective structures.[9]

The project is predicated on reducing risks of landslides, which are triggered by extreme weather events and are likely to be exacerbated by future climate change. As such, the project is categorized as a Type 2 adaptation project and is eligible for up to 100% adaptation finance classification.[10] In acknowledgement of the multiple climate-related and geophysical triggers of landslides, a conservative figure of 50% is applied.

D. Climate Risk Screening Tool and/or Procedure Used

Desk-based analysis and United Nations Environment Program Global Risk Data Platform.[11]

GIS = Geographic Information System, RCP = Representative Concentration Pathway.

IV. CLIMATE ADAPTATION PLANS WITHIN THE PROJECT

Adaptation Activity	**Target Climate Risk**	**Estimated Adaptation Costs** ($ million)	**Adaptation Finance Justification**
Design of all landslide risk engineering measures (including for soil disposal sites) consider climate risks, with detailed design including analysis of climate data and recommendations to address future climate changes.	Increased temperature and winter precipitation, resulting in larger snowpacks, an earlier rise of the snowline and earlier thawing with respective runoff and infiltration.	$19.5 million	The project is predicated on climate change and geophysical risks, and 50% of project finance is tagged as climate change adaptation finance.
Improved landslide monitoring system (including on-site			

[7] The Kyrgyz Republic. 2015. *Intended Nationally Determined Contribution. United National Framework Convention on Climate Change Paris Agreement.* Bishkek.
[8] Government of the Kyrgyz Republic. 2018. *The Development Program of the Kyrgyz Republic for the Period 2018–2022: Unity. Trust. Creation*. Bishkek.
[9] Government of the Kyrgyz Republic. 2018. *Strategy for the Comprehensive Protection of the Population and the Territory of the Kyrgyz Republic from Emergency Situations for 2018–2030*. Bishkek.
[10] ADB. 2016. *Guidance Note on Counting Climate Finance at ADB.* Manila.
[11] Available online: https://preview.grid.unep.ch/index.php. Accessed 26 January 2021.

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systems) integrates monitoring of hydro-meteorological parameters.			
Improved landslide risk database and GIS platform integrates hydro-meteorological parameters, climate change projections and other information on climate risks (including on vulnerability).			
Updated landslide risk assessments (national, oblast and site-specific) integrate climate change and its impact on landslides, especially considering soil freezing/ thawing.			
Community risk assessment sessions integrate information sharing and discussion on how climate change risks, impacts and adaptation options.			
Standard procedures and associated training materials (and all capacity building activities) on landslide risk mitigation integrate knowledge and skills on climate risks and adaptation.			

GIS = Geographic Information System