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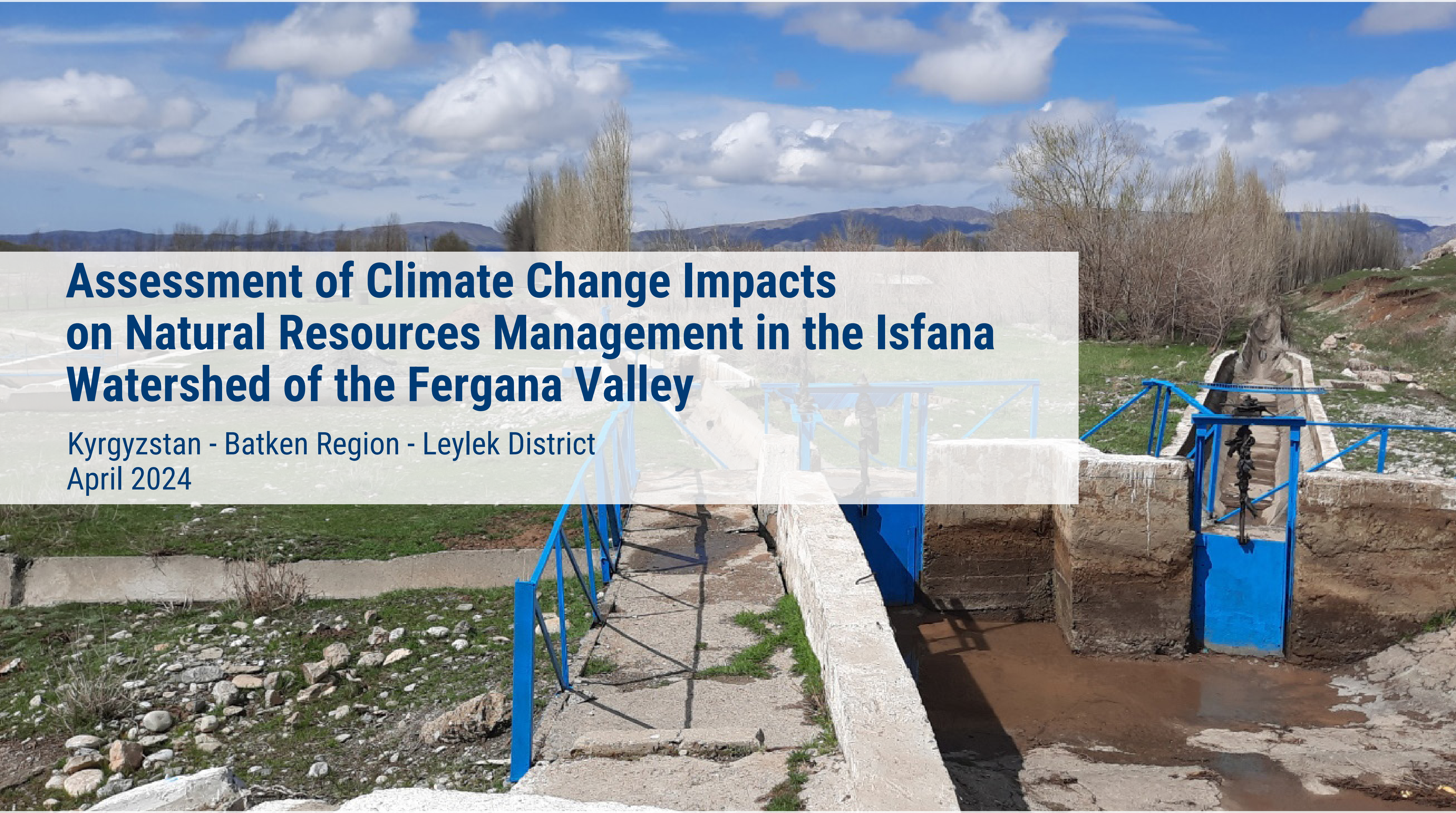

Assessment of Climate Change Impacts on Natural Resources Management in the Isfana Watershed of the Fergana Valley

Kyrgyzstan - Batken Region - Leylek District
April 2024

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Contents

Disclaimers

The following report is a product of the analysis of data from the following three sources:

- Official statistical data published by the Agency of Statistics Under the President of the Republic of Tajikistan.
- Detailed desk reviews of research conducted in 2014, 2015, and 2023 by Acted under the SDC-funded, "National Water Resources Management | Tajikistan," project.
- Open-source data on the internet, including all satellite imagery for hazard exposure analysis.

Official boundaries for Local Self- Government (LSG) administrative areas and water network data were obtained from the SDC project, and have been used in previous studies.[1]

It should be noted that the watershed boundaries for the Hydrological Watershed Analysis and Watershed Hazard Analysis differ slightly; the Watershed Analysis considers only the geologic features relevant to the Khojabakirghan river's waterflow, while the Watershed Hazard Analysis includes settlements, land, and canals which use the water from the river in addition to its distinct geologic features.

No other proprietary data has been used. All data is presented as percentages, or otherwise presented in a way to obscure the actual original values to limit the re-printing of official data as much as possible.

This report from the project is made possible by the support of the American people through the U.S. Agency for International Development (USAID). The contents are the sole responsibility of ACTED and do not necessarily reflect the views of USAID or the United States Government.

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1. Acted, Helvetas, GIZ, National Water Resources Management in Tajikistan: Summary Report on Main Findings and Conclusions of the Disaster Risk and Watershed Assessment of the Khojabakirghan/KHoja-Bakirgan Watershed, August 2015.

Key Messages

1. Socio-economic environment: The population was found to be highly dependent on agriculture and remittances, suggesting that communities are highly vulnerable to climate change. According to the Leilek District Statistical Committee (Statkom) data, agriculture and livestock farming were the main income sources for 28% of the workforce in the Isfana watershed[2]. Households were highly dependent upon remittances for meeting their needs; at least 27% of households overall, and over 50% of households in Toguz-Bulak LSG were reported to be receiving remittances from family members working abroad as agriculture fails to sufficiently support the community.

2 National Statistical Committee of the Kyrgyz Republic, 2023.

2. Irrigation Water Management: The Isfana watershed irrigation network was reported by water managers and water users to face systemic water loss challenges due to outdated and deteriorating water infrastructure, which are in dire need of repair. In non-concreted, dirt-constructed canals managed by Water User Associations (WUAs), water loss was reported by water managers to be as high as 60%.

3. Climate Change Impacts: Climate change was found to have exacerbated water management and agriculture production challenging situations regarding water shortages by reducing snowpack and making precipitation patterns more irregular, making it more challenging to supply the water needed for irrigation networks. General water scarcity, including changes in rainfall patterns, has led to a decline in the use of rainfed land for crop cultivation, reducing overall agricultural productivity overall. Hydrological SWAT (Soil and Water Assessment Tool) modeling[3] suggested that a short-term increase may occur, future projections suggest a slower, more gradual decrease in water volume.

3 SWAT | Soil & Water Assessment Tool.

4. Agricultural land Management: Overall, in 86% of the watershed's assessed villages, village leaders reported that land in near-village areas, including agricultural and pasturelands had degraded. Overgrazing and extreme weather were identified as main causes by 71% of village leaders, while 57% of them pointed to poor farming practices. Additional reported challenges included a labor shortage, extreme weather conditions with unusually hot summers exacerbating widespread pests and crop diseases, cold winters damaging apple and walnut trees and a lack of information on drought-resistant crops and water-saving technologies, particularly in the Kyrgyz language.

IMPACT, Isfana canal and bridge, April 2023

5. Pastureland Management: Pasture committees reported that overgrazing has degraded pasture conditions, which have been further exacerbated by extreme weather events such as heavy rainfall and droughts. Up to 44% of the pastureland in the watershed was found to have degraded. Restoration efforts were reported by respondents to have been primarily in upper watershed areas; however, these initiatives have encountered significant challenges, reportedly hindered by financial constraints and a lack of support from pasture users.

6. Women's Roles in Natural Resource Management (NRM): Large disparities in women's participation in NRM processes were found between rural and urban communities. Women were reported to have to balance between the physically demanding and irregular tasks of water and pasture management which were reported to often conflict with household responsibilities. In the district center, this balance was easier to manage, and women were reported to play a strong role in the district governance and Local Self Government (LSG) Councils, the main decision-making bodies at community level. However, it was reportedly more challenging for women in rural areas to participate as fully or consistently as men due to their greater participation in farming and livestock herding. This may have major implications for community participation in rural areas, as many men have left to work abroad, and women have taken on more roles in household management.

7. Disaster Risk Management (DRM): Mudflows, drought, and heavy rains were reported to pose the greatest risk to communities within the Isfana watershed. Disaster preparedness within the watershed was further reported to be lacking; in Suluktu city, emergency managers noted that there are no designated evacuation centers or safe zones for residents during hazards, especially in winter. Additionally, there is a reported shortage of essential equipment, such as heavy machinery for example bulldozers, necessary for effective emergency response and disaster mitigation. Emergency managers noted that residents insured their houses without clear policy details, leading to denied compensation for wind damage due to eligibility issues.

IMPACT, Pump Station, April 2023

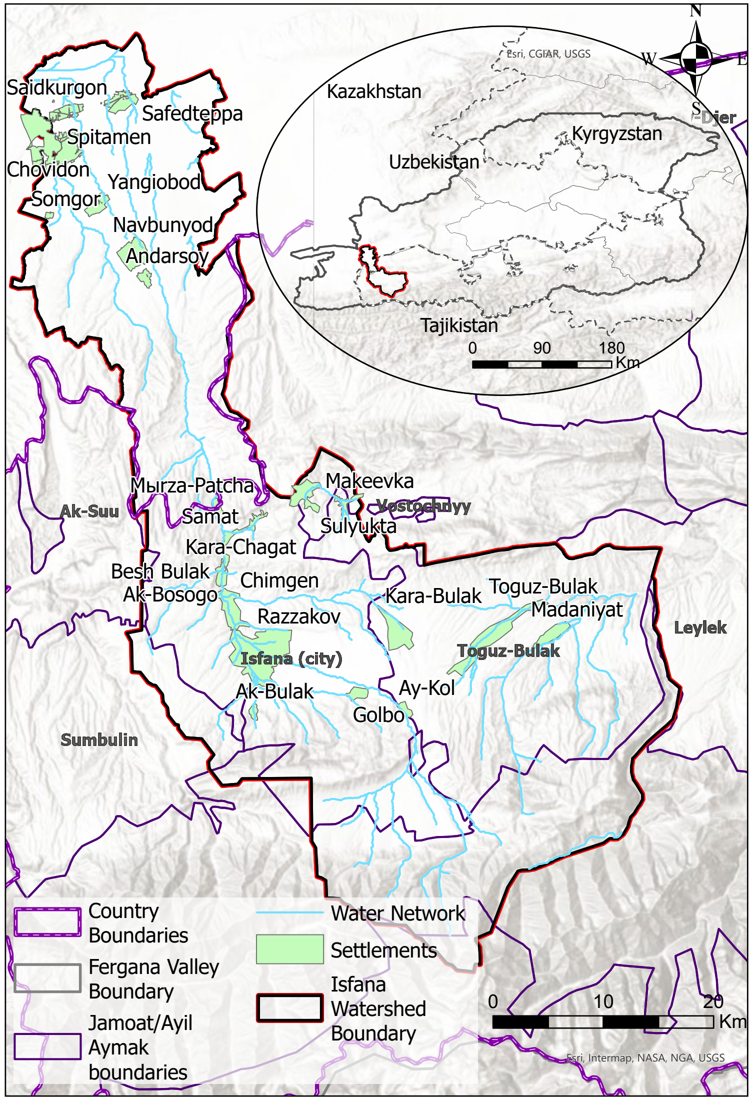
Context & Rationale

The Syr Darya River Basin, which stretches from Kyrgyzstan, Tajikistan, and Uzbekistan as it flows through the Fergana Valley, serves a 14 million population[4] in all three countries. However, the basin lacks centralized management, leading downstream communities within its complex network of rivers, canals, and dams to often be dependent on the water policies of neighbouring countries. Challenges in water management have often had negative consequences for agriculture, livestock, and hydropower in the Valley, which are all dependent on the river basin to function.[5]

Recent external stressors have put additional pressure on these networks, including climate change, which has led to a reduction in snowmelt and irregular rainfall, as well as changes in glacial discharge,[6] as well as inefficient irrigation practices, outdated infrastructure, and mismanagement of canal networks. This has large implications for agriculture yields and pasture sustainability, which are the main source of the income and livelihood outcomes for communities in the valley.[7] In extreme cases, this has contributed to border conflicts.[8]
To help address climate change challenges to the water and natural resources management in local watersheds in the Fergana Valley, Acted, IMPACT and International Alert, with funding from USAID, launched the STREAM program in 2022.[9] Research conducted as part of the initial project in the Ak-Suu, Isfayramsay[10] and Kozu-Baglan[11] watersheds and highlighted the interconnectedness of climate change, anthropogenic activities, and effective natural resources management.
In addition, the evidence-based, tailored approach, integration of advanced technologies, and community involvement findings underscored the need for comprehensive strategies such as the implementation of integrated water resources management to address the complex challenges posed by climate change in the greater Syr Darya River basin. Additional support from EuropeAID has allowed for the expansion of the STREAM program into the nearby Isfana watershed, shared by Tajikistan and Kyrgyzstan, and will be implemented by Acted, IMPACT, and Central Asian Alliance for Water and Ecology (CAAWE), to support local communities improve their overall effectiveness in managing water and other natural resources in the watershed. To do this, a comprehensive and updated understanding of sustainable climate implications on natural resource management in the Isfana watershed within the Fergana Valley is required.

Building upon lessons learned from its previous STREAM exercise, IMPACT conducted a detailed Area Based Assessment of natural resource management in the Isfana watershed (map 1),[12] particularly with regards to the impact of climate change focusing on hydrological and ecological processes in river, rainfed land, agricultural and pasturelands, forests, industry and other water and land uses.

Map 1. Geographical Location of the Isfana Watershed, 2024



The assessment aims to enhance understanding and knowledge of watershed capacities and subsequently propose effective strategies for mitigation and adaptation in irrigation water management for agriculture, pasture, livestock, and the sustainability of water and land resources in the context of evolving climate conditions.

4 Ferghana Valley Rural Enterprise Development Project, Report No: PAD3058, 2019
5 International Alert, The impact of climate change on the dynamics of conflicts in the transboundary river basins of Kyrgyzstan, Kazakhstan and Tajikistan, July 2021 – January 2022.
6 International Alert, The impact of climate change on the dynamics of conflicts in the transboundary river basins of Kyrgyzstan, Kazakhstan and Tajikistan, July 2021 – January 2022.
7 International Alert, The impact of climate change on the dynamics of conflicts in the transboundary river basins of Kyrgyzstan, Kazakhstan, and Tajikistan, January 2022.
8 Reuters, Kyrgyzstan, Tajikistan agree ceasefire after border clashes, 1 May 2021.
9 Concept note. Sustainable Transboundary Resource Allocation Mechanism for Peace (STREAM for Peace). Acted.
10 Ak-Suu & Isfayramsay Watersheds, Watershed Profile, Kyrgyzstan - Batken Region - Kadamjay District. August 2023
11 IMPACT, Kozu-Baglan Watershed, Watershed Profile, Kyrgyzstan - Batken Region - Leylek District September 2023.
12 Local Self Government (LSG) boundaries are from Ministry of Emergency Services and are obtained from Humanitarian Data Exchange. Boundaries are current as of 2021. River data was provided by Acted from an earlier 2015 analysis by HYDROC. Watershed boundary is from HYDROC 2015 and modified by IMPACT and Acted to account for irrigated areas in the north of the watershed.

Methodology Overview

Research was conducted in two LSGs: Razzakov and Toguz-Bulak of Leylek District, and Suluktu city of Batken Region between April 15-20, 2024. Suluktu city, an industrial city relying entirely on Isfana watershed for drinking water, lacks agricultural or pastoral land, and therefore the study focused only on collecting Disaster Risk Management (DRM) and essential cross-cutting information in Suluktu city. Key Information on the LSGs of interest is shown in table 1.

This assessment used a mixed-methods approach, combining Semi-Structured Focus Group Discussions (FGDs) and Mapping Focus Group Discussions (MFGDs) with local leaders from key resource management administrations and natural resources users at local and district levels, as well as quantitative Key Informant Interviews (KIIs) with village heads and activists. In addition, secondary statistics data from local branches of the National Statistical Committee of the Kyrgyz Republic,[13] were used, as well as Geographic Information Systems (GIS) analysis using remote sensing and hydrological modeling techniques[14] to provide a comprehensive understanding of natural resource management and climate change impacts within the Isfana watershed.

FGD and MFGD participants contributed to both semi-structured discussions and mapping exercises. Additionally, two specific FGDs were held on Women's Issues and Social Development to capture issues related to NRM. This qualitative approach provided contextual insights that quantitative methods alone could not capture, allowing for a deeper exploration of community-specific issues.

The Quantitative KIIs used a standardized Kobo tool to gather essential cross-cutting information at village level, mostly focused on DRM at a localized level (table 2). All interview participants were male, except for the Women's Issues and Social Development interviews.

Throughout data collection, IMPACT found that the planned number of participants was often insufficient to fully address all questions to be asked, especially on water infrastructure and land management. This was addressed through follow up interviews with additional local experts to fill in gaps in the analysis.

During the data collection, Kyrgyzstan was in the process of undergoing some LSG-level administrative reorganization,[15] and the research involved interviewing the local government departments and community leadership structures as they existed at that time of data collection in April 2024.

