Memorandum to the File (MTF)

DATE: December 4, 2017

TO: William Gibson, BEO/Asia

FROM: Laura Cizmo, Economic Growth Team Lead, USAID/CA/Tajikistan

THROUGH: Nina Kavetskaya, USAID/CA Regional Mission Environmental Officer, Climate Integration Lead
Andrei Barannik, Regional Environmental Adviser for Central and South Asia, and for Office of Afghanistan and Pakistan Affairs

SUBJECT: Documentation of Tajikistan Agribusiness Competitiveness Activity under Feed the Future Programmatic IEE and restatement of environmental conditions

<table>
<thead>
<tr>
<th>Activity/Project Name:</th>
<th>Tajikistan Agribusiness Competitiveness Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development Objective (DO)</td>
<td>DO 1- “Expanded diverse and competitive trade and markets” Intermediate Result 1.2 Enhanced Agriculture Competitiveness and Food Security</td>
</tr>
<tr>
<td></td>
<td>Sub IR 1.2.1: Enhanced Agricultural Productivity in target populations</td>
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<td>Sub IR 1.2.2: Expanded agribusiness value chains</td>
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<td></td>
<td>Program areas: 4.5 Agriculture</td>
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<tr>
<td></td>
<td>4.6. Private Sector Competitiveness</td>
</tr>
</tbody>
</table>

| Country and/or Operating Unit | USAID/Central Asia (CA)/Tajikistan |

| Originating Office | USAID/CA Economic Development Office |
|                    | USAID/CA/Tajikistan Country Office |

| Memo to a PAD Level IEE file | Provide DCN: Asia DCN: Asia 15-010, Programmatic Feed the Future IEE (P-IEE) |
| Memo to a Supplemental IEE file | Approved: 12/10/2014 |
| Memo to a RCE/IEE file | Expiry Date: FY 2020 |
| Memo to an ERC file | |

Activity Start/Current: September 2018 – July 2023
1.0 Purpose

The purpose of this MTF is to:

1) Document that the new USAID’s Tajikistan Agribusiness Competitiveness Activity (TACA) is covered by the Programmatic Feed the Future IEE Asia 15-010, that was not explicitly mentioned in this P-IEE. The expected period of performance is five years. The activity will be implemented leveraging investments within the US government’s Feed the Future zone of influence in Khatlon province. The Activity originator and Regional Mission Environmental Officer (MEO) and Climate Integration Lead (CIL) have reviewed the proposed Activity and determined that TACA is consistent with and similar in the scope and nature to activities approved by the BEO/Asia under the referenced P-IEE, which also contains language permitting addition of new activities.

2) Conduct first review of climate risk management for TACA as required by the ADS 201mal, and establish that additional climate risk screening shall be conducted by the implementing partner (IP)(s) as warranted and in consultation with the Activity Manager and the MEO/CIL.

3) Establish that all conditions, limitations and stipulation for revisions approved in the original P-IEE remain in force for the duration of the TACA FY 2018-2023.

4) Establish that all conditions, limitations and stipulation for revisions are fully transposed into procurement instruments.

5) Establish that at the “post-award conference” TACA Activity Manager together with the MEO/CIL explain to the IP(s) all conditions, limitations and stipulation for revisions approved by the BEO/Asia in the original IEE and this MTF.

2.0 Background

The goal of TACA is sustainable economic growth through interventions aimed at improved competitiveness of Tajikistan’s agribusiness enterprises, leading to increased economic development, employment, and livelihoods. Improving the economic viability of the agriculture sector will create both on and off-farm employment and encourage investment in supportive infrastructure and services in rural areas. This activity will have a particular focus on building agribusiness competitiveness within targeted value chains, especially in the Southern Khatlon region bordering Afghanistan, and improving product quality, services, and logistics to increase links to domestic, regional and international markets.

The Tajikistan Agribusiness Competitiveness Activity supports USAID/Central Asia’s Regional Development Cooperation Strategy through Development Objective 1: “Expanded diverse and
competitive trade and markets.” Activities contribute directly to Intermediate Result (IR) 1.1, “More diverse and competitive private sector” and IR 1.2, “Enhanced agricultural competitiveness and food security.”

The activity will build off investments USAID has made in increasing quality and quantity of crop production within the horticulture and dairy value chains through Feed the Future programming, by supporting all(any) actors along the value chain. The activity is not limited to those two value chains and can look to include other value chains that are identified as having high potential for growth. The activity will provide targeted demand-driven assistance to agricultural associations, cooperatives, market integrators, and/or small and medium enterprises (SMEs) in targeted sub-sectors to take advantage of domestic, regional and international market opportunities.

The contractor will have the flexibility to recommend to USAID for approval a set of demand-driven interventions in its Performance Work Statement (PWS) aimed at generating rapid, broad based and sustainable economic growth within measured by increased of sales, exports, and employment. USAID encourages innovation within mechanisms/competitions for private sector engagement proposed in the PWS. Grants Under Contracts, deliverables-based sub-contracts, and other result-based financing mechanisms will be considered in the PWS.

The activity objectives and results are presented in Table 1 (Section 3) below.

**Illustrative U.S. Government Standard Indicators** include:
- EG.3.2-21 Number of firms (excluding farms) or civil society organizations (CSOs) engaged in agricultural and food security-related manufacturing and services that have increased profits or become financially self-sufficient with USG assistance
- EG.5.2-1 Number of firms receiving USG-funded technical assistance for improving business performance
- EG.5.2-2 Number of private sector firms that have improved management practices or technologies as a result of USG assistance
- EG.3.2-5 Number of public-private partnerships formed as a result of USG assistance
- EG.2.2-1 Number of firms receiving USG-funded technical assistance to export

**Illustrative Custom Indicators** include:
- Increased quality of targeted products to meet regional and international trade standards and certification requirements
- Increased quantity of targeted products that meet regional and international trade standards and certification requirements.
- Trade balance in the targeted value chains will improve by TBD%.
- Adoption of Quality Management Systems and International Standards in beneficiary firms.
- Participating firms improve their sales/profitability by at least TBD% cumulatively over of the life of the project.
- Participating firms’ employment will increase at least TBD% cumulatively over of the life of the project.
- Increased availability of services provided in targeted value chains.
The TACA guiding principles include sustainability, collaboration and participation. For sustainability it will follow a Facilitation and Market Systems Approach to catalyze systemic changes through partnerships with the private sector and local actors. Facilitation is an approach to implementing value chain development that is fundamental to achieving the sustainability of these outcomes. Facilitation aims to stimulate systemic change without taking a direct role in the market system. It involves working through market participants and ensuring that they are drivers of the change process. Market systems approach is the guiding framework for scaling technologies, practices and business models, with the objective of developing market systems that are competitive, and resilient.

Stakeholders and counterparts include private sector entities, the Government of Tajikistan, non-governmental organizations, business associations, farmers, and other development partners (donors). The contractor should leverage other development partners (donors) and USAID IPs working in relevant areas to identify means of coordination and collaboration to achieve sustainable results and leverage resources.

2.1 Lessons Learned

During FTF project implementation, it was clear that some of activities have potential environmental impacts and are prone to failure if proper design and environmental monitoring and mitigation measures are not in place.

