CLIMATE CHANGE ASSESSMENT[1]

I. BASIC PROJECT INFORMATION

Project Title:	Hunan Xiangxi Rural Environmental Improvement and Green Development Project
Project Cost ($ million)**:**	420.73
Location:	Xiangxi Tujia and Miao Autonomous Prefecture, Hunan Province, People's Republic of China
Sector:	Agriculture, natural resources, and rural development
Theme:	Inclusive economic growth, environmentally sustainable growth
Brief Description:	The project will demonstrate environmental improvement and green development in rural areas by (i) improving rural waste and sanitation management facilities and services with innovative technologies and arrangements, (ii) developing local-featured ecological agricultural and forestry products, and (iii) improving value chains and promoting ecotourism to add values to local products.

Source: Asian Development Bank.

II. SUMMARY OF CLIMATE CHANGE FINANCE

Project Financing		**Climate Finance**	
Source	**Amount** ($ million)	**Adaptation** ($ million)	**Mitigation** ($ million)
Asian Development Bank			
Ordinary capital resources (regular loan)	200.00	9.03	17.78

Source: Asian Development Bank.

III. SUMMARY OF CLIMATE RISK SCREENING AND ASSESSMENT

A. Sensitivity of Project Components to Climate or Weather Conditions and the Sea Level

1. **Wastewater management systems.** Increase in severe storm and flood events can (i) directly flood wastewater treatment facilities, and (ii) disperse garbage and deteriorate the living environment. High temperatures promote the decay of garbage, and the accompanying increase in bad odors and pests deteriorates the living environment.

2. **Local-featured ecological agricultural and forestry products development.** Increase in severe storm and flood events can directly flood facilities for local-featured ecological agricultural and forestry product development. High temperatures can lead to negative impacts such as increased water demand. Changes in precipitation can result in a reduction of water availability for crops. An increased frequency and intensity of droughts can disrupt agricultural production. Climate change may trigger the spread of pests and diseases, with potential to severely limit crop production.

3. **Value addition to local products through value chains and ecotourism.** Increase in severe storm and flood events can directly flood farmlands and facilities for value addition to local-featured ecological agricultural and forestry products. Increase in rainfall intensity may intensify soil erosion. Infrastructures such as roads are highly vulnerable to flood and heavy precipitation events. High temperatures can lead to negative impacts such as increased water demand. Changes in precipitation can result in a reduction of water availability for crops.

B. Climate Risk Screening

Future climate change was projected based on Regional Climate Model RegCM4 under two RCP scenarios (RCP4.5 and RCP8.5). The projected climate change trend is based on the analysis for 2020−2099, and

[1] This report was prepared based on a detailed climate risk and vulnerability assessment conducted by a climate change specialist under the transaction technical assistance for project preparation.

the changes in spatial patterns of annual mean temperature and annual precipitation are based on the analysis for 2021−2050. The baseline period for the study is 1986−2005.

Climate change observed during 1961−2018 reveals a warming characteristic with annual mean temperature increasing at a warming rate of 0.15°C/10 years in Xiangxi. The number of heat waves is increasing, while the number of cold event days is decreasing slightly. Total annual precipitation is slightly decreasing at rate of 4.7 millimeters/10 years with big annual variability. The number of annual rainfall days shows a sharp fall at 7.6 days/10 years, combined with increasing mean daily precipitation and maximum daily precipitation. Heavy precipitation will occur more, with more severe impacts of storms and floods, while droughts will be severer in spring and summer.

1. **Temperature increases.** The projected changes of annual mean temperature show substantial warming during 2020−2099, with more than 0.39°C/10 years under RCP8.5, and about 0.13°C/10 years under RCP4.5. The spatial pattern of projected annual temperature changes during 2021−2050 shows that annual mean temperature will increase by about 1.08°C−1.18°C under RCP8.5 and by about 0.90°C−1.02°C under RCP4.5. The projected warming will be high in the east and north of Xiangxi than that in the middle and west of Xiangxi under both RCP4.5 and RCP8.5.

2. **Rainfall changes.** Projected annual precipitation under both RCP4.5 and RCP8.5 tends to slightly decrease during 2020−2099. The spatial pattern of projected annual mean precipitation changes during 2021−2050 shows that annual precipitation will increase by about 1.0%−2.5% in north of Xiangxi, and will decrease by about 0.0%−5.0% in the middle and south of Xiangxi under RCP4.5. The projected annual precipitation will decrease consistently by about 0.0%−10.0% in Xiangxi. However, increase in rainfall variability will lead to increased risk of floods and droughts.

The climate risk screening identified the following risks which may affect the project: lack of precipitation (seasonal drought), increase in frequency and extent of intense rain and seasonal floods, extreme changes in temperature leading to heatwaves, etc.

Climate Risk Classification: Medium

C. Climate Risk and Adaptation Assessment

1. Wastewater management systems

Potential climate risk: Increase in severe storm and flood events can (i) directly flood wastewater treatment facilities, and (ii) disperse garbage and deteriorate living environment. High temperatures promote the decay of garbage, and the accompanying increase in bad odors and pests deteriorates the living environment.

Risk level: High

Adaptation options: (i) adoption of a wastewater collection system separated from storm water, which can reduce the amount of wastewater to be treated and decrease the risk of pollution diffusion to be caused by flood and storm; (ii) adoption of more resistant pipes for wastewater collection, which can reduce the risk of pipe cracking as the consequence of soil movement caused by flood and drought; (iii) construction of wastewater treatment plants in areas with less flood risk; (iv) construction of flood control dykes; and (v) capacity development of residents for garbage classification and recycling.