As noted, the research was additionally supplemented by an in-depth GIS analysis of environmental impacts and hydrological modelling, to provide a deeper understanding of the current and likely impacts that climate change and natural resource management were having on the watershed. This involved the use of remote sensing methodologies that analysed satellite imagery, meteorological data, and the latest climate change models to build an understanding of how, and where, land and water systems had changed due to the aforementioned NRM practices and climate change impacts highlighted by local experts in the FGDs and KIIs. In addition, data collected by the MFGDs was used to provide a spatial analysis for key issues identified by respondents. Table 3 below outlines the analyses conducted; a detailed explanation of each model and analysis can be found in annex I.

Table 1. Administrative and Geographical Characteristics of Research Areas

Name	Administrative Status	Elevation (meters above sea level)	Governing Structure	Center location	Total area (hectares)
Suluktu	City (Industrial city directly under Batken Region)	1,380	1 city	Suluktu city	1,733
Razzakov	City Hall, Capital of Leylek District	1,300	1 town and 6 villages	Razzakov City	29,402
Toguz-Bulak	LSG	1,534	6 villages	Ming-Jygach village	28,431

Table 2. Interview Type and Participants' Number

OID	Respondent Type	Interview Type	Razzakov	Toguz-Bulak	Suluktu	Participant numbers
1.	Water & Irrigation (Water managers, water specialists, water users associations (WUA), and village heads)	FGD/MFGD	X			17
2.	Agricultural Practices (LSG representative, land specialists, farmers, village heads)	FGD/MFGD	X	X		11
3.	Pastural Practices (LSG representative, pasture committee, land specialist, village heads, WUA, herders)	FGD/MFGD	X	X		10
4.	Forest Management (Leylek forest Unit staff)	FGD/MFGD	X			3
5.	Disaster Risk Management (Emergency managers)	FGD/MFGD	X		X	4
6.	Labor & Social Protection (Social Development Department staff)	FGD	X			2
7.	Women's Issues & NRM (Women councils, Social Development Department staff)	FGD	X	X		4
8.	Village Information (Village heads, activists)	KII		X	X	15
	Total:					**66**

13 National Statistical Committee of the Kyrgyz Republic.
14 The Soil & Water Assessment Tool
15 Decree of the President of the Kyrgyz Republic "On the Implementation of Administrative-Territorial Reform at the Level of Aiyl Aimaks and Cities of the Kyrgyz Republic in a Pilot Mode" dated December 29, 2023, No. UP-370, and the Resolution of the Cabinet of Ministers of the Kyrgyz Republic dated December 29, 2023, No. 735.

Table 3. Geospatial Data and Analysis Methods

OID	Map	GIS Method
1	Irrigation Network Infrastructure Status, April 2024	Participatory mapping
2	Change in Water Discharge, 1985-2065	Hydrological Modelling, Climate Modelling
3	Change in Precipitation, 1970–2060	Climate Modelling
4	Change in Temperature, 1970–2060	Climate Modelling
5	Advanced Drought Risk Analysis, 2020–2024	Remote Sensing
6	Pasture Degradation Change, 2000–2024	Remote Sensing
7	Earthquake Hazard Exposure, 2024	Secondary Data

Many households rely on remittances from family members working abroad in other countries for income, and most households have a large number of vulnerable dependents, including single parents with children and people with disabilities (graph 2).

All climate change and hydrological modelling used the latest Coupled Model Intercomparison Project 5 and 6 (CMIP5, CMIP6) models for climate change from the Intergovernmental Panel on Climate Change,[16] SSP5 - 8.5 or, "Fossil-fuelled development" scenario for its climate change analysis.[17] To analyze changes in water discharge for the SWAT analysis, the CMIP5 model was used to compare the baseline period of 1970–2000 with the projected period of 2061–2080, relying on data from the Water Weather Energy Ecosystem[18] due to the lack of ground data. Compared to CMIP6, although it is an older model, the CMIP5 model for RCP 8.5 produces similar projection results of carbon dioxide emissions to CMIP6 SSP5 - 8.5, although the projections are slightly lower over time and therefore more conservative. The CMIP6 SSP5 - 8.5 model was used to show changes in temperature and precipitation over time, comparing the baseline period of 1970–2000 with the projected period of 2061–2080. These models envision a set of different global climate change scenarios or, "Shared Socioeconomic Pathways" (SSPs) in which carbon dioxide emissions are managed to a greater or lesser degree, resulting in 5 distinct SSPs. IMPACT used SSP5 - 8.5 or, "Fossil-fuelled development" scenario for its climate change analysis.[19] This was the most severe, but also mostly commonly used scenario due to it representing something of a "baseline" group pathway where minimal to no policy efforts are made to reduce carbon dioxide emissions.[20] As a result, all climate change analysis should be interpreted in the context of a worst-case scenario should few efforts be made to reduce greenhouse gasses on a global scale.

16 CMIP6: the next generation of climate models explained
17 The SSP5 is defined fully as, "Fossil-fueled Development. Global markets are increasingly integrated, leading to innovations and technological progress. The social and economic development, however, is based on an intensified exploitation of fossil fuel resources with a high percentage of coal and an energy-intensive lifestyle worldwide. The world economy is growing and local environmental problems such as air pollution are being tackled successfully." (https://www.dkrz.de/en/communication/climate-simulations/cmip6-en/the-ssp-scenarios)
18 WETechData
19 The SSP5 is defined fully as, "Fossil-fueled Development. Global markets are increasingly integrated, leading to innovations and technological progress. The social and economic development, however, is based on an intensified exploitation of fossil fuel resources with a high percentage of coal and an energy-intensive lifestyle worldwide. The world economy is growing and local environmental problems such as air pollution are being tackled successfully."
20 Explainer: The high-emissions 'RCP8.5' global warming scenario


IMPACT, Part of water infrastructure, April 2023

Limitations:

- There are no water meters providing consistent data on the water flow of the Isfana river, and as a result, IMPACT was not able to identify a reliable source of water flow that could be used to calibrate the water flow findings of the Isfana river. The Water Users Association users (WUA) reported that they used basic methods for water distribution, and modern water meters were deemed too costly, especially in higher elevations where generators were needed, and cold weather could easily damage equipment. As a result, all trends on water levels from the SWAT analysis should be taken as indicative, rather than exact measurement.

- Similarly, the limited number of meteorological monitoring stations in Kyrgyzstan and the high costs associated with obtaining official meteorological data forced IMPACT to rely on satellite imagery from online, proprietary services.[21]
  However, previous research has noted that many meteorological observations collected during the 1990s and 2000s in Central Asia were often incorrect or done with inadequate equipment, so satellite imagery may be a more accurate set of data to use for the SWAT analysis.[22]

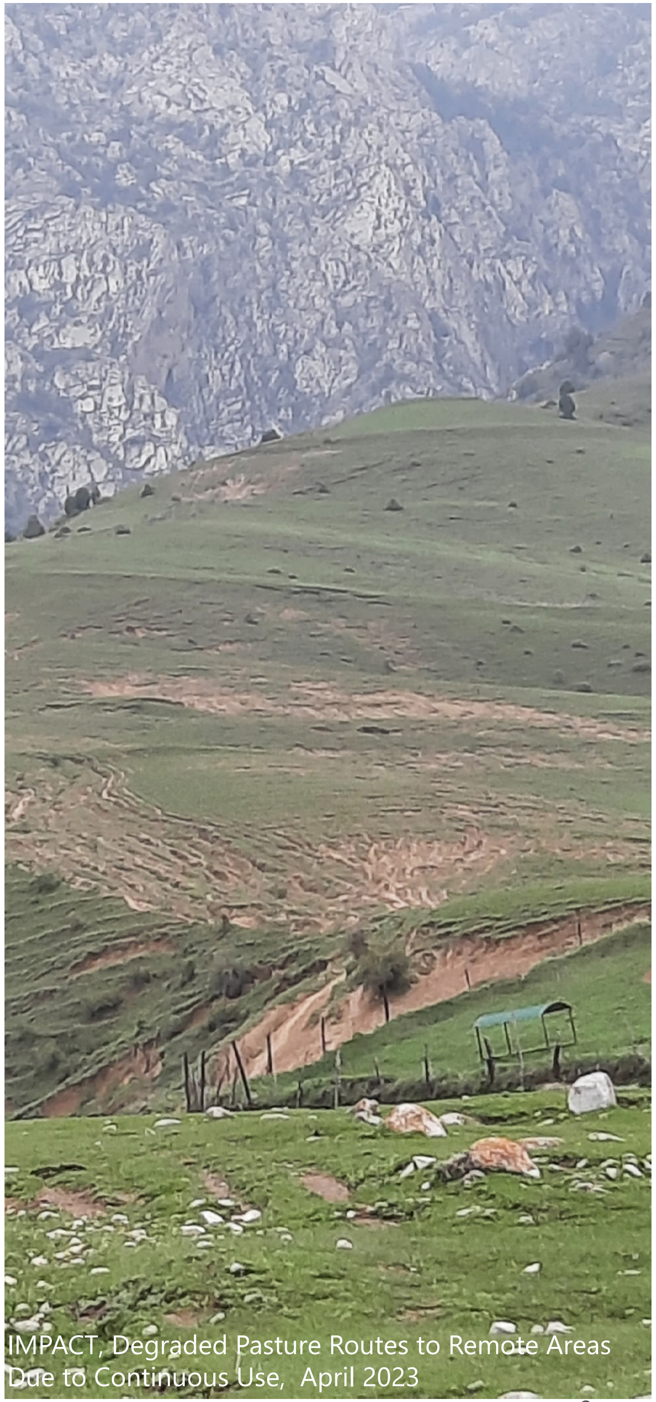
- Due to the absence of sufficient hydrological and meteorological data on the ground, IMPACT had to rely on available data from the Water Weather Energy Ecosystem.[23] CMIP5, while still valuable, provides less detailed and more cautious projections, particularly regarding carbon dioxide emissions and climate impacts, compared to CMIP6's advanced modeling capabilities. This limitation meant that a more conservative result assuming slightly lower carbon dioxide emissions were produced. If CMIP6 data is made available, a new analysis can be run, which will likely show slightly lower levels of water discharge over time.

- Due to a lack of high-quality available data, groundwater could not be incorporated into the SWAT analysis. Previous studies indicate an increasing reliance on groundwater to supplement surface water, though no current studies have been published that accurately estimate the availability of groundwater for individual watersheds and a lack of groundwater data for watershed modeling studies in Central Asia is common.[24] IMPACT plans to update the SWAT models when such datasets become available.

- For the majority of FGDs and MFGDs conducted, including on irrigation water, agriculture, and pastureland management, all respondents were men, restricting gender perspectives on NRM issues. While the Razzakov City Hall administration includes more women in social development departments, we were unable to fully capture women's challenges in farming or their views on natural resource management.

- The report findings might offer only a partial picture, as data collection was limited to specific focus groups rather than the entire population, potentially missing important perspectives on resource use, vulnerability, and adaptation strategies. Additionally, the results may have been impacted by a significant mudflow event that occurred shortly after the assessment was completed.

21 Water Weather Energy Ecosystem
22 Climate Risk & Vulnerability Assessment
23 Water Weather Energy Ecosystem
24 Sustainable Use of Groundwater Resources in the Transboundary Aquifers of the Five Central Asian Countries: Challenges and Perspectives

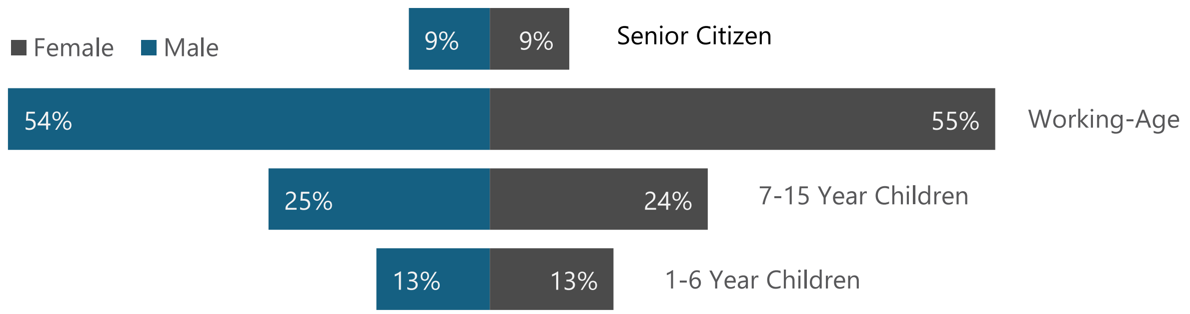

IMPACT, Degraded Pasture Routes to Remote Areas Due to Continuous Use, April 2023

1. Socio-economic environment

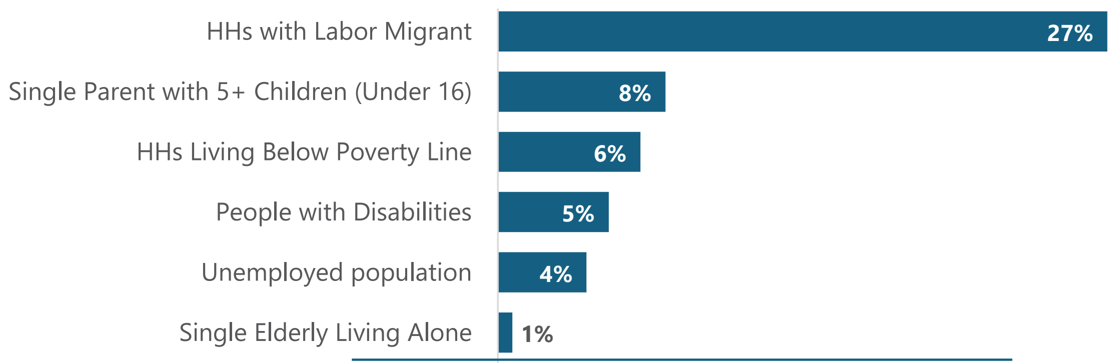
The Isfana watershed has a total population of 62,116 individuals spread across 13,239 households.[25] This data represents the officially registered residents according to Statkom records,[26] which may differ from the number of people actually present. As shown in graph 1, the number of men and women in each demographic group was relatively balanced.[27] Many households rely on remittances from family members working abroad in other countries for income, and most households have a large number of vulnerable dependents, including single parents with children and people with disabilities (graph 2).[28] Healthcare services were lacking and concentrated in the cities in the lower parts of the watershed. Toguz-Bulak LSG, in the upper watershed, lacked hospital and healthcare resources.[29] Graphs 3 and 4 show both the total healthcare facilities and resources in the watershed.[30]

25 A household was defined as a group of individuals living together in a housing unit (or a single individual) who share a common house, fully or partially pooling their individual budgets for shared expenses such as food and daily needs, or who have a common budget, whether they are related by kinship or not. Households and Families of Kyrgyzstan, 2011, Bishkek, National Statistical Committee of the Kyrgyz Republic
26 National Statistical Committee of the Kyrgyz Republic, 2023.
27 National Statistical Committee of the Kyrgyz Republic, 2023.
28 National Statistical Committee of the Kyrgyz Republic, 2023.

Graph 1. Population Gender Distribution by Age Categories in the Watershed, 2023.



Graph 2. Vulnerability Indicators of Households in the Watershed, 2023



HHs - 13,239; Population - 62,116; Working-age population - 33,617

The labor trends in the watershed are characterized by traditional gender roles, agricultural employment, and high rates of migration abroad for work. The reliance on remittances was reflected in the data from the Statkom,[31] which shows that at least 27% of households overall depend on remittances from family members working abroad to meet their needs. However, FGD respondents from the Social Development Department reported an even greater reliance on remittances within the community. They reported that remittances were crucial for the local economy; 70% of all households receive them, and 60% of households were reported to have at least one member working abroad or engaged in internal labour migration. It should be noted, however, that not all migration statuses are reported to the statistical committee, particularly in cases of internal migration, which may lead to an underrepresentation of the community's true reliance on remittances.

These remittances supported basic needs of households in the watershed, improved living standards, and gave access to social development, entrepreneurship, education, healthcare, and poverty reduction. In 2022, the population census showed that 32% of Kyrgyzstan's economically active population was living abroad.[32] High emigration rates, with 37% of migrants were driven by the desire to improve financial situations and earn more money. Most emigrants left for employment, while the rest departed for family reasons, education, and other purposes. The remittances provided significant support to households; according to the National Bank of Kyrgyz Republic in 2023, the share of remittances comprised more than 2.7 million USD.[33] The highest outflow was observed in the Batken region, where approximately 40% of the working-age population was reported to have migrated.[34]

According to the Statkom data,[35] agriculture is the main employment sector in the watershed with self-employed small-scale farming,

29 National Statistical Committee of the Kyrgyz Republic, 2023.
30 National Statistical Committee of the Kyrgyz Republic, 2023.
31 International Migration of Population by Countries of Origin and Destination - 2022
32 International Migration of Population by Countries of Origin and Destination - 2022
33 Migration Situation Report Kyrgyzstan, 2023, IOM
34 Situational Report on Migration in Kyrgyzstan as of December 2023, IOM UN Migration, 2024.
35 National Statistical Committee of the Kyrgyz Republic, 2023.