The following FTF related activities in Tajikistan have been implemented under the FTF P-IEE:

**Tajikistan Agriculture and Water Activity (TAWA), September 2015- March 2020:**
TAWA assists farmers residing in the zone of influence (ZOI) in southern Tajikistan to increase, diversify, and add value to their agricultural production in order to address dietary deficiencies and market surplus production. TAWA introduces and builds on modern technologies and practices to support the growth and sustainable development of the agriculture extension, vegetable, fruit, dairy, and irrigation sectors within the ZOI.

**Women’s Entrepreneurship for Empowerment Project (WEEP), September 2014- September 2018:**
The project empowers women who are currently economically inactive to start microenterprises; facilitates greater access for women to value chains, new markets, customers, and to business services; and works to positively influence societal attitudes toward women’s entrepreneurship. The program is implemented in seven districts of Khatlon Province in Tajikistan.

**Tajikistan Land Market Development Activity November (LMDA), November 2016- August 2020:**
The activity focuses on land policy and legal development, private sector capacity development to support land market, simplification of land registration procedures and expansion of knowledge of land use rights among rural government and citizens, especially female landholders.

**Tajikistan Health and Nutrition Activity (THNA), September 2015- September 2020.** The THNA’s goal is to contribute to improvement of nutritional and health status of children and mothers through integration of quality health and nutrition interventions from household and community to regional and national levels.
Only two of the above described on-going FTF activities (TAWA and WEEP) screened, mitigated, monitored and reported to USAID on environmental compliance as most of their activities qualified for a Negative Determination with conditions. This included submission of more than 30 Environmental Review Checklists (ERC) on procurement and installation of greenhouses, cold storages compressors, hydraulic measurement equipment on irrigation canals, small cultivators, mechanical tillers, seeds, pesticides, fertilizers seedlings, juice packing lines, equipment for canning works, procurement of bulls to improve livestock genetics; improvement of cattle feeding formula, and some other activities as was envisioned by the P-IEE. To ensure the success and sustainability of these activities, mitigation measures recommended in P-IEE were pursued. Some of them included:

- Engineering designs of greenhouses and buildings where cold storage equipment was installed were analyzed by USAID engineers. As a result, business owners of buildings not resistant to earthquakes and not meeting Tajikistan construction codes requirements were fully rejected for partnership if needed renovations of buildings did not take place.
- Compressors for cold storages were procured with refrigerants allowed in the country in accordance with requirements of Vienna Convention on Protection of Ozone Layer and Montreal Protocol on Ozone Depleting Substances.
- Procurement of pesticides and pesticide trainings were done in accordance with PERSUAP requirements, specifically only approved in PERSUAP pesticides were procured or recommended for same or similar use under TAWA and WEEP.
- Flipbooks, brochures, calendars, publications, scenarios and trainings containing recommendations for application of pesticides have been reviewed and cleared by the Mission Environmental officer prior to an activity start.
- Provision of fruit and vegetable processing equipment was done only after partner’s implementation of good agricultural and manufacturing practices as required by Codex Alimentarius standards including following proper sanitation and hygiene conditions.
- Installation of stream gauges on irrigation canals required canal survey with respect to availability of erosions and selection of appropriate place for installation in accordance with guiding hydrological manuals and implementation of mitigation measures preventing and controlling potential erosion development around measuring devices.
- For multiple agricultural demonstration pilots including nurseries and greenhouses, full pilot passport data was recorded to reflect environmental, soil, water, agronomy and other factors. This allowed to avoid cases which would have resulted in obtaining un-representative results and poor crop yields.
- For drip irrigation installation IPs followed a requirement for using only clean water for irrigation and in case of fertigation, used water capacities were cleaned up with polluted water spilled off into specially designated ground pits not connected hydraulically with irrigation and drinking water sources.
- Voucher support recipients who got fertilizers as part of a voucher package were familiarized with Integrated Fertilizer Management and Safety Use Principles. For example no fertilizer was applied unless soil samples were taken or information on NPK and other soil parameters was found. Projects ensured that these principles are pursued and P-IEE required reporting is provided.
- Bull procurement was done with full understanding of possible limitation factors, such as possible competition for food with local breeds and possible inability to winterize in cold winters.
Overall all activities have been in full compliance with USAID requirements established in P-IEE, Framework Environmental Mitigation and Monitoring Plan, ERCs and other USAID acceptable recommendations. CORs and MEO visited multiple project sites and conducted environmental compliance monitoring of these activities. This monitoring of activities qualifying for a Negative Determination with conditions might be improved by increasing a number of visited sites by CORs, activity managers and MEO.

3.0 Environmental Compliance

3.1 Environmental Compliance screening of new activity

Screening of new activity is presented in Table 1.

Table 1.

Environmental Compliance Screening of TACA Proposed Activities

<table>
<thead>
<tr>
<th>Project/Activity</th>
<th>Types of Activities with Environmental Implications</th>
<th>Threshold Determination</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective 1: Diversify the agricultural sector to include higher-value commodities and value-added products.</td>
<td>Result 1.1: Leverage innovation and technology to diversify production to higher-value commodities and value-added products. Result 1.2: Increased technical skills and knowledge necessary to diversify fresh and processed goods ready for trade. Result 1.3: Improve product development, design, and marketing of agricultural products.</td>
<td>NDC Conditions are established in FTF IEE Table 2, Section III CE, NDC Conditions are established in FTF IEE Table 2, Section II NDC Conditions are established in FTF IEE Table 2, Section III</td>
<td>For all objectives: --TACA will have to develop Environmental Manual and Environmental Mitigation and Monitoring Plan after the activity is awarded. --Additional climate risk screening should be conducted by the IP(s) as required by ADS 201 mal. The IP may use sources referenced in this MTF and information in attached Climate Change Risk Profile as well as information and tools available at <a href="https://www.climateLinks.org">https://www.climateLinks.org</a></td>
</tr>
<tr>
<td>Objective 2:</td>
<td>Result 2.1: Increased</td>
<td>CE, NDC</td>
<td></td>
</tr>
</tbody>
</table>
Strengthen linkages between aggregators, wholesalers, exporters, and international and domestic end-markets.

**Result 2.2:** Leverage innovative technologies to deliver higher-value commodities and products to end markets.

**Objective 3:** Partnering and leveraging of resources to catalyze systemic change in the agribusiness sector and increase productivity of value chain actors.

**Result 3.1:** Leverage private sector investment across market systems to facilitate firms and farmers to take better advantage of growth and trade opportunities.

**Result 3.2:** Support entrepreneurs through technical, business and financial capacity building and capital support.

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**CE = Categorical Exclusion, NDC = Negative Determination w/Conditions**

### 3.2 Threshold Determinations

**a)** **Recommended Action: Categorical Exclusion** (approximately 50% of funding) for actions specified in the Table 3, *Section I of the P-IEE* that are not expected to have direct, indirect, or cumulative effects. No reporting is required.

**b)** **Recommended Action: Negative Determination with Conditions** (approximately 1-5% of all funding) for activities related to development of policy recommendations and strategic plans. IP can recommend and assist implementation of policy only if environmental screening is done and mitigation measures are proposed to prevent potential negative impact of policy/strategy recommendations implementation (specified in the Table 3, *Section IIa of the P-IEE*).