2. Local-featured ecological agricultural and forestry product development

Potential climate risk: Increase in severe storm and flood events can directly flood farmlands. High temperatures can lead to negative impacts such as increased water demand. Changes in precipitation can result in a reduction of water availability for crops. An increased frequency and intensity of droughts can disrupt agricultural production. Climate change may trigger the spread of pests and diseases, with potential to severely limit crop production.

Risk level: High

Adaptation options: (i) construction of drainage ditches, which can improve flood resistance of farmlands by increasing drainage capacities; (ii) application of water-saving irrigation using automatic spray equipment and integrated water and fertilizer management system, which can improve water use efficiency and achieve water-saving effect; (iii) green crop disease and pest control; (iv) establishment of field weather stations, which can improve microclimate monitoring capacity; and (v) capacity development of farmers and technicians on techniques (for cultivation, fertilization, irrigation, disease and pest control, etc.) for local-featured ecological agricultural and forestry products.

3. Value addition to local products through value chains and ecotourism

Potential climate risk: Increase in severe storm and flood events can directly flood farmlands. Increase in rainfall intensity may intensify soil erosion. Infrastructures such as roads are highly vulnerable to flood and heavy precipitation events. High temperatures can lead to negative impacts such as increased water demand. Changes in precipitation can result in a reduction of water availability for crops.

Risk level: Medium

Adaptation options: (i) construction of drainage ditches, which can improve flood resistance of farmlands by increasing drainage capacities; (ii) construction of hydrological facilities, which can increase the drainage capacity; (iii) ecological slope protection for roads and footpaths, which can improve the slope stability and reduce surface flow; and (iv) capacity development of farmers on agricultural production skills.

D. Climate Risk Screening Tool and/or Procedure Used

Preliminary risk screening was conducted in accordance with the Asian Development Bank's climate change risk management framework.

RCP = representative concentration pathway.
Source: Asian Development Bank.

IV. CLIMATE ADAPTATION PLANS WITHIN THE PROJECT

Adaptation Activity	Target Climate Risk	Estimated Adaptation Costs ($ million)	Adaptation Finance Justification
Flood control dikes for wastewater treatment plants	Increase in severe storm and flood events can directly flood wastewater treatment facilities.	0.12 (ADB loan: 0.05)	Cost of 224.9 m flood control dikes with 4−5 m height for five wastewater treatment plants
Drainage ditches	Increase in severe storm and flood events can directly flood farmlands.	2.77 (ADB loan: 1.21)	Cost of 22.59 km drainage ditches
Water-saving irrigation	High temperatures can lead to negative impacts such as increased water demand. Changes in precipitation can result in a reduction of water availability for crops. An increased frequency and intensity of droughts can disrupt agriculture production.	3.47 (ADB loan: 1.51)	Cost of automatic spray equipment and integrated water and fertilizer management systems
Green crop disease and pest control	Climate change may trigger the spread of pests and diseases, with potential to severely limit crop production.	1.53 (ADB loan: 1.53)	Cost of 500 solar powered pest control lamps and 3 million yellow sticky traps
Establishment of field weather stations	Climate change may cause changes in environment and changes in relationship of crop growth with environment.	0.15 (ADB loan: 0.15)	Cost of field weather stations and relevant research
Ecological slope protection for roads and	Increase in rainfall intensity may intensify soil erosion.	1.66 (ADB loan: 0.73)	Cost of 13.2 km ecological slope protection for roads and 8.47 km slope protection for footpaths

Adaptation Activity	Target Climate Risk	Estimated Adaptation Costs ($ million)	Adaptation Finance Justification
footpaths	Infrastructures such as roads are highly vulnerable to flood and heavy precipitation events.		
Hydrological facilities	Increase in severe storm and flood events can directly flood farmlands.	1.28 (ADB loan: 0.56)	Cost of a pump station
Capacity building	Deterioration of living environment by garbage may be exacerbated by climate change. Climate change may decrease agricultural and forestry production values.	3.29 (ADB loan: 3.29)	Cost of capacity development related to climate change
Total (Estimated Adaptation Cost)		**14.27 (ADB loan: 9.03)**	

ADB = Asian Development Bank, km = kilometer, m = meter.
Source: Asian Development Bank.

V. CLIMATE MITIGATION PLANS WITHIN THE PROJECT

Mitigation Activity	Estimated GHG Emissions Reduction (tCO_2e/year)[a]	Estimated Mitigation Costs ($ million)	Mitigation Finance Justification
Installation of solar panels to 402 small wastewater treatment plants	2,190[b]	4.33 (ADB loan: 4.33)	Cost of the solar panels
Recycling of crop residuals	28,000	1.00 (ADB loan: 1.00)	Cost of equipment for straw recycling
Improvement of forest form and restoration of vegetation	20,745[c]	28.52 (ADB loan: 12.45)	Cost of new tea-picking garden, forest improvement, plant community restoration, and fruit planting in areas of 1,662.67 hectares
Total (Estimated Mitigation Cost)		**33.86 (ADB loan: 17.78)**	

tCO_2e = ton of carbon dioxide equivalent.
[a] Energy savings/year x emission factor = greenhouse gas emission reduction.
[b] Calculated based on the Baseline Emission Factors for Mitigation Project of China Regional Power Grid in 2017 published by the Ministry of Ecology and Environment. About 1 megawatt-hour of solar electricity equals greenhouse gas emission reduction of 0.79 tCO_2e. Annual electricity generated by the solar panels at each treatment facility is about 6,900 kilowatt-hours.
[c] Annual carbon sequestration capacity of forests is 3.4 tons of carbon/hectare/year.
Source: Asian Development Bank.