Graph 3. Social Facilities Numbers in the Watershed

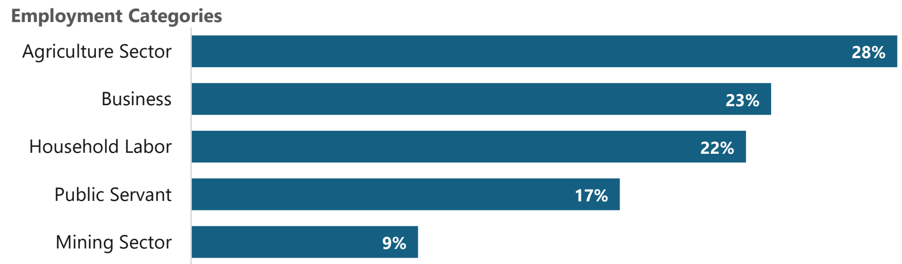
Graph 4. Healthcare Resources (numbers)

which was reported to be increasingly vulnerable to climate change. The vast majority of the workforce (83%) was reported to be self-employed, mainly within the agricultural sector, which is heavily dependent on climate change conditions, threatening livelihood stability in the district. Suluktu city had more formalized hired positions – 66% in the mining sector. Over the past 20 years, the service sector has expanded in the watershed, creating jobs in small businesses, tourism, and transportation, particularly in Razzakov City Hall, the Leylek district's center. However, these opportunities are mainly only available in urban areas in Razzakov City Hall and Suluktu city, where public bodies and small businesses employ the population. In villages, a larger proportion of people are self-employed, primarily in agriculture, crop cultivation, and livestock breeding. Graph 5 illustrates the distribution of employment categories by sector within the watershed.[36]

Water management authorities reported that the main sources of water for the Isfana river and irrigation network came from a combination of natural springs, snowmelt, glaciers rivers, and wells; village leaders from Toguz-Bulak LSG villages also reported hail as a water source. Water from springs and wells was reported to be available year-round and increased

36 National Statistical Committee of the Kyrgyz Republic, 2023.

Graph 5. Employment Categories by Sector in the Watershed, 2023



IMPACT, Remote pastureland, April 2023

during rainy weather, while snow and glacier-fed water was available from May to late September/ early October, depending on weather conditions. No villages reported relying on a single source for water.

Most canals in Isfana river network were reported to have been constructed between 1962 and 1971, with an expected lifespan of up to 25 years, which has long since been surpassed, and are in dire need of repair; 79% of villages leaders reported that their village relied on the irrigation network, but only 7% of villages were receiving enough water to meet village needs. The watershed has a total length of 341.33 km of canals, with approximately 208.7 km (61%) identified by water management authorities as needing rehabilitation with much of the damage concentrated in Lotok canal. This, along with the 118.1 km of earthen ditches that make up WUA-level networks in villages, which are not concreted, were reported by water managers to have up to 60% water loss. Details of this are shown in table 4 and map 2 in the following section.

2.1. Irrigation Water Availability in the Watershed

The lack of availability of irrigation water was reported to be a major challenge in the watershed, with the level of severity reported to be varying across different areas. Village leaders identified the lack of water availability (79%) and declining soil fertility (57%) as the most pressing challenges for farmers. Irrigation in the watershed relies mainly on rivers and borehole water (map 2), managed at the LSG level by WUAs typically with one representative per LSG.

These WUAs play essential roles in equitable water distribution, infrastructure maintenance, and conflict resolution.

Despite expanded responsibilities in integrated water resources management, many WUAs face financial difficulties, relying on irrigation service fees, government support, and donor funding to sustain operations, yet only 68% are self-sufficient across Kyrgyzstan.[37]

Map 2. Isfana watershed irrigation network infrastructure functionality according to local water authorities, April 2024

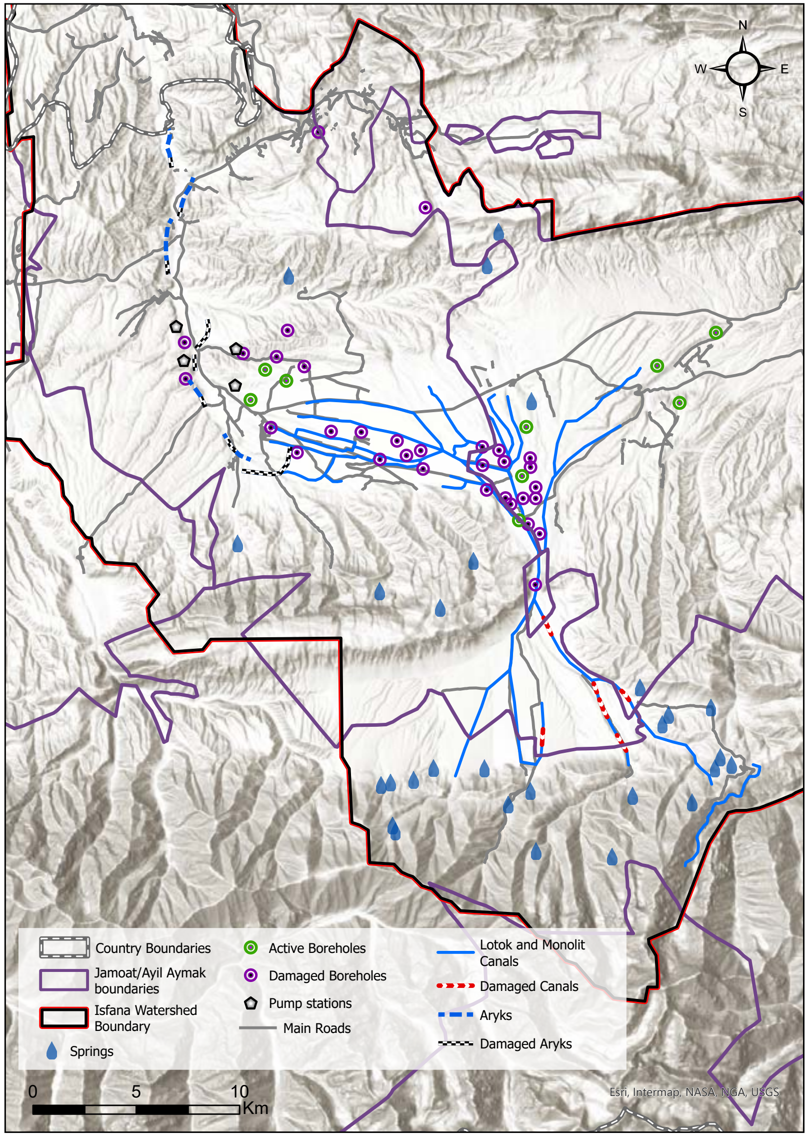


Table 4. Isfana Watershed Irrigation Network Infrastructure by Repair Status, April 2024

Water infrastructure type	Name of locations			Total Lenth (km)		
	Toguz-Bulak LSG	Razzakov City Hall	Suluktu city	Total length of canal infrastructure	Total length of canal infrastructure that needs to be replaced	Percentage of canal infrastructure that needs to be replaced
Lotok canal	18.20	16.06		34.26	23.00	67%
Monolit canal	149.00	24.27		173.27	8.60	5%
Pipes	5.20	10.50	36.00	51.70	6.3	12%
Earth ditches	40.80	77.30		118.10	118.10	100%
Total	**213.20**	**128.13**	**36.00**	**341.33**	**208.70**	**61%**
Wells	21	13		34	24	71%
Pump stations	2	4		6	4	67%
Sluice gates	1	12		13	13	100%

Village leaders in Razzakov City Hall mostly reported moderate challenges with water availability, though a minority acknowledged significant or very significant challenges. Populations in Toguz-Bulak LSG were reported to experience more severe water scarcity. This was due to a variety of reasons, mainly linked to climate change and inadequate water management methods and infrastructure. Changes in weather patterns were reported to have greatly reduced the amount of water available for agriculture in the watershed, mainly through a reduction in snowfall, changes in glacial melt, and increasingly irregular precipitation patterns.

Many water management methods were also reported to be inadequate in managing the changes in water availability; water resources were reported to be prioritized for upstream villages, leading to shortages in downstream villages, notably in Ak-Bosogo in Razzakov City Hall and Aibike in Toguz-Bulak LSG, creating tensions between communities over water usage. Flooding from heavy rains and melting glaciers was also reported to have impacted irrigation and livestock due to erosion and infrastructure damage, threatening the stability of the distribution network. And most local water managers reported a lack of necessary resources to rehabilitate and improve the water network themselves.

Households in both LSGs were reported to have used a variety of different irrigation techniques, including 1) traditional, manual,[38] surface,[39] and modern irrigation techniques, such as sprinkler[40] and drip irrigation[41] across the watershed. Drip irrigation was reported to be known by farmers in the watershed, but less common; only 36% of surveyed villages leaders reported drip irrigation being used in their villages, of these, only 1–5 farmers in their village had adopted the practice due to its high cost. Households in Toguz-Bulak LSG were also reported to have employed a broader range of approaches than in other parts of the watershed, including furrow irrigation and sprinkler irrigation. Flood irrigation[42] was reported to only be used in Toguz-Bulak LSG.

IMPACT, The Isfana River collects its water from natural springs, April 2023

37 CABAR Asia. (2022). Kyrgyzstan: A Country of Water Resources Still Fails to Provide Drinking Water to Population. Retrieved from https://cabar.asia/en/kyrgyzstan-a-country-of-water-resources-still-fails-to-provide-drinking-water-to-population
National Water Resources Management Project (NWRMP). (2021). National Water Resources Management Project Report, Q1 2021. Bishkek: Department of Water Resources, Ministry of Agriculture, Water Resources, and Regional Development of Kyrgyz Republic.
38 Manual Irrigation: Traditional Irrigation involving manual labor to transport and distribute water to crops. Precision Agriculture: Evolution, Insights, and Emerging Trends (2003). Chapter 6: “Precision Irrigation: Challenges and Opportunities”.
39 Surface Irrigation: furrow irrigation method was used, where water is distributed to the crop field through small ditches, or furrows.
40 Sprinkler: System that sprays water over crops.
41 Drip Irrigation: system that delivers water directly to the root zones of plants through small emitters, providing water in the form of droplets.
42 Flood Irrigation: where water was distributed over the surface by gravity.

3. Climate Change

To better understand the impacts of climate change on water availability in the Isfana Watershed, IMPACT conducted a SWAT (Soil and Water Assessment Tool)[43] analysis to produce a hydrological model of the Isfana watershed. The datasets and specific methodology are developed in annex I. Historical data was used to produce a baseline flow for the periods of 1985–1990 and 2000–2005, to measure average water flow across the year in cubic meters per second (m^3).

Following the establishment of a baseline, projections of the expected annual average water flow for the periods of 2035–2040 and 2065–2070 were conducted. Based on the available climate data for hydrological analysis IMPACT utilized the SWAT methodology to run the model using the CMIP5 RCP-8.5 scenario.[44] It should be noted that, due to the lack of consistent water monitors in the Isfana watershed, the flow data could not be calibrated to observed waterflow, and therefore all findings should be taken as indicative.

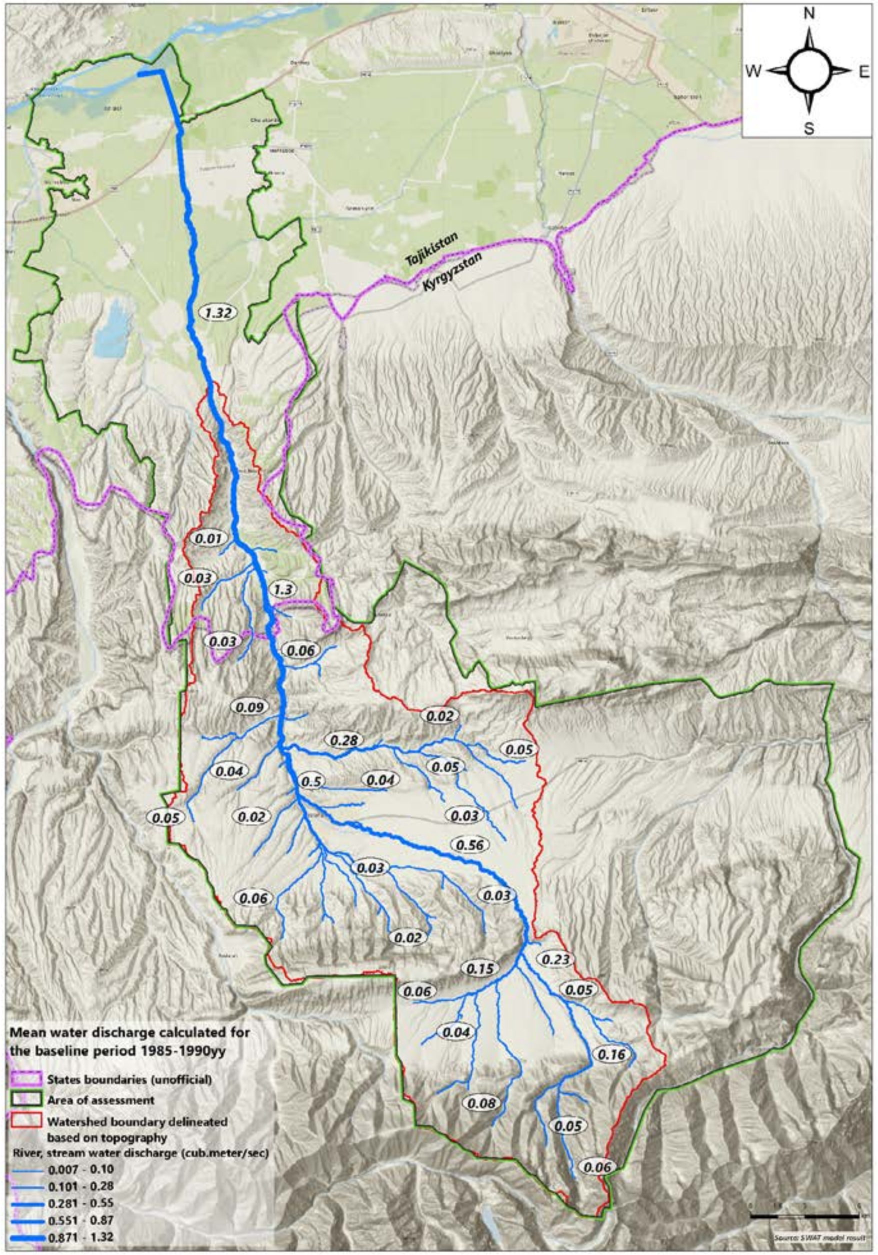
The analysis found in map 3. Between the two baseline periods (1985–1990, 2000–2005) the overall flow of water in the Isfana river decreased from $1.32m^3$ to $0.82m^3$, a reduction in 38% of the river's total flow volume. Climate change projections predicted a much slower decline for both forecasting periods (2035–2040 and 2065–2070), with a slight increase to $0.89m^3$ in 2035–2040, and falling to $0.71m^3$ by 2065–2070. This represents a 46% decline in water volume since the initial 1985–1990 baseline period, though only a 13% decline since the 2000–2005 period, suggesting a steadier decline since the beginning of the 21st century.

The flow patterns suggest that, in a scenario without major reduction in carbon emissions on a global scale, the Isfana watershed is rapidly approaching, or has reached, "peak water" in which water from the glaciers feeding a watershed begin to melt at a rate in which they can no longer regain their mass each year, leading to temporary increases in a watershed's volume as glacial runoff increases, following by a permanent decline in glacier mass and runoff.[45]

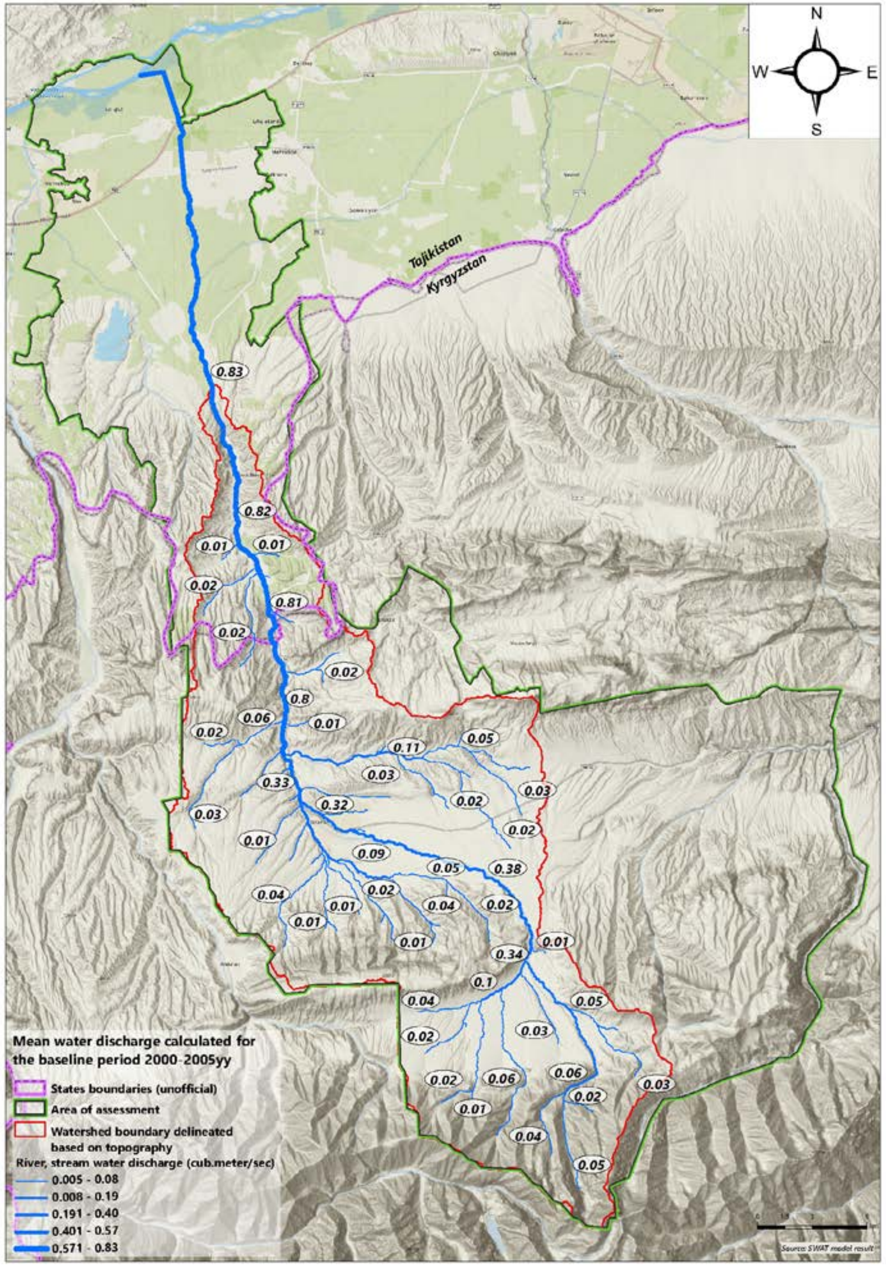
While rainfall is projected to increase during this same period of time (see below) the SWAT modeling found that it is not enough to counteract the reductions in snowfall and glacier runoff, leading to an overall decline in water discharge. Due to the aforementioned lack of measured data on the ground, additional research is needed to verify these findings. However, discussions with water experts on the ground confirmed the overall trend of the large decline in water volume between the two historical baseline periods, lending validity to the findings at an indicative level.