**c)** **Recommended Action: Negative Determination with Conditions** (approximately 10%-20%) for activities involving grants that have a potential for an adverse impact on the natural or physical environment. This includes developing technical recommendations for small commercial agribusiness firms and farmers that may have the potential for significant adverse environmental impacts. IP should develop a detailed list of GAP, GHP, etc. as discussed in P-IEE and include environmental considerations in all components (specified in *Section IIb of the P-IEE*)
d) **Recommended Action: Negative Determination with Conditions** (approximately 20%-30%) for activities involving grants and sub-awards that have a potential for an adverse impact on the natural or physical environment. This includes: promotion of improved agricultural technologies, small scale construction activities introduction of improved agribusiness and marketing practices as specified in **Section III of Table 2.** Environmental Manual and Framework Environmental Mitigation and Monitoring Plan (FEMMP) should be developed. In addition, a programmatic PERSUAP (Asia 17-022) should be annually updated for any activity involving assistance in procurement or use of pesticides including crop protection trainings as required by P-IEE. Note: activities affected cannot go forward until the programmatic PERSUAP is amended by BEO/Asia approved professional and then approved by the BEO/Asia.

**e) Recommended Action: Negative Determination with Conditions** (approximately 1-5% of all funding) for activities involving grants, when following normal good practices, engineering methods, and standard instructions will help to avoid potential environmental problems. This includes procurement of computers and other electric and electronic equipment, commodities, and materials as specified in **Section IVa of Table 2.** The proposed action is that the IP should provide evidence that equipment and materials are procured from certified retailers; environmental safety and quality certificates conforming with national and/or international standards are available; equipment and materials are used in an environmentally sound and safe manner, properly disposed of when applicable at the end of their useful life in a manner consistent with best management practices according to USG, European Union or equivalent standards.

**f) Recommended Action: Negative Determination with Conditions** (approximately 1-5% of all funding) for facilitating financing, the Implementer is required to review the adequacy of the environmental capabilities of the partnering financial institutions as specified in **Section IV b of Table 2.**

3.2 Climate Risk Management Analysis (CRM)

The activity doesn’t fall under a PAD or Regional Development Cooperation Strategy for which a climate risk analysis has already been performed. A Climate Risk Analysis is therefore required. This MTF presents a targeted climate risk analysis that focuses specifically on proposed agricultural sector in Tajikistan. To provide context for how projected climate change may impact the long-term benefits of proposed activity components, the Tajikistan Climate Vulnerability Profile outlines mid-term and long-term climate change scenarios in **Annex 1.** Based on this Profile, Tajikistan will experience a hotter and dryer climate overall, and will particularly experience a change in water resources – including an increase in water resource levels until 2020-2030 and then a decrease in water resource availability by the end of XXI century because of exhaustion of glaciers due to accelerated melting. In addition, changes in climate may increase the frequency and intensity of extreme weather and natural events such as heavy rainfalls, floods, flash floods, mudflows, land-slides, avalanches, droughts, heat waves, wildfires, pest and disease infestations, increase in duration of extremely hot summer periods with air temperature above 40°C.

These predictions suggest that potential impacts of climate change on the TACA medium- to long-term efficacy include extreme events that could lead to loss of agriculture crops and business failure due to increased temperatures, droughts, intensive rainfalls, flooding, mudflows, etc. In terms of specific climate risks at the proposed activity location, in Khatlon Region- current climate
models are not geographically precise enough to make a confident assessment of what conditions will occur. However, in general, the south of Tajikistan is not expected to experience such significant changes in climate vulnerability as some other areas in the country. The conclusions of the updated vulnerability assessment under the Third National Communication under the United Nations Framework Convention on Climate Change (TNC)¹ show that the impact of the climate change on natural resources, economy and the population is likely to be significant and negative in case of extreme scenarios. According to the assessment of WB (2008)², Tajikistan tops the list of 28 countries of Central and Eastern Europe, Caucasus and Central Asia on the Climate Risk Index being a sensitive country with low adaptation potential. The negative impact of climate change over the last decade includes floods in Pyanj, Vakhsh, Zerafshan and Kafirnighon river basins, desertification of fertile lands in southern districts of the country, land erosion resulting from inadequate irrigation and intensive precipitation, a shortage of water due to droughts, and loss of agricultural crops due to heat and frost. The greatest impact has been felt on dryland farms and in pasture lands as they occupy 29% of total land area. Within the country, the central mountainous districts of Tajikistan are considered to be the most vulnerable. The more populated plain and mountainous districts in the south of the country (the Khatlon region), as well as communities living in northern slopes of the Zerafshan and Turkestan ranges (Soughd oblast) represent the 2nd level of vulnerability. This assessment is based on the current and expected impact of climate change, and also the low potential for adaptation at the local level, including quality of life, education, and income diversification.

Cumulatively, the proposed TACA potential to accelerate development of climate resilient crops and development of sustainable agribusiness activities far outweighs the relatively low to medium climate risk that climate poses to the activity components. The activity’s development team has determined that these risks are acceptable, however the contractor will have to take into account adaptation measures suggested in TNC, National Action Plan for Climate Change Mitigation in Tajikistan³, FAO and other donors recommendations available in various internet and literature sources. The table below outlines Climate Change risks to the activity, explains how risks have been addressed so far under USAID agricultural activities and what other opportunities exist for integrating climate resilience or mitigation measures.

Table 2. Activity-level Climate Risk Management Summary Analysis

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¹ Third National Communication under the United Nations Framework Convention on Climate Change (UNFCCC), 2014
² Tajikistan’s Vulnerability to Climate Change. Zvi Lerman, 2011
³ National Action Plan for Climate Change Mitigation in Tajikistan, 2003
<table>
<thead>
<tr>
<th>Defined or Anticipated Project Elements (Purpose/Sub-purpose, Area of Focus, or Activity/Mechanism, etc.)</th>
<th>Climate Risks - List key risks related to the project elements identified through either the strategy or project level climate risk assessment.</th>
<th>Risk Rating - Low/ Moderate/ High</th>
<th>How Risks are Addressed at Project Level - Describe how risks have been addressed at the project level. If a decision has been made to accept the risk, briefly explain why.</th>
<th>Further Analysis and Actions for Activity Design/Implementation - Describe CRM measures to be integrated into activity design or implementation, including additional analysis, if applicable.</th>
<th>Opportunities to Strengthen Climate Resilience - Describe opportunities to achieve development objectives by integrating climate resilience or mitigation measures.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective 1: Diversify the agricultural sector to include higher-value commodities and value-added products.</td>
<td>Climate change poses a higher threat to air temperature rise in Tajikistan above global mean increases, causing droughts in low land plains, heat waves, heavy rainfalls and increased frequency of extreme events (mudflows, avalanches, etc) in most parts of agricultural areas. As TACA is planning to work with different agricultural crops and systems, examples of key risks may include: - Higher temperatures may significantly reduce yields - Soil surface temperature greater than 60 °C can cause seedling mortality or thermal injuries - Under warmer climate and increased CO2 levels drastic increase in weeds, pests and fungi thriving may take place</td>
<td>Low to Moderate</td>
<td>Multiple adaptation and mitigation measures have been used during implementation of on-going FtF activities. This includes introduction of efficient water technologies (drip irrigation; water measuring devices in the irrigation canals); introduction of heat resistant varieties of fruit trees and crops; introduction of principles of sustainable crop and land management, including nutrition management and integrated pest management.</td>
<td>-IP will have to conduct additional climate risk analysis after PWS spells out in a more detail all possible interventions within the SOO. This condition is included in the solicitation and award Environmental Compliance language.</td>
<td>--IP may work jointly with private sector and Government of Tajikistan to include climate resilience in future policies, strategies and programming. --IP may increase the climate change resilience knowledge of agricultural sector players such as agbusinesses, farmers, intermediaries, etc. --IP may increase the capacity of agbusinesses and farmers to support disaster planning and management to ensure agbusinesses protection from extreme events continued --IP may select agricultural technologies with a lower...</td>
</tr>
<tr>
<td>Objective 2: Strengthen linkages between aggregators, wholesalers, exporters, and international and domestic end-markets.</td>
<td></td>
<td>Low</td>
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around flowering can reduce pollen viability and grain set in major cereals
- Heat stress can increase vulnerability of domestic animals to disease, reduce fertility, and reduce milk production.
- Increased glacial melting can cause floods while after ice resources are exhausted, water deficit for irrigation in plain parts of Khatlon can cause loss of crop yield
- Higher temperatures with lack of precipitations can cause loss of rain-fed crops
- Decrease of productivity of orchards in Khatlon due to temperature increase
- Due to increase in length of period of abnormally hot weather in summer, plants and trees will be subjected to huge stress and may die.

See more examples of potential risks in Table 2 of Annex 1.

4.0 Revisions
If during implementation, new activities are considered outside of those described in this document, an amendment shall be submitted. Pursuant to 22 CFR 216.3(a) (9), if new information becomes available which indicates that activities to be funded by the project might be ‘major’ and the project’s effect ‘significant’, this determination will be reviewed and revised by the IP, in collaboration with the COR of the project, and submitted to the MEO and BEO/Asia for approval and, if appropriate, an environmental assessment will be prepared.

DRAFTED BY:

sent by email on 11/20/2017
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Central and South Asia, and for
Office of Afghanistan and Pakistan
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Concurred by email on December 5, 2017
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Date: 12/6/2017
Distribution:
- Project Files
- Asia Regional Environmental Advisor
- Asia Bureau Environmental Officer
- OAA
- RL

Attachment:
- Technical Proposal
FACT SHEET

Climate Change Risk Profile

TAJIKISTAN

COUNTRY OVERVIEW

Tajikistan is a small, mountainous, landlocked country located in Central Asia. Tajikistan’s geography is characterized by deserts and semi-deserts in the west and the huge mountain ranges of the Pamir and Tian Shan in the east, creating a great diversity of environmental and climatic conditions. More than half of Tajikistan lies above an elevation of 3,000 meters. Even the lowlands, which are located in the Fergana valley in the far north and in Khatlon Province in the southwest, are well above sea level (Map 1). Millions of people depend on the condition of snow reserves, glaciers and amount of precipitation in the mountains of Tajikistan - the ‘water towers’ of Central Asia. The rivers of the country supply approximately half of the flow to the Aral Sea basin.

Map 1: Topography of Tajikistan

Tajikistan is the poorest of the Commonwealth of Independent States, with 19.5 percent of the population living on less than USD 1.90 a day and 56.6 percent subsisting on less than USD 3.10 a day. Tajikistan’s economy is dominated by minerals extraction, metals processing, agriculture, and reliance on remittances from citizens working abroad. The country is subject to natural disasters, including droughts, heat waves, floods, mudflows and landslides that are already responsible for land degradation, infrastructure damage and loss of life. The conclusions of the updated vulnerability assessment under the Third National Communication under the United Nations Framework Convention on Climate Change (Third NC) show that the impact of the climate change on natural resources, economy and the population is likely to be significant and negative in case of extreme scenarios. Climate change is seen as a “threat multiplier,” exacerbating existing threats to security and increasing environmental and social stress, adding to pressures that can push the responsive capacities of governments to their limits.

CLIMATE SUMMARY

Tajikistan’s climate is continental, subtropical, and semiarid, with some desert areas (Map 2). The Fergana Valley, South Khatlon and other lowlands are shielded by mountains from Arctic air masses, but temperatures in that region still drop below freezing for more than 100 days a year. The subtropical southwestern lowlands of Khatlon (Kurgan-Tyube region) has hot climate with extremely hot summer (average July temperature is about 28-30°C; absolute maximum is 46-46°C), mild winter (average January temperature is about +2 -+3°C, absolute minimum is -23-24°C) and low amount of precipitation (150-200 mm a year). This climate is favorable for some heat-loving plants, including cotton under irrigation. Pomegranates, melons, stone fruit, and citrus (with winter protection) grow well under such conditions. In the eastern Pamirs, the average July temperature is 5 to 10°C, and the average January temperature is -15 to -20°C. The Eastern Pamir is known for its extreme climate and here the lowest temperature reaches minus 63°C. Tajikistan is the wettest of the Central Asian republics, with the average annual precipitation for the Kafirnighon

1 World Bank World Development Indicators
2 Third National Communication under the United Nations Framework Convention on Climate Change (UNFCCC), 2014 [ 1 ]
and Vakhsh valleys in the south being around 500 to 600 mm, and up to 1,500 mm in the mountains. At the Fedchenko Glacier, as much as 223.6 cm of snow falls each year. Only in the northern Fergana Valley and in the rain shadow areas of the eastern Pamirs is precipitation as low as in other parts of Central Asia: in the eastern Pamirs less than 100 mm falls per year. Approximately 75% of annual precipitation takes place during the colder times of the year.

Map 2: Climate zones of Tajikistan (Koppen climate classification)

GREENHOUSE GAS EMISSIONS

According to the inventory of GHG emissions (2004-2010) the level of absolute and per capita emissions in Tajikistan remains the lowest in Central Asia (about 1 ton CO2-eqv per person)[1]. The current level of emissions as compared to 1990 (25 million tons of CO2-eqv) has declined by two thirds (to 8 million tons of CO2-eqv), due to the collapse of the former Soviet Union economy and to structural changes resulting from the transition to a market economy and independence. The most dramatic decline in GHG emissions occurred in the energy sector - a staggering reduction of more than 80 percent - but not without socioeconomic and environmental consequences: high reliance on imported fossil fuels and their unsecure supply creates major difficulties for businesses and the population at large. Coal mining and use, negligible in Tajikistan for 20 years, is starting to grow in the residential, industrial and power sectors with current levels estimated at 0.5 million tons per year. Tajikistan’s emissions profile differs from other Central Asian countries. In 1990, the energy sector dominated GHG emissions (almost 70 percent of the total). From the late 1990s to the present, agriculture has been the main source of GHG emissions (60 percent). Road transport is extensively using a low-emission fuel (more than 50 percent of cars are run on natural gas). Tajikistan’s Intended Nationally Determined Contributions (INDCs) set a 2030 target of a reduction to 65 - 75 percent of 1990 emissions levels subject to substantial international funding. On the adaptation side, the INDC outlines an ambitious set of initiatives the country is pursuing, but reports that national funding is insufficient to implement all the programs [2].