43 SWAT is an extension to the ArcGIS software developed by Texas A&M university to conduct detailed climate change modeling of river basins.
44 Although climate models have been updated to CMIP6, which uses 5 Shared Socioeconomic Pathways, the two RCPs under CMIP5 are roughly equivalent to SSP1 and SSP5, the most and least optimistic global carbon emissions scenarios.
45 Mountain glacier melting

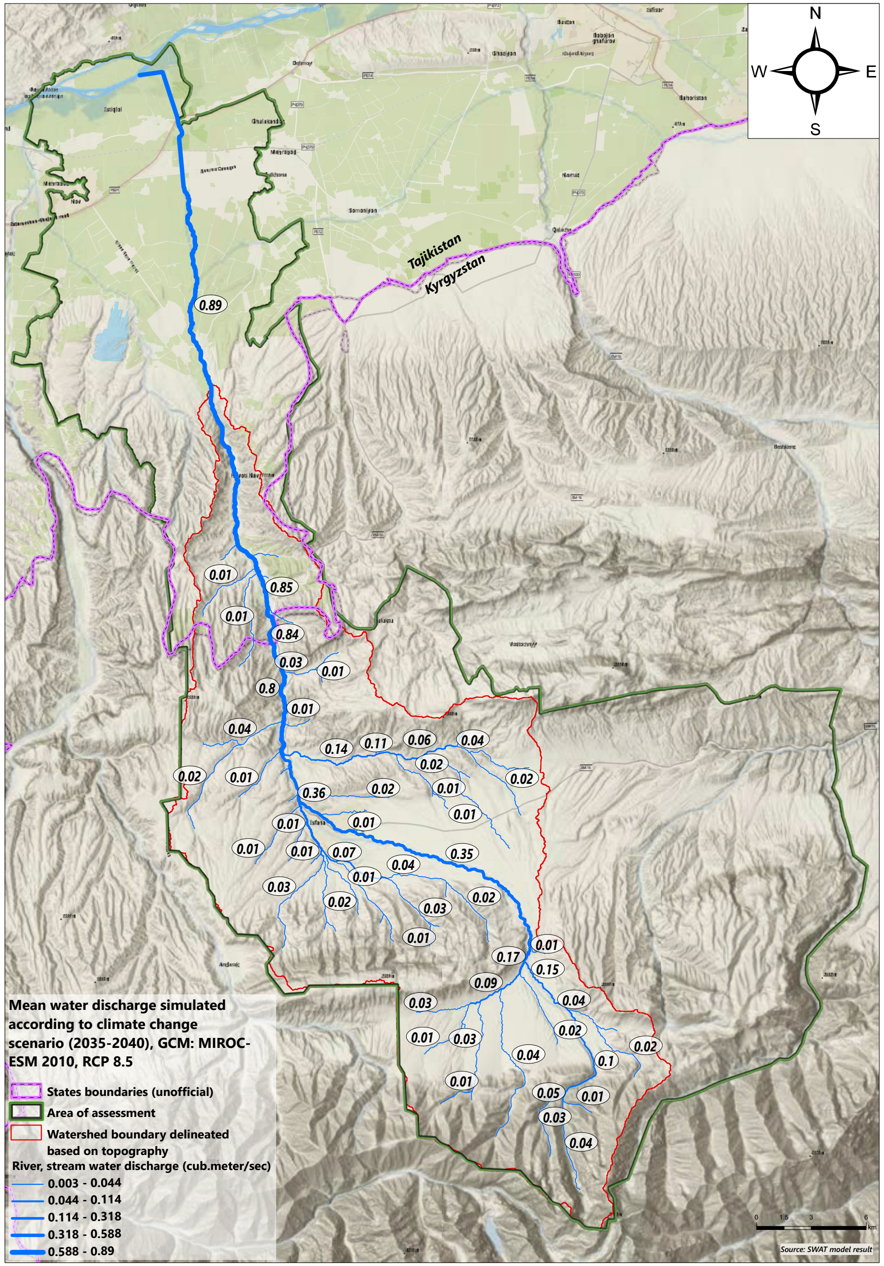
Map 3. Hydrological Analysis Flow 1985-1990



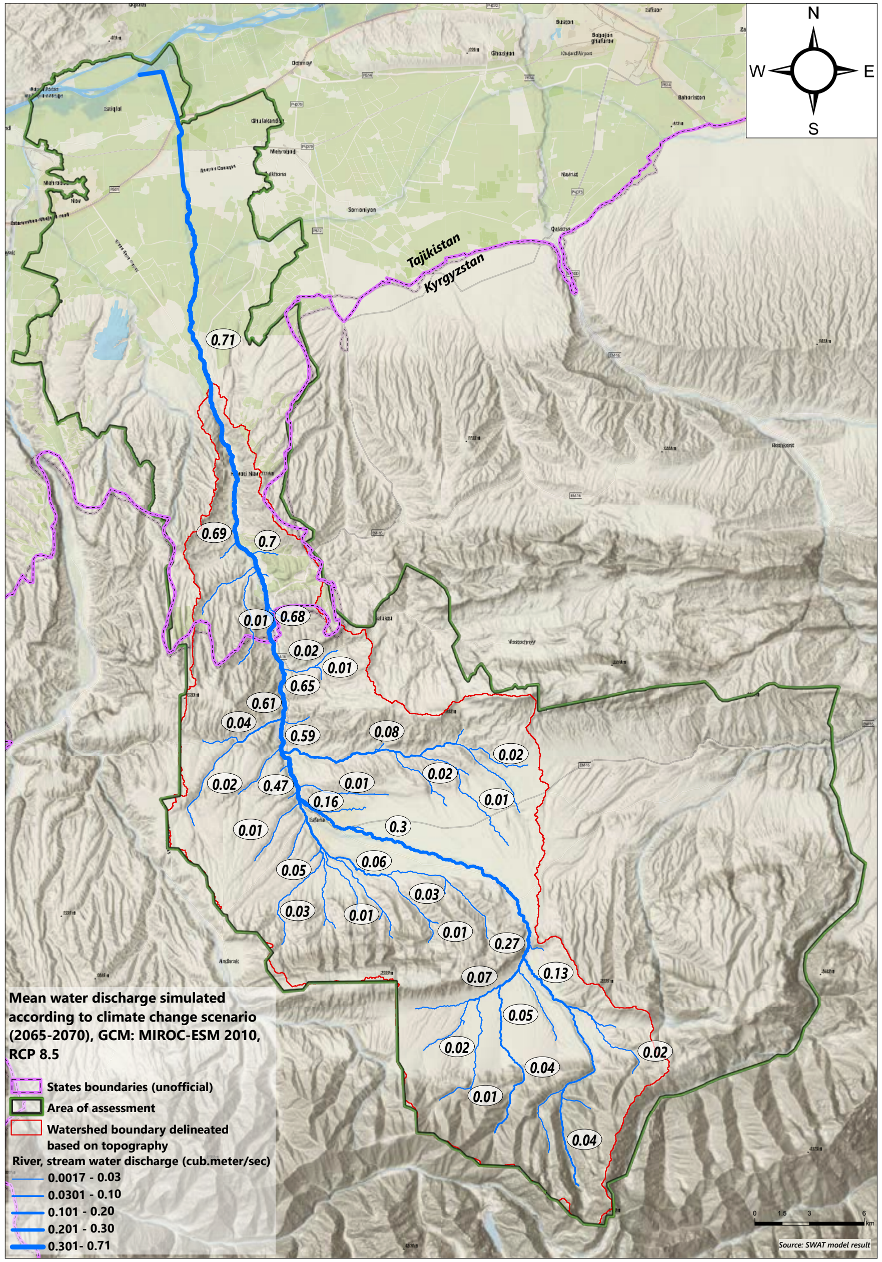
Map 3-1. Hydrological Analysis (Flow 2000-2005)



Map 3-2. Hydrological Analysis (Flow 2035-2040)



Map 3-3. Hydrological Analysis (Flow 2065-2070)



In addition to hydrological modeling, IMPACT conducted an analysis of climate change using the WorldClim dataset, which analysis climate change according to each of the five CMIP6 climate change SSPs through 19 bioclimatic variables. This was done using baseline data from 1970 – 2000 and used to make projections. In maps 4 & 5 below, IMPACT analyzed the respective estimated changes in temperature projections between 2000 – 2080, using the SSP5 (RCP 8.5) scenario for changes in temperature in the hottest 3 months of the year, and annual precipitation change.

The results show that, under an SSP5/RCP8.5 scenario, the temperature in the Isfana watershed is likely to rise between 3.9°C and 4.3°C during the hottest months of the year comparing the baseline period (1970-2000) with the future projection period (2061-2080), a major increase in temperature that is likely to have a large impact on crop yields and livelihoods within the region. This is likely to be worse in the flat, lower parts of the watershed, where most of the irrigation infrastructure and industrial agriculture is located.

Over the same period, annual precipitation is likely to increase by 3.6 to 12.1 millimeters per year, depending upon the watershed locations. These increases are more likely to be in the upper parts of the watershed, which will feed the watershed's main river. Rainfall will probably be lower in the predominantly flat agricultural areas, where it is most needed for crop production. The increases in annual precipitation are likely to be uneven, with wet months becoming wetter, and dry months becoming drier. These extremes will presumably make crop growth, particularly in rainfed lands, more difficult, as rainfall patterns become more irregular and less predictable.

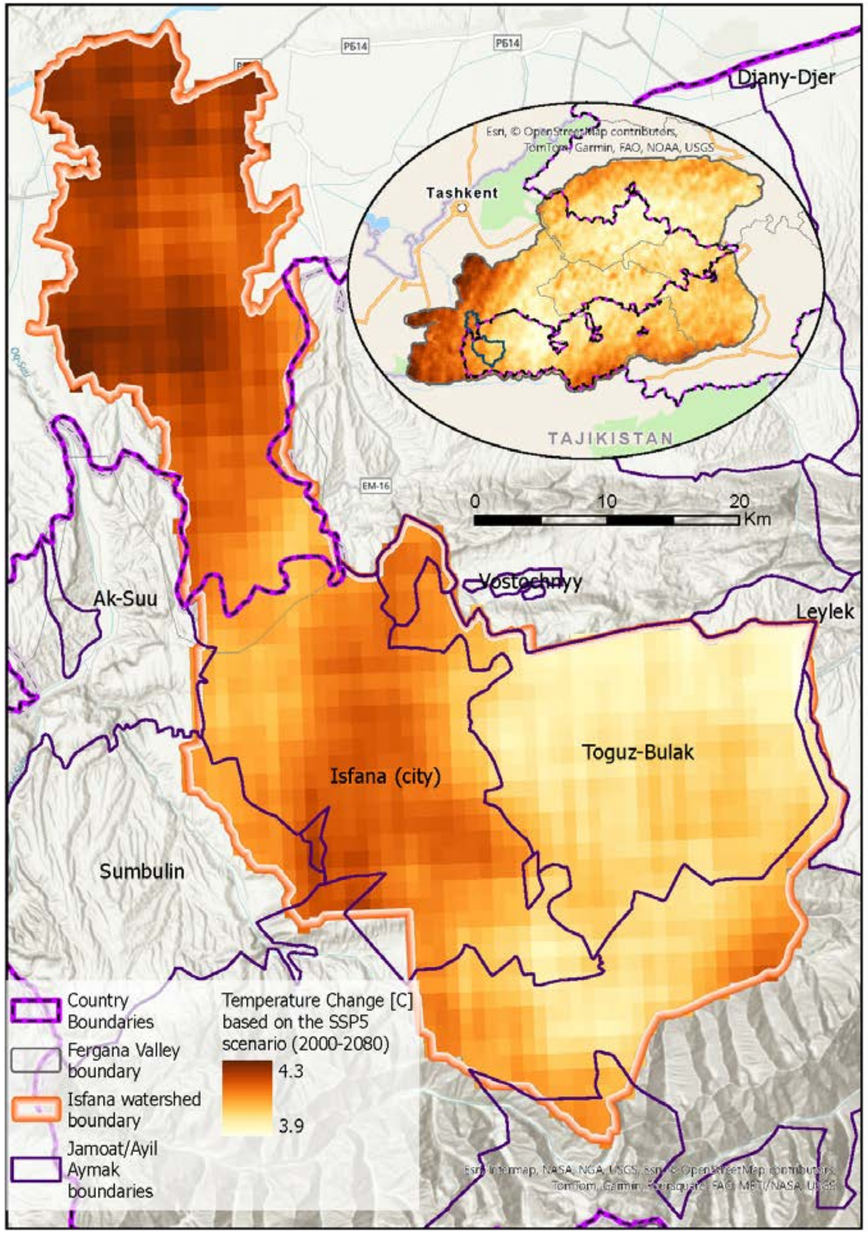
These trends are part of a larger projected pattern in the Fergana Valley. While the eastern parts of the Fergana Valley, where the Syr Darya watershed originates, are likely to see lower temperature increases and greater increases in precipitation, while the western parts of the valley, where the Isfana watershed is located, are likely to see much greater increases in temperature and lower increases in precipitation. These trends make populations in the western parts of the valley more vulnerable to climate change, and in greater need of support and assistance.

In addition to the hydrological analysis, IMPACT conducted an additional analysis of snow cover change using data from the GLIMS glacier database and satellite imagery. This is important, as previous research found that the vast majority of water in Watersheds in Central Asia comes from snowmelt.[46] A full technical description of the analysis can be found in annex I.

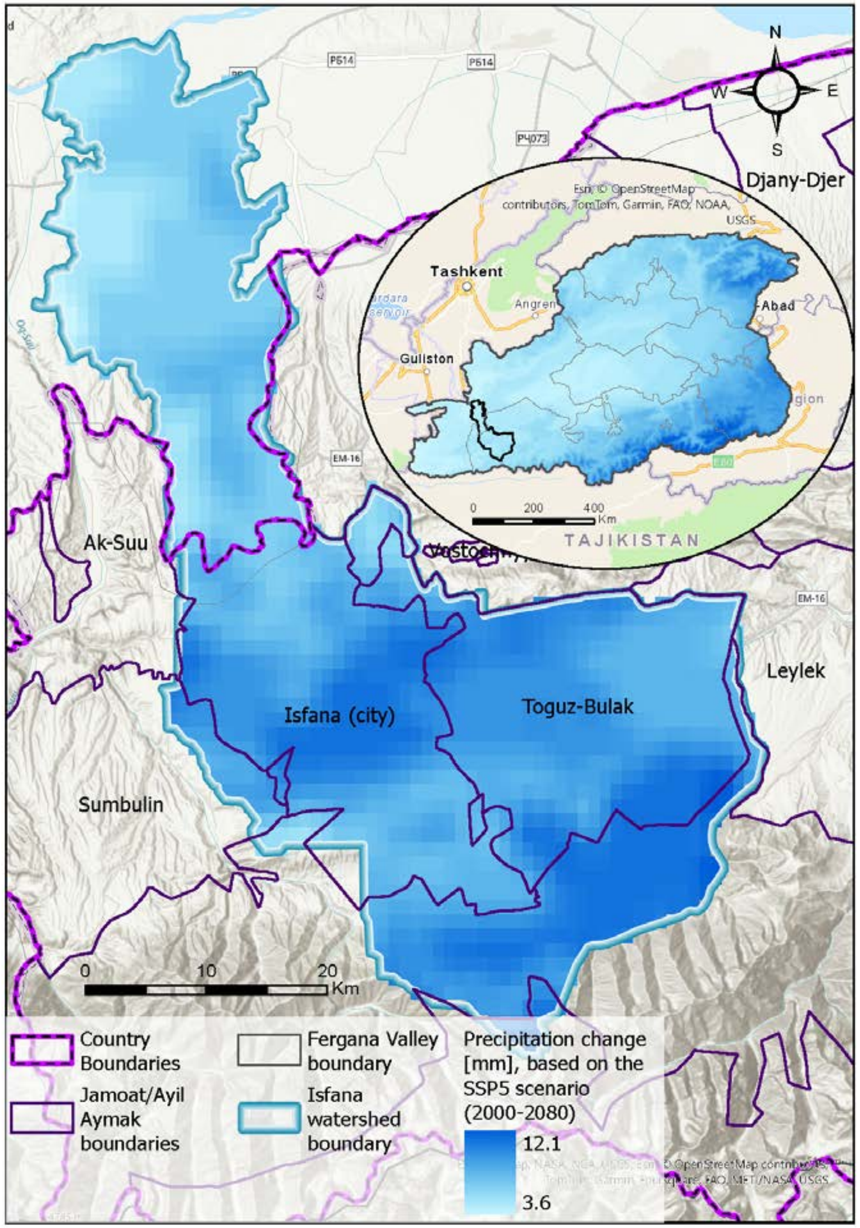
The average snow value for the period mid-October to mid-February was used for analysis using a Normalized Difference Snow Index (NDSI). This period was selected as it is the high point of snowpack presence in watersheds in Central Asia. Comparison

46 Modeling of Hydrological Systems in Semi-Arid Central Asia

Map 4: Changes in Temperature Between Baseline (1970–2000) and Projection Period (2061–2080)



Map 5. Changes in Precipitation Between Baseline (1970-2000) and Projection period (2061-2080)

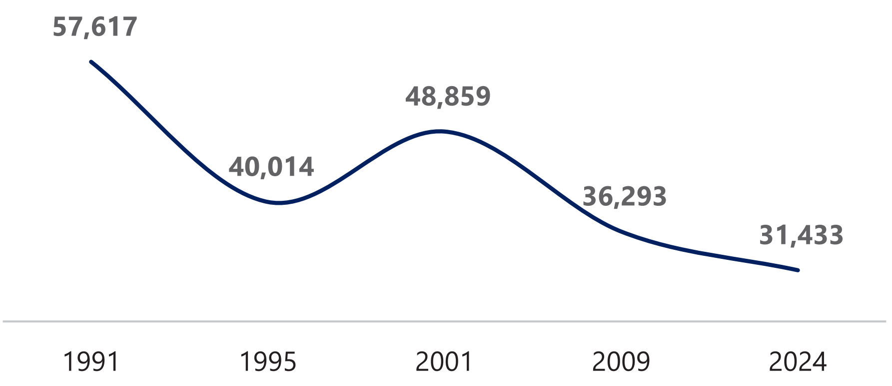


of images from 1991, 2009, and 2024 revealed a significant 46% reduction in snow cover (see map 6, graph 6) over the entire analysis period, with most of the decline occurring after 2001, though a very sharp drop in snowpack was also recorded between 1991 and 1995, with a reduction of 31% in just 4 years. As snowmelt is usually the largest source of water flow (65-75% snowmelt, 23 % precipitation, and 2 % - 8 % glacier melt approximately of total water flow in the Syr Darya watershed),[47] this has likely had a major negative impact on overall water flow in the watershed, and can explain most of the forecasted decline in river volume shown in the SWAT modeling.[48]

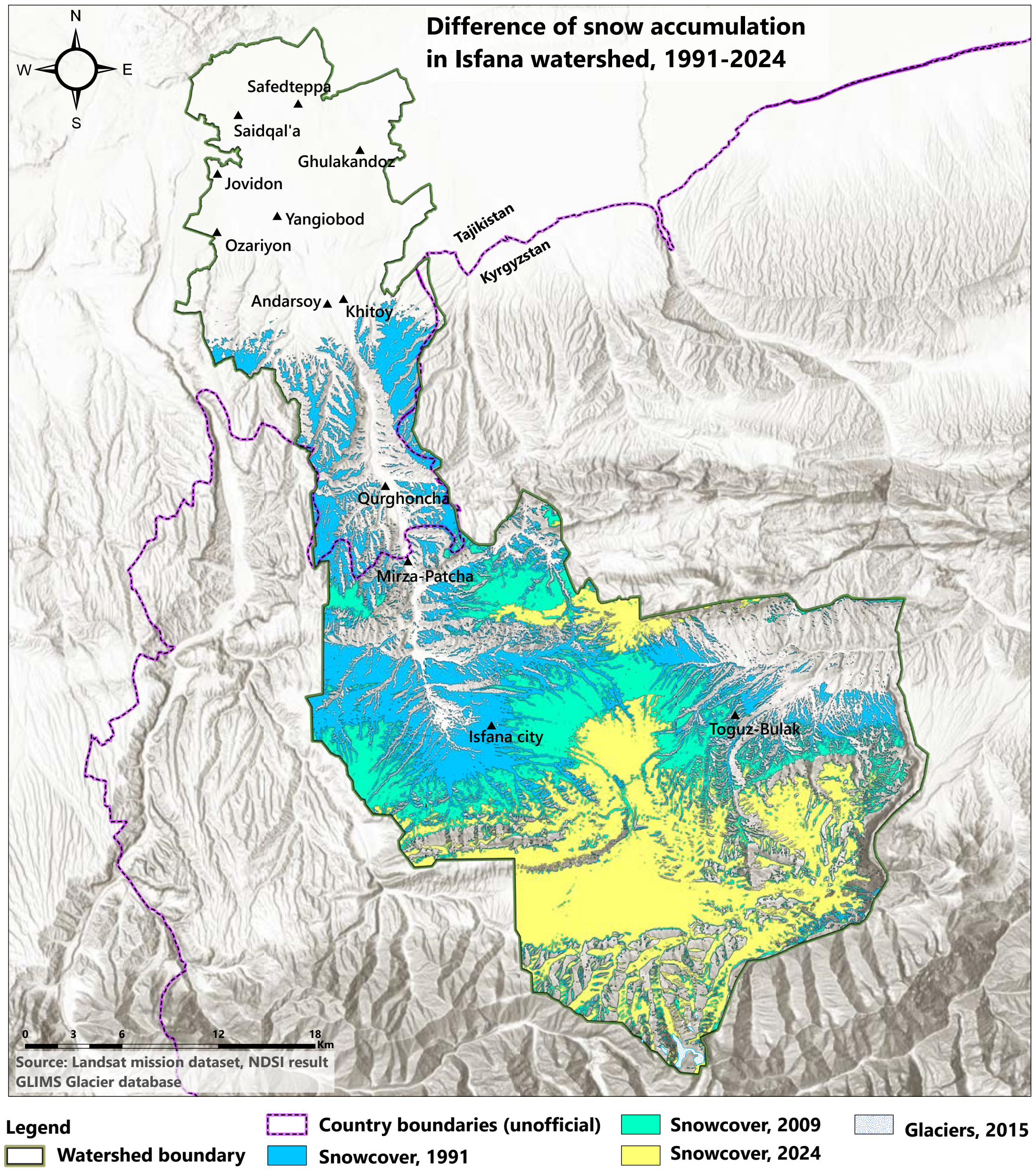
Glacial melt is generally a smaller contributor to waterflow in watersheds of the Syr Darya watershed (2–8%),[49] and due to a lack of many glaciers in the watershed itself, IMPACT did not conduct an analysis specifically on changes in glacier volume.

47 Modeling of Hydrological Systems in Semi-Arid Central Asia - 6 Snow and Glacier Data
48 Snow Situation in Mountainous Central Asia
49 Runoff from glacier ice and seasonal snow in High Asia: separating melt water sources in river flow

Graph 6. Snow Cover Area (in ha), 1991–2024



Map 6. Snow Cover Analysis, in Hectares, 1991–2024



4. Agricultural Practices

Agriculture is the primary livelihood source in Razzakov City Hall and Toguz-Bulak LSG; most land is dedicated to farming and livestock. Suluktu city is the exception, as its economy is focused on mining and lacks notable agricultural or pasture lands. Therefore, the following sections only cover Razzakov City Hall and Toguz-Bulak LSG, where statistics show that an average 26% of the total land was used for agriculture.[50]

Agricultural land in the watershed is divided into rainfed and irrigated land, with a majority of agriculture in the watershed conducted on rainfed lands. These lands are typically more vulnerable to seasonal and climatic shifts, given their reliance on consistent, seasonal rainfall.

Graph 7 illustrates the agricultural land type composition across the watershed. Razzakov City Hall was reported to have more diverse land use and greater irrigation capacity, whereas land in Toguz-Bulak LSG was more suited for pasture.

According to LSG sowing and harvest records, wheat and barley were the most common crops in the watershed, and were grown on both irrigated and rainfed lands, with barley being more concentrated in rainfed areas. In addition, rainfed land is used for perennial grasses or hay, and smaller portions for oilseed and leguminous crops. Some land was left fallow to maintain soil health.

Communities in the watershed generally cultivated similar crops, with no distinct patterns of crop diversification, however there were key differences in how they allocated and depended on irrigated versus rainfed lands:
Lower Elevation Area Agricultural Practices (1,100–1,300 meters above sea level (m a.s.l.): Areas (table 5),[51] such as Samat, Ak-Bosogo, and Chymgen, show higher crop diversity, although these parts support a wide variety of crops, the areas dedicated to each are relatively smaller compared to higher elevations.

Middle Elevation Area Agricultural Practices (1,300–1,500 m a.s.l.): In Razzakov, Tailan, and Aibike, there was a significant expansion in areas dedicated to staple crops such as wheat, barley, and potatoes.

Upper Elevation Area Agricultural Practices (1,500 m a. s. l. and above), areas like Toguz-Bulak, Kara-Bulak, Golbo, and Ai-Kol exhibit limited crop diversity. These areas primarily focus on staple grains, such as wheat and barley, while other crops, like fruits and vegetables, are either reduced or absent. Elevations of agricultural areas were obtained from Google Maps.[52]

Graph 7. Distribution of Agricultural Land in the Watershed, 2023

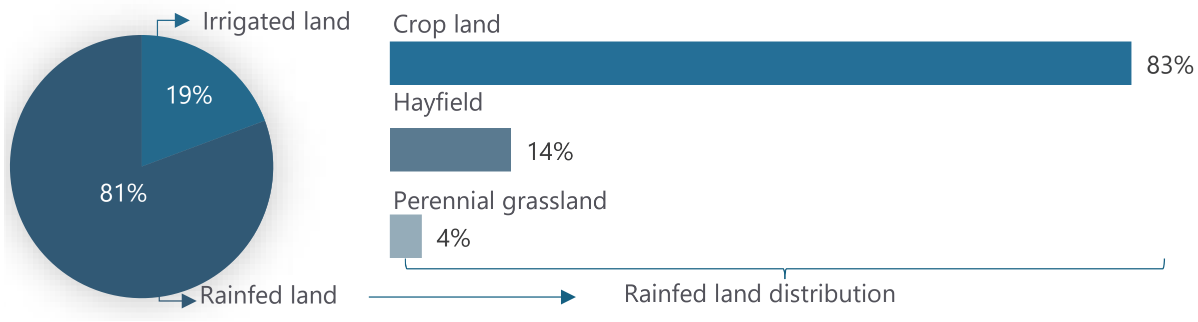


Table 5. Proportion of Crop Allocation, 2023 and Agricultural land Elevation (m a.s.l.) in LSGs, 2024

LSG name	Crop type	Elevation m a.s.l.	Wheat	Barley	Maize	Leguminous (beans)	Oilseed crop	Potatos	Vegetables	Fruits and berries
Razzakov	Samat	1,110								
Razzakov	Ak-Bosogo	1,125								
Razzakov	Chymgen	1,180								
Razzakov	Golbo	1,200								
Razzakov	Razzakov	1,300								
Razzakov	Tailan	1,350								
Toguz-Bulak	Aibike	1,350								
Razzakov	Ak-Bulak	1,450								
Toguz-Bulak	Toguz-Bulak	1,520								
Toguz-Bulak	Gordoi	1,520								
Toguz-Bulak	Ming-Jygach	1,540								
Toguz-Bulak	Kara-Bulak	1,585								
Toguz-Bulak	Ai-Kol	1,760								

50 National Statistical Committee of the Kyrgyz Republic, 2023.
51 National Statistical Committee of the Kyrgyz Republic, 2023.
52 Google Earth Pro. Google LLC, 2024.

Irrigation Patterns for Main Crop Cultivation

Both wheat and barley occupied substantial areas across the watershed. In irrigated land irrigation frequency typically ranges from one to two times across elevations, depending on water availability. In lower elevation, such as Ak-Bosogo and Ak-Bulak, crops are irrigated only once, whereas in middle and upper elevations like Razzakov, they receive irrigation twice. Potatoes and vegetables, being high water-demand crops, generally required 4–5 irrigation cycles across various elevations.

Potatoes were primarily concentrated in upper elevation areas, while vegetables were more commonly found in lower and middle elevations. Maize required moderate irrigation, typically 2–4 cycles across elevations, and was predominantly found in lower to middle elevations. Leguminous and oilseed crops were grown in rainfed areas, mostly in lower to middle elevations. Fruits and berries also had moderate irrigation needs, around 2–3 cycles, and were distributed across the watershed, with a concentration mainly in lower to middle elevations.

A full distribution of crops by land type in 2023[53] is shown (due to the smaller proportions, not all crops grown were included in the graph 8, so percentages may not add up to 100%) in graph. Due to its lower elevation, which leads to higher temperatures, sowing and harvesting come slightly earlier in Razzakov City Hall than in Toguz-Bulak LSG. Toguz-Bulak LSG grows winter wheat during winter months, and both LSGs grow vegetables and fruit trees, including apples orchards.

Local agriculture experts identified 6 major crops grown in the Isfana watershed, divided by season. Wheat, barley, and corn were spring crops that were reported to be sown between February and April and harvested between July and October. Potatoes, vegetables, and sunflowers, summer crops, were reported to be sown from April to May, and harvested from July to September.

Figure 1 shows the details on sowing and harvesting periods,

53 National Statistical Committee of the Kyrgyz Republic, 2023.

Graph 8. Crop Cultivation Distribution in Agricultural Land, 2023

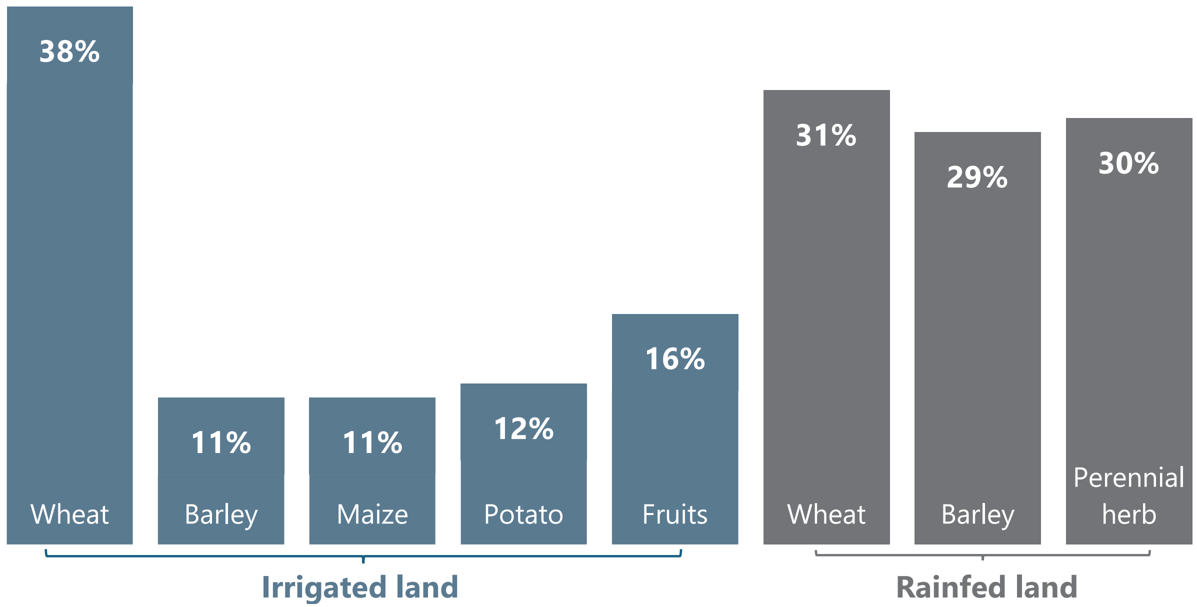
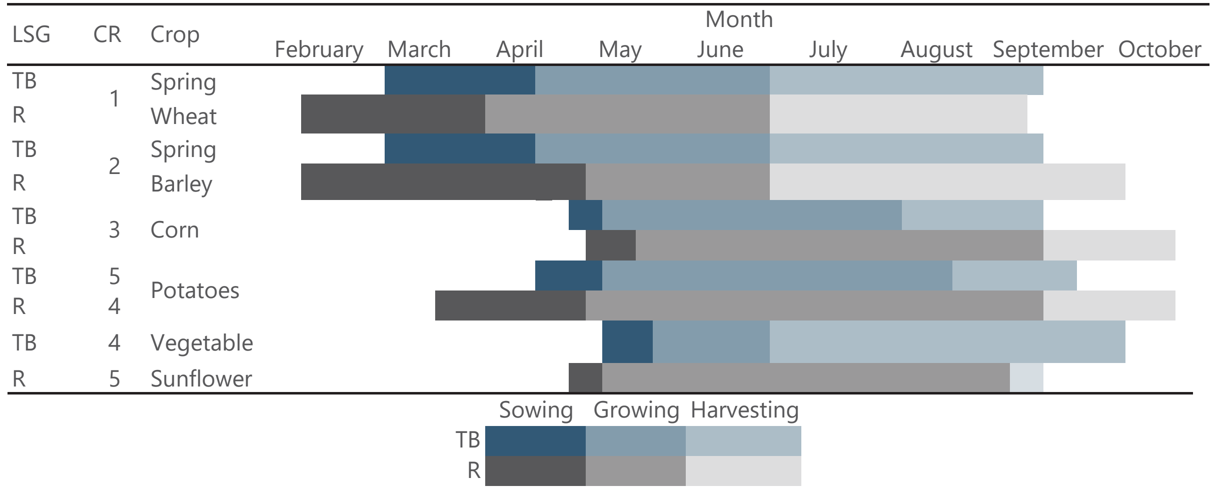


Figure 1. Crop Sowing and Harvesting Periods in the Watershed



Note: R – Razzakov; TB – Toguz-Bulak; CR – crop rank 1 (top) to 5.