CLIMATE CHANGE SUMMARY

In accordance with Second (2008) [3] and Third (2014) NCs for the Republic of Tajikistan average increase in plain regions of Tajikistan constituted, on the average, 0.1-0.2°C in decade. Climate projections indicate that it could further rise, reaching, by 2050, a level up to 2.9°C higher than that of the 1961-1990 period. If the present rate of glacier retreat persists, the small glaciers of Tajikistan will disappear totally in 30 to 40 years and the glacial area will shrink by 15-20 percent from its present extent (Table 1). The main vulnerabilities of natural resources and people to climate change are the quality and quantity of water supply and the dependent sectors of farming, livestock breeding, wildlife use, drinking water supply, forestry and the related energy sector. Furthermore, natural disasters are expected to increase. This is a result of the expected seasonal fluctuations of water supply due to glacier retreat and temperature rise, increasing extreme weather events and seasonal shifts of precipitation. A sustainable management of natural resources is key to adaptation to climate change in Tajikistan. Various mitigation and adaptation measures should be considered for inclusion in project activities (Tables 2 and 3 below).
### Historical Climate Change

- Increase in mean annual temperature by 0.1-0.2 °C/10 years, during the period 1940-2012 in low land plain area.
- Increase in annual average temperatures by 0.3-0.5°C/60 years in mountainous areas
- The biggest increase of annual mean temperature in the mountainous zone (1.0º-1.2ºC) was observed in Khovaiing, Faizabad and Ishkashim
- The biggest increase for 65 year period is noted in Dangara (1.2ºC) and Dushanbe (1.0ºC), for the rest of the territory it constitutes 0.5-0.8ºC, in Khujand it is 0.3 ºC because of development of irrigation and cooling effect of the Kayrakkum water reservoir
- In altitudinal zones above 2500 m asl the increase of temperature on average constituted 0.2-0.4ºC and up to 0.6ºC in Djavshangoz. The fall of temperature (-1.1ºC) during this period is noted in the kettle of Bulunkul Lake which could be related to the features of climate in the Eastern Pamir
- Increase in frost-free period by 5-10 days
- Increase in all average maximum and average minimum temperatures in all altitudes
- Increase in the frequency of "hot" days and nights
- During the period under review, the highest number of days with air temperature above 40°C in the plain areas of Tajikistan were observed over two decades: 1940-1950 and 2000-2010.
- The number of days with temperature equal or above 40 °C increased in the most flat areas of the country with exception of those territories where development of land and construction of water reservoirs took place.
- A trend to warming during the cold season of the year, especially in November-December, reaching 1-3ºC. The trend to temperature fall was observed at all high altitudes in February, March, May, June and October.

### Climate Change Projections

- All used prediction models show the following:
  - An increase in temperature will be observed in all districts of the country
  - An increase in mean annual temperature by 0.2–0.4 ºC is expected in most areas of Tajikistan by 2030 (in comparison with the period 1961–1990)
  - The maximum increase of temperature is expected in winter, by 2°C and more by 2030
  - By mid-century mean annual temperature could further rise, reaching, by 2050, a level up to 2.9°C higher than that of the 1961-1990 period
  - By the end of XXI century the temperatures may increase by 5 ºC and more in southern districts, central mountainous areas and west Pamir compared with 1961-1990 period
  - Winter and summer temperature in mountains (Pamir, Hindukush) may increase faster than in valleys and low desert plains
  - Maximum daily temperature and heat waves will increase especially in low lands of south Tajikistan
  - Diurnal temperature ranges will increase as will the number of heat waves, especially in the lowland districts of southern Tajikistan
  - The risk of drought will increase due to an increase in total evaporation and earlier snowmelt

### Precipitation

- Due to the mountainous relief of the territory of Tajikistan, distribution of precipitation and their long-term changes vary significantly.
  - Between 1940 and 2012 annual precipitation slightly increased by 5-10%, especially in central
- Projected precipitation patterns are expected to show large variations in terms of change, intensity, and geographical distribution.
  - While the irregularity and increase in intensity of precipitations is expected to continue in the

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3 Sources: Second and Third National Communications under the UN FCCC [1,3].

Note: There have been multiple climate change assessments for Tajikistan and Central Asia over the last 30-90 years. There is a consensus on the characteristics and impacts for some river basins and geographic zones, whilst in others the trends and scenarios are different and remain uncertain [1].
high mountainous areas. However, the diversity of geographic and climatic zones in Tajikistan creates a varied and complex pattern of change.

- Annual precipitation haven’t increased significantly over Tajikistan territory in altitudes below 2500m (by 8% on average), and decreased by 3% in high mountainous zone. The increase is more clearly seen in the zone below 2500 m asl in summer and autumn, mostly due to highly intensive rainfalls
- The amount of annual precipitation in the Eastern Pamir (mountainous plateau with elevation of 4,000-6,000 m asl) reduced by 5-10%, and in Murghab by 44%
- The similar reduction trend of the reduction of precipitation occurs in the southern lowland areas of the republic (Kurghan-Tyube, Shaartuz)
- A slight increase took place in average annual precipitation during 1940-1912 by 5-10%.
- A slight increase took place in intensive rainfall in some valleys and foothills (Dushanbe, Dangara, Faizabad, Hovaling), and decrease in snowy days
- Some increase in precipitation is caused by the growth of their intensity with decrease of number of days with precipitation
- In all mountainous zones the trend for precipitation growing in cold season was observed.
- In many districts, especially in the central mountain districts, the number of days with precipitation of more than 5mm has increased
- Heavy snows are rare in the plain areas and north of Tajikistan and most frequent in mountainous districts above 1,500 m asl.
- Snowfalls are extremely rare in the canyon-shaped valleys and east of Pamir.
- In general, there is no clear picture on the frequency of heavy snowfalls.

**Glaciers And Water Resources**

- During the whole period of instrumental observations (since 1930s), the glacial area of Tajikistan decreased by around 1/3
- The current glacier degradation levels are 0.5-0.8% per year.
- In view of the degradation and intensive melting of glaciers, river discharges have increased by 5% and even more in glacier and snow fed rivers.
- Reduced snowfalls and earlier melting of snow cover due to an increase in air temperature during winter and spring
- An analysis of annual data covering 1930 to 2012 shows an increase of annual discharge in the Kafirnighon river especially over the last two decades by 7-14% against mean annual discharge
- The Vakhsh river discharge has not experienced a significant reduction in flow as the estimated reduction of 3-5% is within the margin of error for hydrological measurements.

future, most of the climate models do not reach consensus with regard to future rainfall projections. However, summers are expected to be wetter, while winters are expected to be drier, which could result in both floods and longer droughts [4].
- All used prediction models don’t show significant precipitation change in Vahsh and Pyanj basins, however intensive rainfalls will increase in some areas, especially in the Pamirs.
- Annual precipitation may decrease in the south Tajikistan lowland plains, but will increase in mountains
- Summer and winter precipitation may increase all over Tajikistan, while spring and autumn precipitation may decrease.

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**Flow prediction varies significantly depending on prediction source, climate scenario, and a model chosen.**

- National Communications on climate change of all countries of Central Asia indicate that in the case of warming, the main river flows resources could decrease by 10-20% or more by the end of 21st century.
- Based on [5], the Kafirnighon, Vakhsh and Pyanj river flow will decrease as of 2020 by 3%, as of 2035 - by 5% and as of 2050 - by 6%, i.e. the decrease will not be significant
- Based on [1, 6], as a result of the active melting of glaciers feeding mountainous rivers, discharge can initially increase.
- In the long term, the impact is opposite - the discharge will decrease due to a depletion of glaciers. E.g., in Kafirnighon river basin river flow will decrease by 2050 as the glaciated area of southern slopes of Gissar range where the Kafirnighon river is

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4 Note: The reduced frequency of hydrological observations after 1994 has made the modelling of water flow rather challenging and resulted in contradictory predictions by different authors [5].
For the Pyanj River, during 1941 to 2010, there were insignificant increases in discharge mostly due to flow increases on some major tributaries and because of mudflows and floods on them.