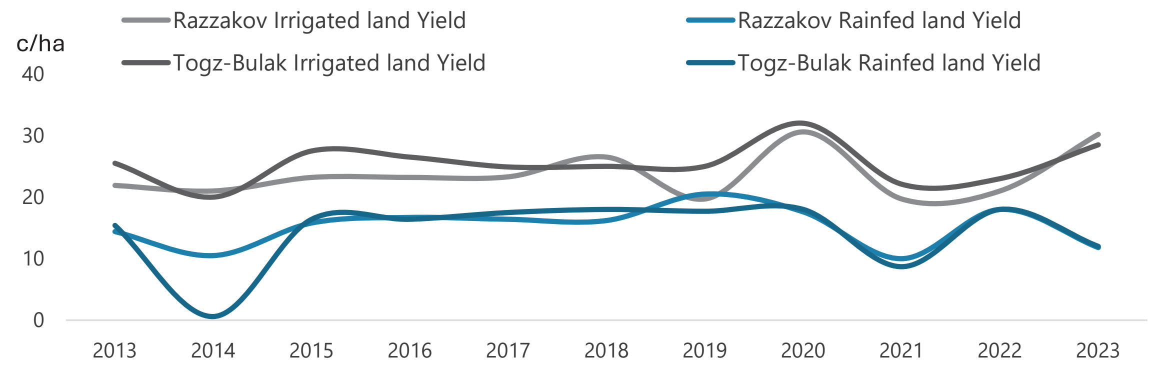
and the importance of each crop according to local agriculture experts.

Wheat and barley were reported by local agricultural experts to be particularly sensitive to environmental conditions, especially climate changes. Irrigated land was found to consistently produce more stable and higher yields for these crops compared to rainfed land, despite some fluctuations caused by varying climatic conditions. In 2021, wheat and barley yields were at their lowest (graph 9, 10), coinciding with a severe drought in Kyrgyzstan. The Advanced Drought analysis Index (ADRI) analyses revealed that 76% of the watershed area was affected by these drought conditions.

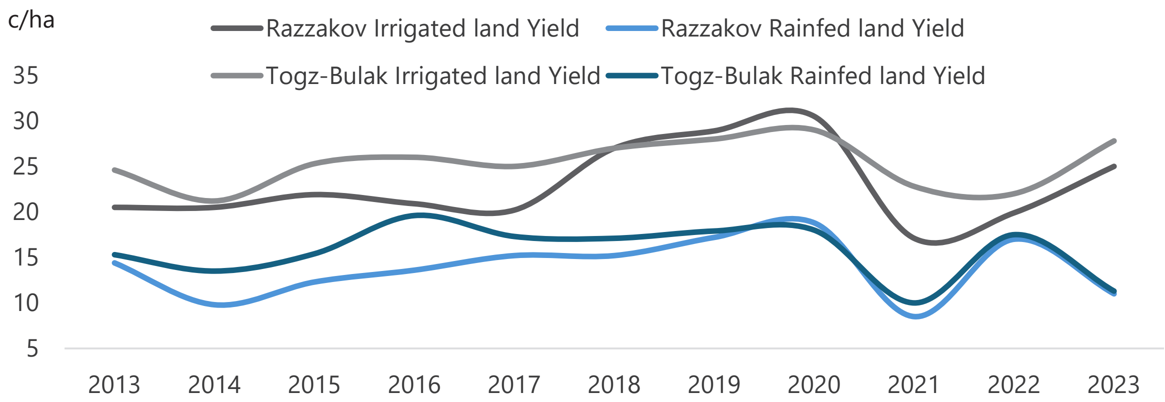
4.1. Climate Impact and Agricultural Challenges in the Watershed

Agricultural experts reported in FGDs agricultural challenges due to a combination of climatic and socio-economic factors, which have impacted crop yields; 86% of interviewed village leaders attributed degradation of watershed land near agricultural and pasture areas to either overgrazing, changing

Graph 9. Wheat Yield Comparison of Irrigated and Rainfed Lands



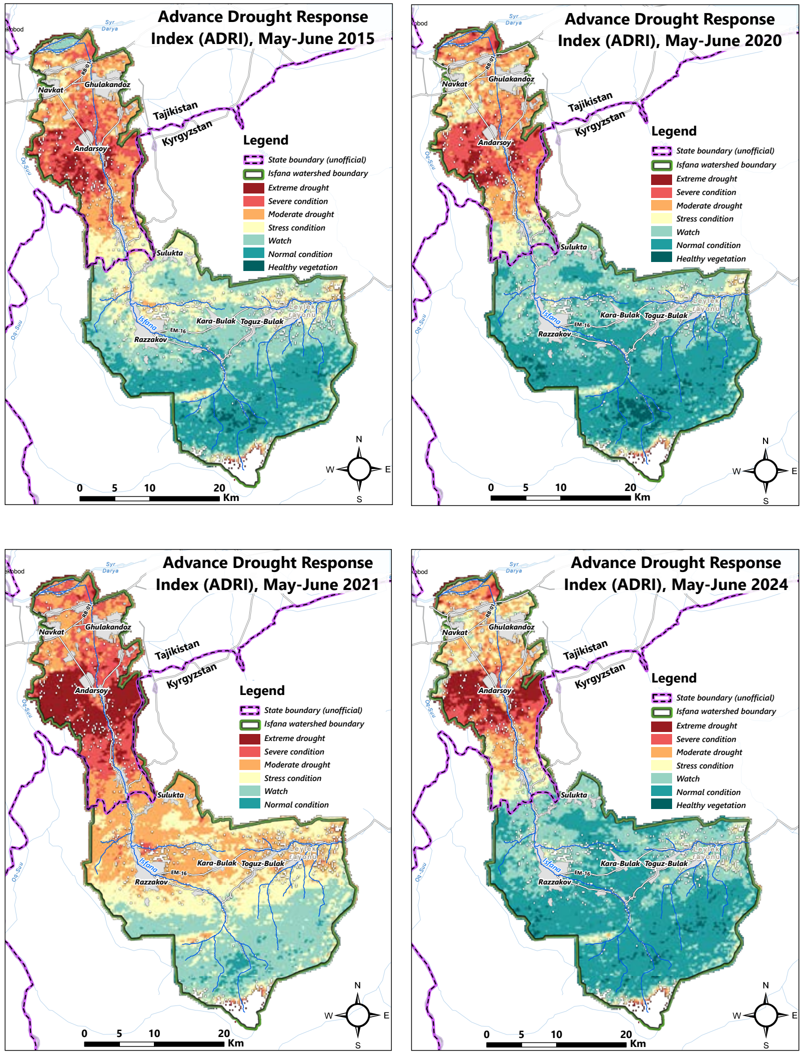
Graph 10. Barley Yield Comparison of Irrigated and Rainfed Lands



weather patterns, drought, or poor farming practices. Agricultural experts also noted widespread challenges in maintaining soil fertility, with high market prices for fertilizers and seeds impacting their livelihoods. Heavy rains following prolonged dry spells reportedly caused mudflows, which eroded soil and deposited sand and stones on farmers' lands, further degrading land. Agricultural experts further reported in FGDs that mudflows had directly impacted 36 hectares in Toguz-Bulak LSG, rendering the land unproductive. Farmers also mentioned that a reduction in snowfall in the upper watershed has, over time, led to decreased water availability, further degrading the land.Pests and crop diseases were commonly noted by farmers, the recent unusually hot summers exacerbated these issues. Unusual cold winters damage some apple and walnut trees. Apple disease emerged in the eastern part of the watershed; a new disease that was affecting poplar bark was also noted. These weather conditions were reported by Agriculture FGD participants to have also led to a surge in locusts, damaging crop yields. Unpredictable weather was reported to have forced farmers to adjust their crop sowing times, complicating harvest planning and often reducing yields. Furthermore, heavy rains (especially after prolonged droughts) were reported to contribute to soil erosion, washing away fertile topsoil essential for healthy crop growth. To examine the implications of these trends on the Isfana watershed, an Advanced Drought Response Index (ADRI) analysis conducted by IMPACT (see map 7) in 2015, 2020, 2021, and 2024 revealed that in recent years, areas of the watershed in drought conditions ranged between 20% to 51% during peak growing seasons; these areas were mainly primarily in flat, irrigated areas responsible for a majority of productive agriculture in the watershed. The most severe drought conditions were reported in 2021, during the Central Asia Drought which affected most of the Fergana Valley. In this year, drought conditions affected all but a few parts of the upper watershed in Toguz-Bulak. However, in all other analyzed years, at least 20% of the land in the watershed was found to be affected by drought conditions, suggesting high vulnerability to climate change. Other research has noted that climate changes' predicted effects on irrigation networks in the area are a major risk to agriculture and livelihoods in Kyrgyzstan more broadly.[54]

54 International Fund for Agricultural Development, The Kyrgyz Republic: Country Strategic Opportunities Programme Results Review, 2021.

Map 7. Advanced Drought Analysis Response Index of the Isfana watershed May-June 2015–2024



3.2. Agricultural Practices and Collaborative Efforts in the Watershed

To address agricultural challenges, various partnerships were reported to have been established with stakeholders through both top-down governmental bodies, like the Ministry of Agriculture, which provided up to a 10% discount on providing seeds, fertilizers via the Batken Region government. Bottom-up channels through direct engagement of local communities were also used, including though Jamaats (Union of Communities; a voluntary association formed by communities to coordinate their activities, protect and represent common interests, implement joint projects, and address shared issues).[55] The Leylek district department of the Ministry of Agriculture conducted free pesticide treatments spraying against locusts on 13,000 hectares of agricultural land in the Razzakov City Hall in 2023. Outside of the government, the World Food Program (WFP) and JICA work closely with Jamaats in the watershed, while local NGOs and private sector representatives were also reported to have engaged directly through personal connections with farmers. Ongoing initiatives, supported by public-private partnerships, promote drip irrigation, new climate resilience crop seeds, and agricultural productivity. National banks like "Ayil Bank" and RSK Bank further support local farmers by offering concessional loans through the national "Support for Farmers" program. Farmers indicated that in the watershed LSGs, district authorities hold annual meetings with public organizations, businesses, farmers, and local councils to address land and water issues. These meetings reportedly enabled farmers to submit requests to local authorities aligned with community needs. Additionally, farmers participate in district or regional and national agricultural fairs, which facilitated the expansion of partnerships and the establishment of contracts, thereby supporting the growth and sustainability of the agricultural sector.

Farmers in the watershed reported shifting from clover to sainfoin (a perennial forage plant in the legume family) over the past 5-6 years due to its higher yield, drought resistance, and suitability for water-deficient conditions. Farmers introduced Golden Delicious apples from local varieties for their resilience and longer storage life. In addition to drip irrigation, they were reported to have adopted polyethylene mulching to conserve soil moisture, control weeds, and protect crops, although the scale of new implementations remains limited due to a lack of funding. Farmers in Toguz Bulak LSG emphasized the need for training on drought-resistant crops, rational fertilizer use, effective weed and pest control, and efficient irrigation methods.

Farmers in Razzakov City Hall emphasized the importance of conducting specialized research on soil composition to enhance fertilizer application and improve crop quality, identifying a need for detailed analysis of soil properties to tailor fertilizer use more precisely to the specific requirements of their crops. Farmers additionally reported labor availability issues, with those in Toguz-Bulak LSG experiencing the most difficulties. The out-migration of young people was also reported to have resulted in a shortage of skilled agricultural workers. Agriculture experts in Razzakov City Hall noted that they independently determine agricultural practices and crop rotation without professional guidance, selecting crops they consider suitable. Additionally, they mentioned that over the past 20 years, mechanization has decreased the need for low-skilled labor in agriculture, particularly for planting and harvesting.

55 Law of the Kyrgyz Republic "On Jamaats (Communities) and Their Unions" dated February 21, 2005, No. 36

5. Pastureland Practices

Pasture Manager FGD respondents reported livestock herding in the watershed was conducted in both near-village and distant pastures. Near-village pastures are managed by LSG-based pasture committees and account for 57% of the total land in the LSGs. These provide grazing land year-round. Distant pastures, managed by the Leylek Forestry Unit, were used from late May to mid-September (until snowing) and reportedly currently accommodate 70% of the livestock of both LSGs. The remaining 30% of livestock (mostly dairy cows and goats) were reported to be kept in the nearby village pastures all year round. Statistical data showed that communities in the watershed produced similar livestock products, including meat, raw milk, eggs, and wool. Approximately 56% of livestock products were reportedly sold at markets.

Pasture Manager FGD respondents reported that the Ministry of Agriculture had developed livestock grazing rules that govern grazing capacity of pastures. Based on these regulations, pasture committees and the Forestry Unit issue pasture tickets, specifying the allowable number of livestock and the duration of use for designated pastureland. However, these rules were reported to be outdated and did not address current levels of pasture productivity in the watershed.

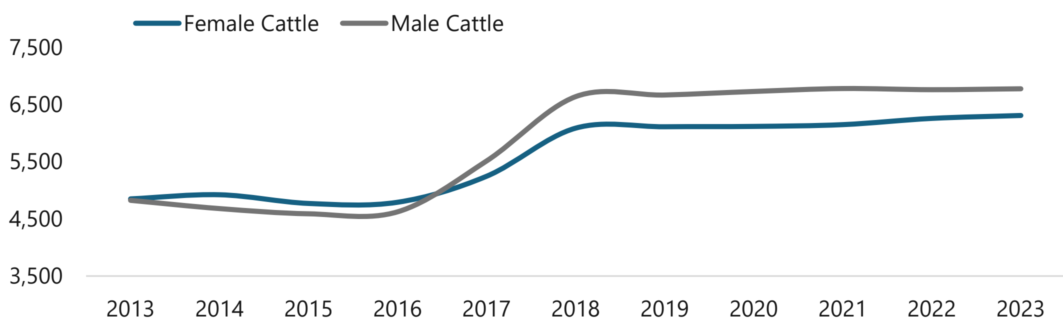
Pasture and Forest Manager FGD respondents indicated that inadequate pasture maintenance and climate change, particularly heavy rains following droughts, have exacerbated erosion and triggered mudflows, washing out roads and bridges to remote areas, thereby raising repair costs and limiting access to distant areas. Overgrazing has further degraded the pastures, promoting the spread of weeds such as thistle and rosehip, which outcompete forage plants.

Livestock numbers were reported by pasture committees to be growing annually, but existing pastures no longer had the capacity to absorb them. Government statistics (2013–2023)[56] showed that the watershed experienced an increase in total livestock since 2015 (see graphs 11 & 12). The FGD participants further reported that until 2015, unfavorable weather conditions led to a decrease in the livestock population (mainly goats and sheep), primarily due to fodder shortages, particularly in the spring. This resulted in significant livestock losses, forcing people to sell their animals at reduced prices, as the animals were in poor condition, and the market value for underweight livestock dropped.

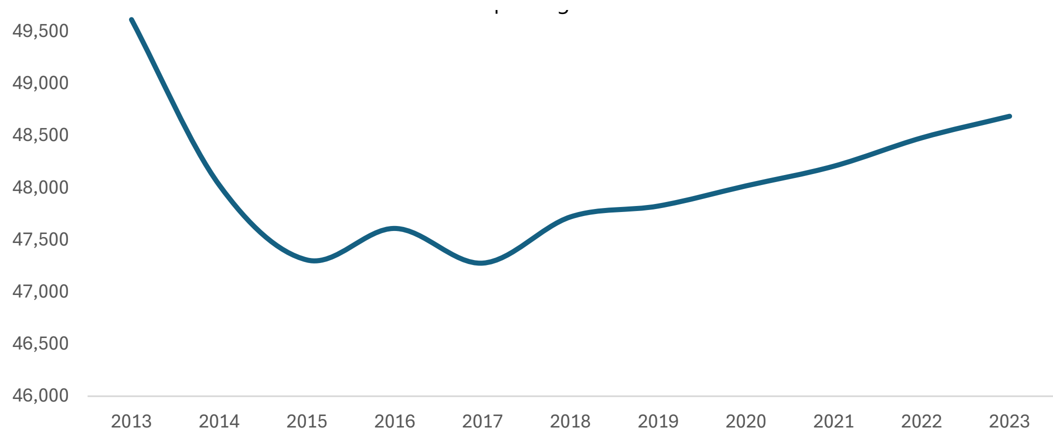
In response, local banks introduced low-interest loans (10%) to support farmers and later simplified the application process. Whereas farmers initially had to pledge property to secure loans, banks began offering unsecured loans, enabling more people to invest in meat and dairy production, which contributed to a rise in the livestock population, particularly cattle, which take up more space and consume more grazing area and feed. FGD respondents noted that the restocking of sheep herds in recent years (graph 12) was done mainly with Hissar and Afghan sheep, primarily for meat production.

The increase in livestock has likely contributed to the already widespread unregulated pasture use, which was reported by pasture managers to have contributed to an increasing rate of ecosystem degradation.

Graph 11. Livestock Trends in the Watershed



Graph 12. Livestock Trends in the Watershed



56 National Statistical Committee of the Kyrgyz Republic, 2023.

Government reports further noted that intensive grazing was reported to have also reduced forage grasses necessary to sustainably maintain livestock herds, increasing weeds and non-forage plants.[57]

To better understand the full scope and locations where pasture degradation was prevalent in the Isfana watershed, IMPACT conducted a spatial analysis of the change in healthy pasture lands between 2000 and 2024. To do this, vegetation growth for a baseline period of 2000–2003 was compared with the current 2021–2024 period, to understand where pasture lands had disappeared or degraded over the last 2 decades.

The analysis revealed that 44% of the watershed's pastureland, primarily in the distant pasture has degraded to varying degrees between the 2000–2003 and 2021–2024 periods (see map 8). Furthermore, the greatest levels of degradation were observed in the distant, common pastures in the upper watershed managed by the Forest Unit.

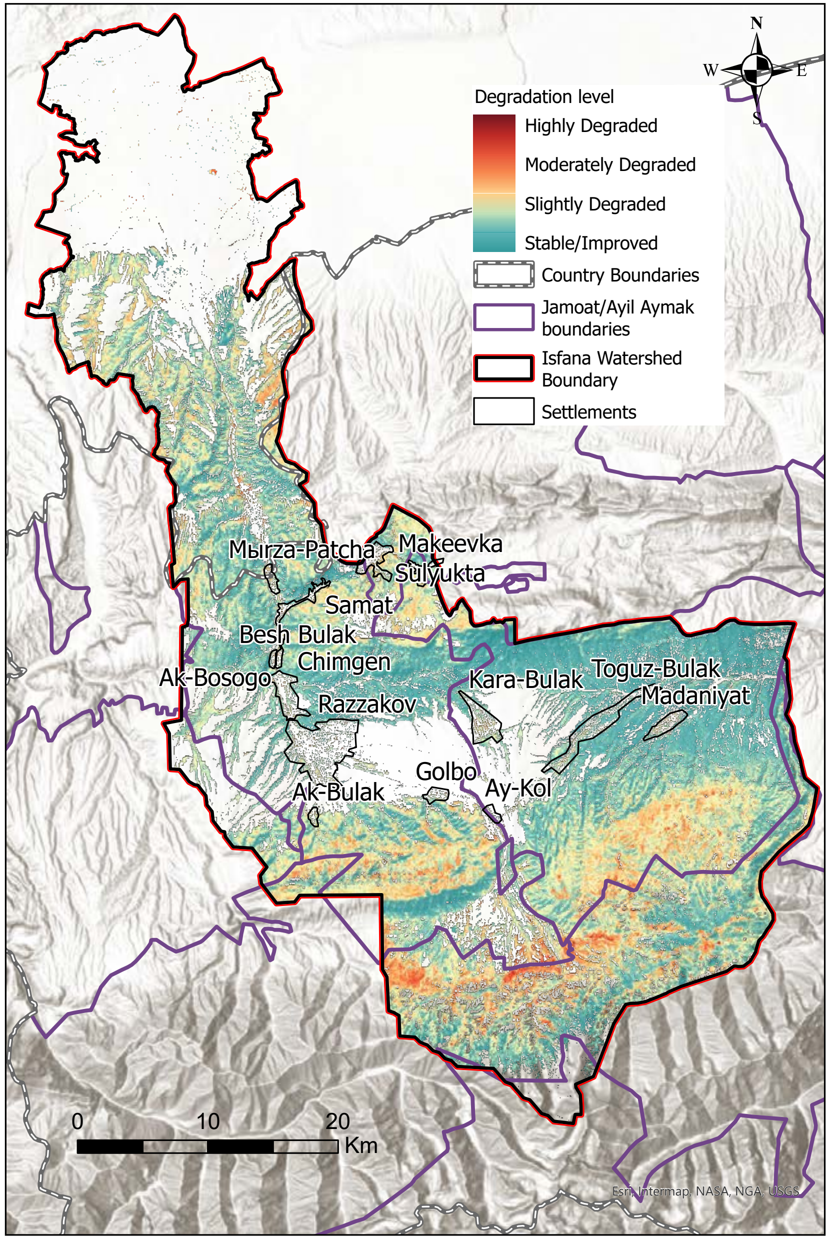
As noted, these pastures are used to graze up to 70% of the watershed's livestock from the end of May until the first snows in early October, making the level of degradation a major threat to sustainable livestock practices in the watershed.

Pasture managers reported in FGDs that pasture lands in the watershed had degraded due to overgrazing, poor sustainability practices, climate change, and socio-economic issues like unemployment.

In the LSGs, the limited staff, consisting of only one land specialist and a pasture committee head, struggled to enforce sustainable grazing practices effectively, leading to overuse and mismanagement of pasturelands.

This is supported by other recent studies on land management in Kyrgyzstan, which highlight coordination failures as a major cause of over-grazing.[58]

Map 8. Spatial Analysis of Pastureland in the Watershed



57 Pasture Development Program of the Kyrgyz Republic for 2024-2029," Resolution of the Kyrgyz Republic dated August 9, 2024, No. 462.
58 International Fund for Agricultural Development, The Kyrgyz Republic: Country Strategic Opportunities Programme Results Review, 2021.

5.1. Remote Pasture Management

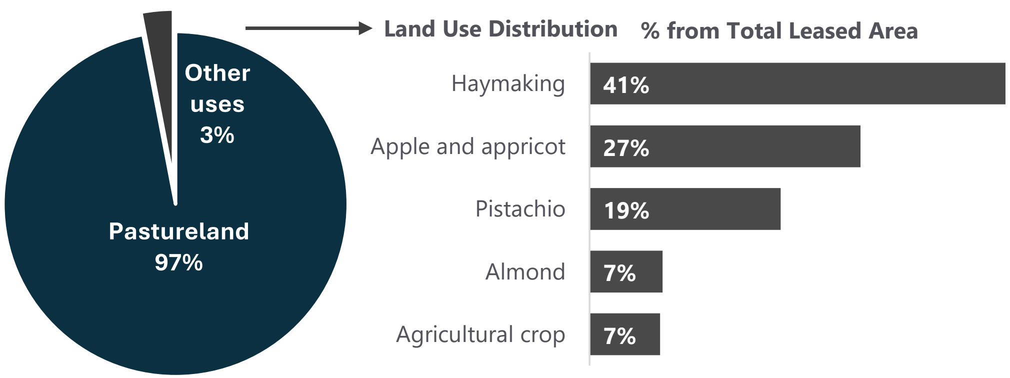
The Leylek Forestry Unit supports 450 local households' income generation through long- and short-term leasing of land. According to forestry managers information, 97% of the land designated for use by communities was dedicated for livestock grazing. The remaining land was leased for various agricultural purposes (see graph 13). Shepherds often used the same routes to travel from their villages to remote pastures, which resulted in persistent trampling, hindered vegetation regrowth, and exacerbated soil erosion.

FGD respondents form the Forestry Unit reported that shepherds frequently violated grazing schedules issued by the Forestry Unit and refused to move to new locations designated by the Forestry Unit to allow the pastureland to recover.

This behaviour was primarily driven by the high cost and logistical challenges associated with shifting locations, as well as issues such as lack of communication (e.g., poor phone coverage), frequent weather changes, and inadequate road infrastructure. These practices led to overgrazing and created conflicts with forest management efforts to create sustainability.

Forestry Unit FGD respondents further noted that herders often disregarded recommendations for grazing area rotation and reverted to familiar locations shortly after being directed to new pastures. Additionally, many pasture users lacked awareness of sustainable grazing practices, which reportedly contributed to in misuse and further degradation.

Graph 13. Leased Land Distribution under Forestry Unit Management




IMPACT, Pre-migration dipping of sheep and goats, April 2023

6. Women's Roles in Natural Resource Management

According to FGD participants from the local women's councils, there was a large disparity in women's participation in NRM decision making between cities and rural areas. In cities like Razzakov, women were reported to participate in decision-making regarding drinking water resources and agricultural policy. However, in rural areas, traditional gender norms that emphasize domestic roles were reported by women's councils to restrict many women to household tasks and small-scale farming. These norms limited their access to resources, land ownership, and decision-making opportunities in larger-scale farming and livestock breeding. Additionally, these traditional norms were reported to restrict women's control over land, livestock, financial decisions, and their participation in irrigation and pasture management. This was reflected by other detailed studies in the Batken region, which have found lower women's participation to directly lead to decreased revenue and institutional support.[59]

Women's council FGD representatives reported that women's councils in the watershed supported activities aimed at empowering women primarily focused on addressing social issues, they placed less emphasis on capacity building for natural resource management. They also emphasized the importance of involving women in events, particularly in training sessions, alongside their husbands. Additionally, it was proposed to involve mothers-in-law, given their traditional influence in family decision-making. As key members of the extended family, they play an essential role in maintaining family harmony and continuity. Their perspectives are often valued in significant decisions impacting the family as a whole.

Women's council representatives noted that men and women did not participate equally in technical work related to irrigation water use, construction and maintenance of water infrastructure, or seed planting in pastures, which were often more accessible to men due to traditional gender roles and societal expectations that prioritize men's involvement in technical and public activities. It was also mentioned that the aforementioned agriculture loan offered by banks for livestock purchase were offered to recipients of both genders on equal terms, but social norms often discouraged women from taking loans or managing agricultural activities.

Single women, in particular, faced challenges due to traditions of avoiding livestock or farming as livelihoods.

At the district and LSG levels, funding was allocated as a grant for women's capacity development. In Razzakov City Hall, women received funding for agricultural development projects; however, some of those projects failed because the grant recipients were not adequately prepared for activities such as beekeeping or small-scale agricultural development.

These disparities were less noted in the LSG capitals. The Local Council in Toguz-Bulak LSG consisted of 50% women, highlighting gender balance in the Leylek District. Despite women's lower involvement in formal water users' associations and pasture committee activities, women contributed through community engagement, informal mediation, and indirect advocacy, women's councils and activists help resolve resource management disputes through informal networks and community gatherings, promoting fair and equitable solutions. More formally, women's councils and activists were reported to work on resolving resource management disputes as a members of the Local LSG Councils.

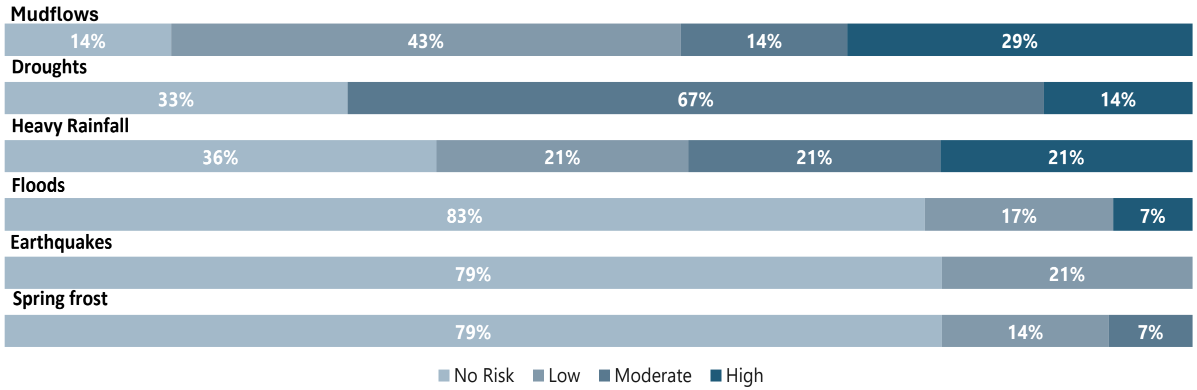
Women's council members reported that women in the watershed contributed to environmental stewardship through tree planting and community clean-up efforts, preparing and cooking during communal work on pastures or water infrastructure cleaning and repairs. In 2023, the "Mazar event" gathered the community to visit sacred places, pray for favorable weather and harvest, and discuss water, pasture, and agricultural land management issues. Women participated in these discussions, offering insights into natural resource management.

Community-based support is provided for vulnerable groups' access to resources, though specific initiatives targeting their unique needs. Efforts are made to consider women's needs and priorities in local natural resource management programs and services. Meetings and activities were scheduled to accommodate women's childcare and household responsibilities, but further integration of women's perspectives was reported to be needed for capacity building for farming and resources management.

59 International Water Management Institute, Strengthening participatory irrigation management in Tajikistan, Water Policy Brief, Issue 41, June 2018.

7. Disaster Risk Reduction

Graph 14. Risk Levels of Various Hazards in the Watershed



According to emergency management KIs, the population in the Isfana watershed faces numerous risks due to natural hazards, including mudflows, droughts, flooding, and earthquakes, among others.

The IMPACT team conducted quantitative interviews with village heads and activists using a structured questionnaire that explored both the presence, frequency, and impacts of different hazards, and the overall population's vulnerability to them. These responses were then converted into a 0–3-point scale for both frequency and impact and multiplied together to provide the overall level of risk. This calculation was categorized by No, Low, Moderate, and High Risk to each hazard (A more detailed methodology can be found in annex II).[60] The results provided an overall understanding of the different risks faced by populations in villages throughout the watershed, and highlighted gaps in population needs often missed by official datasets.

The assessment was conducted at village level, and all quantitative results are reported as a percentage of the 14 villages assessed in the Isfana watershed. An overview of the overall risk for six key hazards is shown in graph 14 below.

Village leaders and activists reported mudflows, followed by drought and heavy rains as the most prevalent hazard with a high or moderate risk in the watershed. Villages in the upper part of the watershed were found to be the most vulnerable overall due to its high reported frequency of multiple hazards. These included heavy rainfall, mudflows, floods, droughts and earthquakes. In contrast, villages in the lower part of the watershed reported frequent mudflows, but no other hazards, and with very low reported damage from these hazards. Higher and sloped elevation was reported to be the main reason for this; locations with insufficient vegetation, steep slopes, low-lying areas, and loose soil were all reported by village leader to be at the highest exposure to the assessed risks.

District Emergency management experts further reported that strong winds and armed conflicts were also major concerns. Additionally, they highlighted the risk of landslides in Suluktu city due to historical coal mining activities; unreclaimed capped pits from closed mining operations in the area continue to pose a potential risk of erosion, particularly during heavy precipitation or seismic activity.

Regardless of location, the entire population in the watershed area was found to be vulnerable to earthquakes. Numerous historical earthquake epicenters, mostly in the northeast and east of the watershed, have occurred, although the magnitudes of these earthquakes have almost always been below 5.0 on the Richter scale, suggesting low overall damage. However, the potential risk of a major earthquake in the Isfana watershed is quite high, with a Modified Mercalli Intensity (MMI) scale ranging from 7.0 to 9.0 according to official seismic maps, suggesting that the potential risk from an earthquake in the future could be very high.

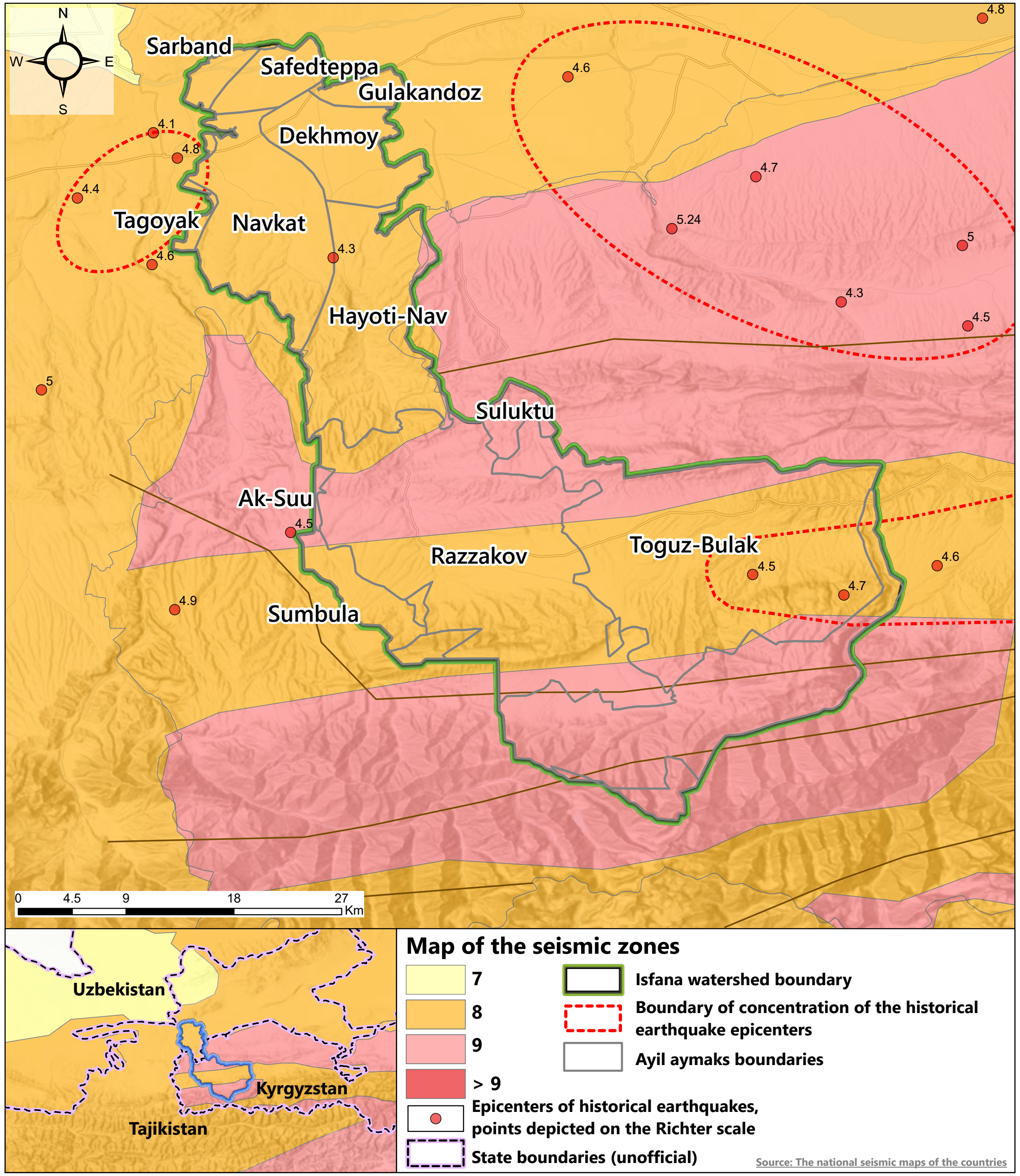
The below map 9 (National Seismic Map of the Country) indicates the locations of previous historical earthquakes, and the current MMI seismic zones for the watershed.