A review of the most recent period i.e. 1972-2012 shows an increase in discharge of the Zerafshan river.

- Beyond 2050 the hydrological regime and discharge of rivers in the complex mountainous area of the Pamirs will depend on actual climate change scenarios. In the case of little or no global climate protection action being taken the volume of glaciers will decrease by 50-70%. This will reduce and shift the peak of summer flows from July to May-June.
- Some models predict an increase in the flows in the Vakhsh river by the middle of 21st century, and some - by the end of 21st century. Some of the models and predictions suggest a reduction of river flow by 10-20% and more.
- The slow increase of river discharge in the Western and Eastern Pamir (Pyanj river basin) is likely to continue up until the middle of 21st century.
- World Bank projections suggest that the water flow may potentially decrease by 10–15 percent in the Amudarya River Basin by 2050 especially in lower reaches of these rivers, worsening the water scarcity situation [4], while Tajikistan is located in upper reaches.
- It’s likely that in second half of XXI century, flow of main rivers will decrease in summer and early autumn; inter-year flow variability will increase.
- TNC suggests that more up to date models conclude that there will be an increase in precipitations and icemelt and a consequent increase of flow by 5-10% by the middle of 21st century and even more by the end of the century [1].

ILLUSTRATIVE SECTOR IMPACTS, VULNERABILITIES AND ADAPTATION MEASURES

AGRICULTURE

With 23 percent of gross domestic product (GDP) and 51 percent of employment, the agriculture sector is a significant component of Tajikistan’s economy. Agricultural land, especially arable land, is scarce due to the country’s mountainous terrain. Of the total land area only 35 percent is classified as agricultural land. Approximately 20 percent of this agricultural land is arable, and the remaining is pasture. Tajikistan’s most important crops and commodities within gross agricultural output are: wheat, cotton, potato, onions, tomatoes, watermelons, milk, beef meat, sheep meat, egg [7]. Cereal and cotton predominate in arable areas, with cotton as the major agricultural export. Fruit and vegetable production is increasing for both domestic and export markets. Cattle and sheep are raised for milk and meat, but herds are small. Livestock are wintered on the farm and then grazed in the mountains during summer and autumn. Local (near village) pastures tend to be overgrazed, as there is limited land for grazing relative to the number of livestock. Mountain pastures are underused due to their distance from villages and lack of water. More than 70 percent of arable land is irrigated (700,000 hectares), and this irrigated land accounts for most of Tajikistan’s crop production. Factors limiting land use for agriculture include the country’s mountainous topography, water, electricity, soil salinization, and lack of mechanization. These geographical and infrastructural limitations, along with constraints within the enabling environment for agriculture, prevent the sector from reaching its full potential. Tajikistan is

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5 Sources: 1,3,6
6 Note: these are only some illustrative impacts and adaptation measures. More information might be found in various sources such as [10-13]
The impacts for the country’s uplands and rain-fed farming areas are likely to include reduced water inflows, diminishing crop and rangeland productivity (with crop yields in some regions expected to fall by up to 30 percent by 2100), changes in crop and forage quality, and the spread of pests and diseases. Irrigated agriculture will also experience additional water stress, with the need for enhancements in water storage capacity and management. These changes will put at risk major sources of exports, like cotton, as well as food security in some regions.

**Table 2**

<table>
<thead>
<tr>
<th>Impacts and Vulnerabilities</th>
<th>Adaptation Measures</th>
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</thead>
<tbody>
<tr>
<td><strong>Crop agriculture</strong></td>
<td><strong>Crop agriculture</strong></td>
</tr>
<tr>
<td>-- The most damage to agriculture in Tajikistan may occur as a result of such hydrometeorological and natural phenomena as shift in average growing conditions, including high temperatures, hot winds, more droughts; heavy rainfalls; Floods and mudflows; Strong winds and sandstorms; Agricultural pests and diseases. -- Extreme air temperatures combined with dry hot winds and droughts, hamper the growing of plants and reduce the amount of accessible water which results in considerable losses to dry-land crops and pastures, as well as causing a rise in the price for goods as was the case in 2000-2001 and in 2008 in Tajikistan. Droughts are considered by local population to be the most devastating consequence of CC based on [1] -- Loss of soil due to increased intensity of rainfalls -- The move up of agro-climatic zones by 550-600m under a temperature increase of 3.0-3.7 °C and slow increase in precipitation [1]</td>
<td>At the central level: -- Adaptation of the agriculture sector and mitigation measures including a wide range of activities which directly and indirectly impact the end result and enable introduction and implementation of the principles of ‘green economy’ in agriculture sector -- Enhance the responsibility of state bodies, including local governments for ensuring that land use rights are not violated and exclude the government from intervening in production or business related decisions of agricultural producers -- Enhance state control in ensuring the safety of agricultural goods (based on Codex Alimentarius) -- Development of organic land management as well as certification and incentive systems for producers -- Create an insurance fund for the agricultural sector during emergency situations and in the context of climate change -- Improve existing and construct new storage facilities for crop and livestock products -- Development of seed varieties in the context of climate change -- Provide timely weather and market information that enables them to manage their resources better and to protect their assets in times of drought -- Identify and implement climate-smart solutions such as those related to improved disaster risk management, hydromet services, climate risk assessments, water resource management, climate resilient agriculture, performance of water utilities and energy systems, and others</td>
</tr>
<tr>
<td>-- Pest and disease infestation: -- The earlier onset of spring and warmer winters could allow some parasites and pathogens to survive more easily -- In areas with increased rainfall, moisture reliant pathogens could thrive -- Milder winters may increase the survival of many frost-sensitive insects -- Under increasing temperature scenarios, new weed species may enter communities as a result of geographic range shifts -- An increasing resistance to pesticides among invasive insects is a problem to farmers and the effectiveness of current IPM and other pest management strategies.</td>
<td>-- Adaptation of the agriculture sector and mitigation measures including a wide range of activities which directly and indirectly impact the end result and enable introduction and implementation of the principles of ‘green economy’ in agriculture sector -- Enhance the responsibility of state bodies, including local governments for ensuring that land use rights are not violated and exclude the government from intervening in production or business related decisions of agricultural producers -- Enhance state control in ensuring the safety of agricultural goods (based on Codex Alimentarius) -- Development of organic land management as well as certification and incentive systems for producers -- Create an insurance fund for the agricultural sector during emergency situations and in the context of climate change -- Improve existing and construct new storage facilities for crop and livestock products -- Development of seed varieties in the context of climate change -- Provide timely weather and market information that enables them to manage their resources better and to protect their assets in times of drought -- Identify and implement climate-smart solutions such as those related to improved disaster risk management, hydromet services, climate risk assessments, water resource management, climate resilient agriculture, performance of water utilities and energy systems, and others</td>
</tr>
<tr>
<td>-- Livestock: -- Heat stress can increase vulnerability of domestic animals to disease, reduce fertility, and reduce milk production. -- Heat stress suffered by animals reduces the rate of animal feed intake and results in poor growth performance -- Drought may threaten pastures and feed supplies -- The quality of some of the forage found in pasturélands decreases with higher CO2. As a result, cattle would need to eat more to get the same</td>
<td>At the local level: -- Crop protection from natural hydrometeorological disasters and increase of incomes through increasing the number of crops per year through the wide introduction of green housing -- Consideration of agro-climatic conditions and wide introduction of drought-resistant crops. Cotton will be profitable under hot conditions as cotton plant is able to cope with higher temperatures and high soil salinity -- Enhance the reliability of agricultural insurance, create seed emergency reserves and self-help farmer groups with savings funds to address and reduce the impacts of natural disasters</td>
</tr>
</tbody>
</table>

Classified by the World Bank as one of the CIS countries that are most vulnerable to climate change risks being a sensitive country with low adaptation potential [1]. Historic and projected trends in temperature and precipitation show that agriculture is particularly vulnerable to climate change, with rising temperatures and falling precipitation—both in the medium and long term. Rising temperatures will increase the rate of glacial melt and the associated risks of flooding and storms in the medium term. Together with falling precipitation, these trends will reduce the availability of water for irrigation in the long term. Rising temperatures will also increase the risks of pest attacks and plant disease.
WATER RESOURCES

Due to specific climate conditions and landscape, Tajikistan is considered the main glacial center of Central Asia. Glaciers retain huge amounts of water, and regulate river flow and climate. They occupy more than 8.0 thousand sq.km, which is about 6% of the total country area. The most ice cover is observed in the western part of Pamir Mountains. Water resources are mainly formed from glacial meltwater and seasonal snow cover in the Pamir Mountains. In Tajikistan's dense river network, the largest rivers are the Syr Darya and the Amu Darya replenishing...
the Aral Sea. The largest tributaries of Amudarya are the Vakhsh and the Kafirnihon rivers. The Amu Darya carries more water than any other river in Central Asia. Average annual long-term natural run-off originating in Tajikistan is estimated at 53 cub. km, which is 3 cub.km less than 50 years ago. Climate change in Tajikistan is mostly about water, bringing more variability and instability to the large water resources of the country, with growing risks for water availability for power production in winter, agriculture downstream in summer (coupled with higher evapotranspiration), and a rise in extremes (glacial melt outburst, floods, and droughts). Tajikistan’s agricultural resource base is characterized by a heavy reliance on irrigation for crop production – more than 70 percent of arable land is irrigated, but only 62 percent is currently in use due to deterioration of the irrigation and drainage infrastructure, waterlogging, and salinization. Climate change, in the form of reduced water availability and increased temperatures, is expected to put increased stress on Tajikistan’s irrigation resources. Communities will also likely suffer critical water shortages, since total water availability is expected to fall amid chronic degradation of water supply and sanitation infrastructure. The availability of sustainable drinking water and sanitation services is a challenge in both urban and rural areas. Water quality in most systems does not meet national drinking standards. Only 14 percent of the population has access to centralized sanitation services. Water supply and sanitation infrastructure is therefore in need of rehabilitation and expansion that will take into account future risks brought by climate change.

**Table 3**

<table>
<thead>
<tr>
<th>Impacts and Vulnerabilities</th>
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<tbody>
<tr>
<td>Decreased water availability in view of predicted reduction in the volume and amount of glaciers and permafrost, reduction of precipitation in the form of snow, and changes in hydrological regime and reduced flow of the main rivers in summer-autumn period will cause the following effects in agriculture:</td>
<td>Future agricultural sector development will need to place a much greater emphasis on responding to the risks of drought, flood, and water scarcity for irrigation, hydrometeorological and natural hazards. This may include:</td>
</tr>
<tr>
<td>-- Increase deficit of water resources for irrigation. This will likely increase biological demand of plants for water due to increased temperature and transpiration</td>
<td>-- Rehabilitation and reconstruction of irrigation systems for reduction of water losses due to filtration and evaporation (canal lining, installation of metering equipment, etc)</td>
</tr>
<tr>
<td>-- Enhance soil salinization</td>
<td>-- Stabilization and strengthening of river beds, where floods and washout are the norm</td>
</tr>
<tr>
<td>-- Increase the risk of water quality loss</td>
<td>-- Construction of water reservoirs in specific agricultural areas; retention in small storages and use of rain water (water harvesting) to create guaranteed water reserves in dry years and to reduce the risk of floods and mudflows</td>
</tr>
<tr>
<td>-- Result in degradation of aquatic ecosystems</td>
<td>-- The Government should guarantee the security and safety of water supply to the population during floods and droughts and ensure that climate change concerns are properly reflected in the design of new water supply and sanitation and water management infrastructure</td>
</tr>
<tr>
<td>-- Increase groundwater abstraction depletion</td>
<td>-- Enhancing the effective use of water resources in agriculture such as wide use of modern water saving technologies (e.g., drip irrigation and sprinkling)</td>
</tr>
<tr>
<td>-- A deficit of water may enhance tensions at the local level among users</td>
<td>-- Reliable access to energy in rural areas through wide use of renewable energy sources</td>
</tr>
<tr>
<td>-- Increase migration</td>
<td>-- Wide application of principles of Integrated Water Resource Management such as transition to the management of water resources based on hydrological basins rather than administrative units, countrywide development of water user associations creation of basin committees and boards, etc.</td>
</tr>
<tr>
<td>-- Increase the incidence of diseases</td>
<td>-- Application of differentiated water tariffs depending on specific conditions; and incentives for saving water and the gradual increase of energy tariffs to fully cover the operational cost of irrigation systems</td>
</tr>
<tr>
<td>-- Cause damage to both the economy and the population due to the all above.</td>
<td>-- Conservation and expansion of forest area and density in river catchment areas</td>
</tr>
<tr>
<td>Floods, mudflows, and landslides will cause:</td>
<td></td>
</tr>
<tr>
<td>-- Significant damage to local infrastructure (roads, small dams, channels, water intake and control facilities, buildings)</td>
<td></td>
</tr>
<tr>
<td>-- Deterioration in sanitary -- epidemiological situation such as the flushing of waste, and clogging of drains</td>
<td></td>
</tr>
<tr>
<td>-- Increased water logging and creation of stagnant water that may contribute to an increased range and risk of communicable diseases, including malaria, intestinal and parasitic infections.</td>
<td></td>
</tr>
</tbody>
</table>
--Adaptation of irrigation modes to the conditions of climate change, including revision of the terms and norms of irrigation and provision of environmental flows
-- Introduction of innovative technologies to improve effectiveness of adaptation measures and reduce costs
-- Raising soil moisture retention capacity to increase water use efficiency and decrease the need for additional water to crops
--Introduction of water reutilization, improvement of water charging and trade to decrease inefficient use of water
-- Enhancing flood plain management to reduce flood vulnerability and create/restore wetlands to reduce flood peaks
--Improvement of drainage systems to reduce extent and duration of flooding
--Introduction of concept “Farmers as ‘custodians’ of floodplains” to decrease risk of flood damages
--Increasing rainfall interception capacity to reduce flood peaks at the local level
---Introduction of insurance to floods or drought to decrease economic losses to the farmer
--Changing crops and cropping patterns to decrease economic risk to farmers
--Addition of organic material into soils to recover soil functions
-- Soil carbon management and zero tillage to reduce soil erosion and improve soil water retention capacity
--Protection against soil erosion to reduce land degradation