The most critical facilities, such as power grids, water pumps, electricity substations, water canals, main roads, landfills, and schools are located in the lower part of the watershed. Infrastructure in Suluktu city is particularly at risk due to its extensive infrastructure and high exposure to a wide range of hazards. Although Razzakov City Hall and Toguz-Bulak LSG are less vulnerable, they still report similar infrastructure to be at risk as well.

District Emergency management staff reported that approximately 80-90% of people living in villages were well-informed about the location and effects of potential disasters. Mentioned that the emergency department in Leylek District lacked essential equipment, such as bulldozers, and relied on external assistance for additional resources, limiting their ability to effectively respond to disasters.

60 Out of a total score of 9, 0 is no risk, 1-2 is low risk, 3-5 is moderate risk, and 6-9 is high risk.

Map 9. Seismic Zones Map of the Watershed and Surrounding Areas



In Suluktu city, the lack of designated evacuation centers or safe zones, especially in winter, raised concerns over the provision of immediate shelter and care for the population during natural disasters. In addition, the population of Suluktu city was reported to be at an elevated risk of landslide events due to unreclaimed capped pits from historical coal mines, especially during heavy precipitation or seismic events.

The Emergency management FGD participants also mentioned that many residents had been misled by insurance agents about their policy details and faced difficulties obtaining compensation for damage from some hazards, such as strong winds. There was also a stated need to amend regulations considering local situations or improve agent trainings to ensure clear policy explanations.

District Managers reported several measures to mitigate disaster risks:

- The Five-year Community-Based Disaster Preparedness plan, which is updated annually to maintain its relevance and effectiveness. These updates incorporate current data, enabling informed decision-making and adaptation to evolve circumstances.
- The "Jashyl Muras" (Green Heritage Project) for planting trees for improving environmental resilience. In the period 2022–2023, 30 ha of trees were planted in the watershed.
- Training and Awareness: Regular sessions on preparedness and response; annually approximately 200–300 households participate.
- Designated local groups to manage local emergencies and coordinate with the district-level commission for effective responses have been established.

Overall Recommendations

The recommendations were developed in consultation with ACTED STREAM program specialists, ensuring relevance and alignment with best practices.

- Investment in modernizing and repairing irrigation infrastructure should focus on replacing outdated canals and earthen ditches and integrating efficient technologies such as drip irrigation to minimize water loss.
- Education of farmers on water-saving techniques along with promoting the adoption of practices such as rainwater harvesting and soil moisture management, enhancing sustainable agricultural practices such as crop rotation and organic methods. Conduct training workshops to disseminate knowledge of these technologies.
- Provision of information and resources on drought-resistant crops and water-saving technologies in local languages is vital. Secure funding for research and dissemination of best practices including value chains and business development plans.
- Support local entrepreneurship through training and resources for small businesses and micro-enterprises, helping households manage effectively and build financial resilience.
- Develop women's capacity-building programs in agriculture and farming to align with the LSGs' women support grant program, incorporating mentorship, financial literacy, and skill-building in areas such as beekeeping and farming.
- Promote women's integration into formal NRM institutions by implementing quotas, advocating for policies that acknowledge their roles and ensure institutional support.
- Implement structured capacity-building programs focused on technical skills in irrigation, livestock management, and sustainable agriculture practices to empower women to take more active roles in decision-making and resource management.
- Develop partnerships to prioritize pastureland restoration in degraded areas, engage local communities in management efforts, and provide training for herders and land managers on effective pasture practices.
- Fundraising and developing partnerships to create and equip designated evacuation centers and safe zones, particularly in high-risk areas, mudflow vulnerable areas protecting riverbanks with gabion nets.
- Updating insurance regulations to better align with local risk factors and hazards. Awareness raising of residents about insurance policies to prevent disputes and ensure fair compensation for damages.

Annex I: GIS Analysis Datasets and Methodology

OID	Map Title	Datasets Used	Analysis Summary
1.1	Reference Map	Villages: Open Steet Map data with subsequent verification and validation by IMPACT's GIS team. (https://download.geofabrik.de/)) Administrative Boundaries: Humanitarian Data Exchange website. (https://data.humdata.org/dataset/cod-ab-kgz?). Water network: Derived through the SWAT hydrological analysis. Basemap: ESRI basemap.	No additional analysis.
2. 1	Snow cover Change, 1991 – 2004	GLIMS glacier database, Satellite imageries from the Landsat missions.	To understand how much snow has accumulated in different years the first task was gathering information about meteorological conditions of the site. This information allowed us to define the period when snow typically starts accumulation and when it begins to melt according to historical climatic observation. By revising different research and official papers it was noted that the start of melting period for Isfana watershed site is at the end of the second and the beginning of third decade of February. Then, it was decided to acquire satellite imageries captured from mid of February to the end of the month. It is worth to mention that the availability of the data for this period of time could be challenging, because of the presence of clouds in mountainous sites during this period. The next step was to apply NDSI or Normalized Difference Snow Index in order derive from the imagery snow feature. For correct extraction snow feature threshold value was assigned as 0.4 as it is recommended by Zhang (Zhang et al., 2019).[61] At the end three imageries for the years 1991, 2009 and 2024 have been compared. And result has shown significant decrease of the snow cover in the target area for the last 30 years. o Flowchart of data processing and NDSI calculation o Satellite data acquisition from mid-end February for the years 1990–1991, 2008–2009, and 2023–2024. o Data merging and averaging by composing single imagery for each year. o Data clipping by area of interest as mask o Calculating NDSI and applying threshold value 0.4 o Statistics calculation

61 Zhang, H., Zhang, F., et al. (2019). Ground-based evaluation of MODIS snow cover product V6 across China: Implications for the selection of NDSI threshold. Science of The Total Environment, 651(Part 2), 2712-2726.

3. 2	Advanced Drought Risk Index, 2020, 2021, 2024	Soil Moisture Data: Satellite data from SMAP project for the topsoil level (0-1m). Precipitation Data: CHIRPS (Climate Hazards Group InfraRed Precipitation with Station data) dataset. Temperature Data: MODIS Land Surface Temperature. Vegetation Data: NDVI (Normalized Difference Vegetation Index) from MODIS.	To perform drought analysis ADRI drought index has been chosen. According to different research the index has approved its efficacy on identification of drought affected areas as well as foreseeing future drought disaster The Agricultural Drought Risk Index (ADRI) is a method used to assess the risk of agricultural drought by integrating various factors, including soil moisture, precipitation, temperature, vegetation health, and other environmental and socioeconomic data. The ADRI is typically used to monitor drought conditions, support decision-making, and manage drought risks in agricultural areas. ADRI=[L×VCIijk×{C+L×(VCIijk+TCIijk+PCIijk+SCIijk+c)1×(TCIijk+PCIijk+SCIijk)}] This formula incorporates several indices and constants: L is a scaling factor or weight. VCI is the Vegetation Condition Index. TCI is the Temperature Condition Index. PCI is the Precipitation Condition Index. SCI is the Soil Condition Index. C and c are constants. All data processing and calculation has been done through the code development in GEE (Google Earth Engine).
4. 3	Earthquake Susceptibility Analysis, 2024	National Seismic Maps of Kyrgyzstan and Tajikistan Earthquake epicentres, NASA Socioeconomic Data and Applications Center (SEDAC)	Flowchart of the processes for earthquake analysis Data acquisition Georeferencing the paper-based maps Digitization of the seismological maps of Tajikistan and Kyrgyzstan, Data conversation ASCII to ESRI shapefile Integration of all data into one environment.
5. 4	Water Flow Analysis and Climate Change Projections, 1985 – 1990, 2000 – 2005, 2035	1. DEM dataset- Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) GDEM with spatial resolution 12.5m. https://asterweb.jpl.nasa.gov/ 2. Land Use Land Cover (LULC) dataset- World cover data from ESA (European Space Agency) https://esa-worldcover.org/en/data-access with spatial resolution 10m.	All data processing was performed in ArcSWAT environment, and out of the five available GCMs it was decided to move forward with MIROC-ESM due to its accuracy and the best suitability for CA area according to recent research. As Representative Concentration Pathways' (RCP) scenario out of four available RCP 2.5 and RCP 8.5 have been tested to see the climate change affect to the Isfana watershed stream flow. To define reference stream flow, historical weather dataset compiled from downscaled global dataset was used. Thus, to define stream flow it was decided to take the period from 1985–1990 as baseline or reference period, and to check the baseline against the periods 2005–2005, 2035–2040, and 2065–2070 with RCP 2.5 as a most soft scenario and RCP 8.5 as worst scenario. As there is an absence of water measurement infrastructure and due to a lack of ground truth data on flow volume for Isfana watershed, it was impossible to either correlate or validate the output of the analysis. Thus, it is difficult to judge the accuracy of the analysis.

5. 4		3. Soil dataset- Harmonized World Soils Database ver. 2.0 prepared by FAO https://gaez.fao.org/pages/hwsd , vector format data. 4. Weather data- data from 2W2E GmbH company have been used. The data contained climatic data with five different GCMs and each model had projection with four RCP scenarios, hence RCP2.6, RCP4.5,https://www.2w2e.com/home/CIMP, RCP4.5, RCP6.0, and RCP8.5 more information can be found here ww.2w2e.com/home/CIMP	Data from DEM dataset[62] - ASTER GDEM with spatial resolution 12.5m;[63] LULC dataset with spatial resolution 10m;[64] Soil dataset- Harmonized World Soils Database ver. 2.0 prepared by FAO, vector format data[65] and weather data- data from 2W2E GmbH company have been used.[66]
6. 5	Projected change in Temperature of hottest quarter, 2041 – 2060	Historical bio-climatic variables and model for the future 2041–2060 from WorldClim.	The analysis for climate change uses WorldClim data, a database of high spatial resolution global weather and climate data, which uses historical climate data based on data collected over time, using a baseline period of 1970–2000. It does climate projections using the CMIP6 downscaled future climate projections. Four Shared Socio-economic Pathways, or climate change scenarios, are measured. IMPACT selected the SSP5-8.5 model for this assessment. IMPACT chose to assess the middle-near term in climate change, 2041–2060. Statistics were then calculated for the specific Isfana watershed area, including descriptive statistics, and took the average value for the watershed area. The maps show the range of the areas in total.
7. 6	Projected change in Annual Precipitation, 2041–2060		
8.7	Change in Pasture Degradation between 2000–2003 and 2021–2024	The process relies heavily on data from Landsat 7, and Landsat 8 as well as the Land type_ESA_WorldCover dataset. Landsat 7 data, from the period between 2000 and 2003 served as a long-term vegetation base.	The analysis starts with the computation of three vital vegetation indexes: NDVI (Normalized Difference Vegetation Index), EVI (Enlarged Vegetation Index) and SAVI (Soil-Adjusted Association). NDVI is calculated between the near-infrared and red light reflected by vegetation, which provides an indication of plant health. This is a versatile index with well-verified applications for tracking alterations in vegetation. EVI enhances sensitivity in high biomass areas and reduces atmospheric influences, giving more details regarding vegetation health particularly areas of dense vegetative cover. In the case of sparse vegetated areas where soil background is often predominant, SAVI has been used to handle soil effects on vegetation indices. For each index, we calculate mean values for the baseline (Landsat 7) and current (i.e., Landsat 8) periods according to four months in a year (March, April, July and August). This is a more reliable indicator of vegetation health as it aggregates multiple indices, mitigating influences due to outliers or specific environmental conditions.

62 Climate Change Data formatted for immediate use in SWAT and SWAT+, WETechData
63 Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) GDEM with spatial resolution 12.5m
64 Land Use Land Cover (LULC) dataset- World cover data from ESA (European Space Agency)
65 Soil dataset- Harmonized World Soils Database ver. 2.0 prepared by FAO, vector format data
66 The data was containing climate data with five different GCMs and each model had a projection with four RCP scenarios, hence RCP2.5, RCP4.5, RCP6.0, and RCP8.5, more information can be find here

		The choice of this dataset was influenced by its extended history of Earth's surface making it ideal for comparative studies and representing past conditions. Period for Recent Vegetation Analysis: One that covers the present time period of recent vegetation analysis (2021–24) using the Landsat 8 data. A stronger image quality and more frequent data collection create up-to-date analysis with this dataset. The Land type_ESA_WorldCover database contains relevant information for the extraction of pasture lands from other land cover types with a higher accuracy level as it represents more detailed, spatially explicit and high-resolution local data.	In order to increase the accuracy, the average of NDVI, EVI and SAVI is finally considered to be vegetation health index. To quantify changes in vegetation health over time, the mean values of the indices of the baseline period are subtracted from the mean values of the indices of the current period. This step provides the NDVI, EVI and SAVI change raster, which highlights areas of improvement/stable or degradation. The NDVI, EVI and SAVI change raster is then masked with pasture lands to ensure the analysis focuses exclusively on these areas. This is done by reclassifying the ESA WorldCover raster to a binary format. The final step involves classifying the NDVI, EVI and SAVI change values into different levels of degradation. This classification is performed using the Reclassify tool in ArcGIS Pro. The overall average of the indices change values are categorized into four levels: Highly Degraded, Moderately Degraded, Slightly Degraded, and Stable/Improved. The classified the indices change raster is then visually represented with appropriate symbology. A professional map is created by adding necessary map elements such as the watershed boundary, title, legend, scale bar, and north arrow. This map provides a clear visual representation of pasture degradation, aiding in communication and decision-making.
9. 8	Isfana watershed irrigation network infrastructure functionality according to local water authorities, April 2024	Participatory Mapping with local water authorities and experts.	IMPACT field teams conducted Mapping Focus Group Discussions with local water authorities, presenting the respondents with a map, where they marked the key water infrastructures, including wells, pipes, and canals, onto a map of the watershed. The respondents then provided information on the functionality of each infrastructure. The completed maps were then sent to IMPACT's GIS team, who digitized the maps using ArcGIS Pro, labelling each infrastructure by its functionality.

Annex II: Risk Assessment Methodology

To conduct the Risk Assessment in Isfana Watershed Villages, IMPACT adopted an abbreviated version of the Comparative Risk Assessment Tool (CRAT), developed jointly by Mission East, Caritas, and Oxfam under the European Commission's DIPECHO project in Central Asia in 2009.[67] The tool is developed as a community assessment tool to map hazard prevalence and the levels of impact that they can cause. IMPACT adopted the tool into a simplified form, where village leaders were asked if the following hazards had ever affected their villages:

For all hazards that were noted as being present, respondents were then asked how frequently the disasters occurred, and how impactful they were on the village population. Each response was given a rank based on its level of frequency or severity. The following ordinal measures were used, with more frequent, and more impactful responses having higher scores:

The final Risk score was then categorized according to the following scores for risk for each individual hazard:

67 ECHO, Risk Assessment Mapping Guidelines for Disaster Management, December 2010.

OID	Hazard
1	Landslides
2	Heavy Rainfall
3	Avalanches
4	Earthquakes
5	Bank cutting (erosion)
6	Droughts
7	Spring Frosts

Following data collection, each village's responses were analysed according to the following formula:

$$Risk_{Hazard} = \sqrt{Frequency_{Hazard}\ x\ Impact_{Hazard}}$$

Hazard Frequency		
Frequency	**Definition**	**Rank**
Multiple times a year	2-3 times a year on average or less	3
Yearly	Every 1-4 years	2
Frequent	Every 5-10 years	1
Rarely	Every 11-49 years	1

Hazard Impact		
Frequency	**Definition**	**Rank**
Minimal	Minimal damage to houses, infrastructure, or crops in the field; any damage that occurs is minor and easily recovered from.	1
Moderate	Cause moderate damage, involving some repairs to buildings, disruptions to services, or losses to crops, but overall impacts are manageable and don't severely disrupt village life or livelihoods.	2
Significant	Causes significant damage, involving widespread damage to buildings, prolonged service disruptions, major crop losses impacting food security, and potentially even posing danger to residents.	3

Frequency					
Multiple times a year	3	4	6	9	Impact
Yearly	2	2	4	6	
Frequently	1	1	2	3	
No Hazard	0	1	2	3	
	No Hazard	Minimal	Moderate	Significant	

- High
- Moderate
- Low
- No Risk