More measures can be found in various sources such as [10—13]

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CLIMATE CHANGE IMPACTS AND VULNERABILITIES IN OTHER SECTORS

HUMAN HEALTH

Health indicators in Tajikistan are among the lowest in the ECA region, with poor health outcomes, misallocation of staff and other resources, inequality of access between urban centers and rural areas, inefficient production of care, and hospital overcapacities. Climate change could translate into new or more severe health risks. The predicted increase in air temperature and precipitation will contribute to an increased range and risk of communicable diseases, including malaria, intestinal infections, and parasitic infections. Climate warming, longer periods of hot weather, floods and droughts may negatively affect the quality of drinking water and contribute to outbreaks of infectious and other diseases, including dysentery, typhoid, hepatitis A, salmonellosis, cholera and lambliasis. The rate of acute intestinal infections in Tajikistan is 10 times higher than in Europe. Half of the cases are of an epidemic nature and children are most prone due to their age and social status. Rise of extreme summer temperatures could also lead to higher infant and adult mortality. There is a need to improve existing programs on enhancement of maternal and infant health, taking into consideration climate change factors, as well as to develop research on the impacts of climate change on human health.

ECOSYSTEMS

In Tajikistan, ecosystems play an important role in sustaining the wellbeing of the population in rural and mountain regions. Climate warming, the increase of carbon dioxide in the atmosphere and other factors greatly influence the ecosystems. Such an influence is expressed in the extinction of species of flora and fauna,
deterioration of biotopes, shifting of phenological parameters of vegetation, degradation of tugai woodlands, winter-spring pastures, etc. The impact of anthropogenic and climate factors lead to intensifying the erosion process, altering the conditions of surface runoff because of changing vegetation, that in turn negatively affect stream flow. Forests in Tajikistan though small in area (3 percent) are critical for biodiversity, soil protection, climate regulation, and rural livelihoods, and they also have value as a source of medicinal products production and raw materials. Weather and climate conditions also affect the number of insect pests and insects transmitting infectious diseases. Over the last decade, due to warming and insufficient forest protection activities, the area of forest prone to plant pest and diseases has increased. The main forest pests include Turkestan peacock moth, pistachio seed eate, seed worm, silkworm, and powdery mildew. The forests of southern Tajikistan are prone to a high risk of fire threats. The frequency and extent of forest and steppe fires are expected to increase, risking further land degradation. These changes have implications for livelihoods, as drying and land degradation affect water and pasture availability. Climate stressors to ecosystems come on top of a myriad of non-climate stressors such as habitat fragmentation, land degradation and pollution.

ENERGY

Tajikistan is the world’s leader in terms of its hydro energy potential (3.6 mln kWh/1 km/year). For the time being, only 5% of this potential is being exploited. Hydropower engineering is the base for the electric energy sector of the country. The total capacity of operating power plants comprises 4,412.7 Megawatts, 93% of which is being produced by hydropower plants. Lack of a reliable (year-round) electricity supply is a major bottleneck to Tajikistan’s development, with severe economic, social, and environmental implications. Approximately 70 percent of the population suffers from extensive electricity shortages during winter, estimated at a quarter of winter electricity demand. In addition, the economic cost of electricity load shedding and unmet demand is estimated at about 3 percent of gross domestic product (GDP). Only 5 percent of the country’s estimated technical potential for hydropower has been developed, and new projects have been identified for energy security and possibly power exports to the region. In order to safeguard Tajikistan development, it is essential that the country’s hydropower potential be developed in a climate-resilient way, as the sector stands to be highly vulnerable to climate change. Ninety-eight percent of Tajikistan power comes from hydroelectric sources, and the river basins in which hydropower facilities are located depend upon glacial meltwater and snowmelt. Expected climate changes will be unfavorable for hydropower engineering, as they will result in a decreased stream flow and increased risk of landslides and floods. The impacts of climate change on hydrology need to be taken into account in the design, rehabilitation, and management of hydropower facilities to ensure that they are able to cope with more frequent extreme events, such as floods and mudslides, and continue to generate electricity safely, efficiently, and reliably under a range of projected climate change scenarios.

POLICY CONTEXT

INSTITUTIONAL FRAMEWORK

Tajikistan acceded to the UNFCCC in 1998 as a non-Annex I Party and ratified the Kyoto Protocol in October 2008. Climate change is now under the purview of the Committee on Environmental Protection under the government of the Republic of Tajikistan and its State Entity for Hydrometeorology (Hydromet). The country prepared its Three National Communication on climate change in 2002, 2008 and 2014. The country ratified the Paris agreement on Climate Change on Feb 13, 2017. The problem of climate change is indicated in the relevant articles of the Law on Nature Protection, Law on Renewable Energy, Law on Energy Efficiency and Energy Saving, the State Ecological Program, the State Program on Public Awareness and Environmental Education, and other documents.

NATIONAL STRATEGIES AND PLANS

At present, the country has developed a series of strategies and action plans on such environmental problems as desertification, biological diversity, climate change, ozone layer depletion, water management and flood prevention. All these documents consider the aspects of climate change problem. In 2016 the Government of Tajikistan adopted the National Development Strategy (NDS) 2016-2030 [14]. The NDS is focused on economic diversification and competitiveness, sustainable jobs, improving energy supply and transport connectivity, ensuring food security, enhancing public administration and developing human resources. The main strategic areas are screened against the need to take into account medium and long term impact of climate change on sustainable development of the country and sectoral economy. There are several important legal documents and recent policy developments that form a good basis for Tajikistan’s aspiration to mainstream low-carbon, climate-resilient considerations into its broader sustainable development agenda. A National Action Plan for Climate Change Mitigation and Adaptation was developed during preparations of the First NC and approved in June 2003 (government decree No. 259) and is currently the only climate policy in effect. The action plan identifies the major directions and priorities of the state policy on reducing greenhouse gas emissions and adapting to climate change and provides information on the adverse impacts of climate change on natural resources, the economy, and public health. However, in 2017 the
Government of Tajikistan began working to formulate and approve a National Adaptation Planning process (NAP) focused on integrating climate adaptation into sectoral policies and strategies in Tajikistan.

The Government of Tajikistan decided to launch the NAP process to adopt a long-term approach for reducing vulnerability to climate impacts and to facilitate the integration of climate adaptation into on-going planning processes at national and sub-national levels, with a focus on integration adaptation and disaster risk reduction. The NAP is currently in draft form and in the review process within the Government of Tajikistan.

**KEY RESOURCES**
1. Third National Communication of the Republic of Tajikistan under the UNFCCC, 2014
2. Intended Nationally Determined Contribution (INDC) towards the achievement of the global goal of the UNFCCC by the Republic of Tajikistan, 2015
3. Second National Communication of the Republic of Tajikistan under the UNFCCC, 2008
4. Tajikistan Overview of Climate Change activities, World Bank, October, 2013
5. The Impact of Climate Change on Water Resources in Central Asia, Eurasian Development Bank, 2009
6. Third National Communication of the Republic of Uzbekistan under the UNFCCC, 2016
10. Adaptation strategies for agricultural water management under climate change in Europe Agricultural Water Management, Volume 155, June 2015, Pages 113-124
12. UN ECE Environmental Performance Reviews. Third Review, 2017