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Regional Strategy for Drought Management and Mitigation in Central Asia for 2021-2030

Almaty 2021

Disclaimer:

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COVER PHOTOS:

- ***The Long Quest for the Pollen*** (taken from Upshare);
- ***Cracking Land Under the Sun*** (taken from uzxalqharakati.com);
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- ***The Ripple of the Sand*** (photo by Yusup Kamalov (CAMP4ASB);
- ***The Road to Nowhere*** (photo by Gennady Ratushenko (CAMP4ASB).

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LIST OF ACRONYMS

AIC	Agro-Industrial Complex
ASBP	Aral Sea Basin Program
CA	Central Asia
CACILM	Central Asian Countries Initiative for Land Management
CAR	Central Asian Region
CAREC	Regional Environmental Centre for Central Asia
CIS	Commonwealth of Independent States
DLDD	Desertification, Land Degradation and Drought
EF	Efficiency Factor
ESCAP	Economic and Social Commission for Asia and the Pacific
EWS	Early Warning Systems
FAO	Food and Agricultural Organization
GDP	Gross Domestic Product
GHGs	Greenhouse Gases
GWP	Global Water Partnership
ICSD	Interstate Commission for Sustainable Development
ICWC	Interstate Commission for Water Coordination
IFAS	International Fund for Saving the Aral Sea
IPCC	Intergovernmental Panel on Climate Change
IWRM	Integrated Water Resources Management
LDN	Land Degradation Neutrality
MoA RK	Ministry of Agriculture of the Republic of Kazakhstan
NAP	National Action Plan
NSC KR	National Statistical Committee of the Kyrgyz Republic
PM RK	The Prime Minister of the Republic of Kazakhstan
PPP	Public-Private Partnership
REP4SD-CA	Regional Environment Programme for Sustainable Development in Central Asia
SDG	Sustainable Development Goals
SDS	Sand and Dust Storms
SIC ICSD	Scientific-Information Center of the Interstate Commission for Sustainable Development
SLM	Sustainable Land Management
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
WEF	Water-Energy-Food Security
WMO	World Meteorological Organization

OVERVIEW

The Regional Strategy (hereinafter the Regional Strategy) for Drought Risk Management and Mitigation in Central Asia for 2021-2030 proposes measures to enhance ecosystem and societal resilience to droughts and periods of water scarcity by moving from a reactive to a proactive approaches and regional integration. Taking into account the natural, climatic and political features of the Central Asian countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan), the Regional Strategy aims to boost joint actions to mitigate problems induced by climate change and the countries' current economic activity in the area of land and water use. The Regional Strategy aims to help the countries of the region achieve their long-term socio-economic, technical and institutional development goals for effective and sustainable management of drought and other adverse natural phenomena, especially with regard to the anthropogenic factors contributing to desertification, land degradation and drought.

Drought is a slow-onset natural disaster, which in due course progresses in scale and force. Caused by a lack of rainfall, resulting in a shortage of water for plants, animals, and people, drought has a serious impact on lives and livelihoods, leading to food insecurity, hunger, disease, and forced migration. For the Central Asian region, drought also has significant implications for socio-economic and livelihood activities in areas such as agriculture, livestock, and water resources. According to the findings presented in "*Climate Change 2014: Impacts, Adaptation, and Vulnerability*" of the Intergovernmental Panel on Climate Change (IPCC), climate change is expected to increase drought frequency, intensity and duration, which will affect a lot of economic sectors including food, water and energy (Hijioka *et al.*, 2014).

Central Asia is the only region in the world composed entirely of landlocked developing countries. The combined GDP of the region is about USD 300 billion. Agriculture being the main driver of economic development in most countries of the region, with over 50% of the population engaged in agriculture and related sectors.

One of the key focus areas of all Central Asian countries is to achieve national commitments under the Sustainable Development Goals (SDG). The countries agree that disaster risk reduction and climate change adaptation should hold center stage to ensure that the national and regional development is not undermined by impact of drought and climate change. Five countries of the region work within the priority areas of the *Sendai Framework for Disaster Risk Reduction (2015-2030)* to prevent new and reduce current disaster risks. At the same time, the *Regional Environmental Programme for Sustainable Development in Central Asia (REP4SD-CA) 2021-2030*, developed by the Interstate Commission on Sustainable Development (ICSD), approaches these issues from the regional point of view and helps achieve certain environmental SDGs through environmental protection and ecosystem restoration activities.

The Regional Strategy is building on the series of consultations with government officials and representatives of hydrometeorological services in each of the countries of the region, as well as research and findings of experts in each country, and contribution of the international development partners. More data and information collected through the consultation process are available in the *Situation Analysis on Droughts in Central Asia*[1].

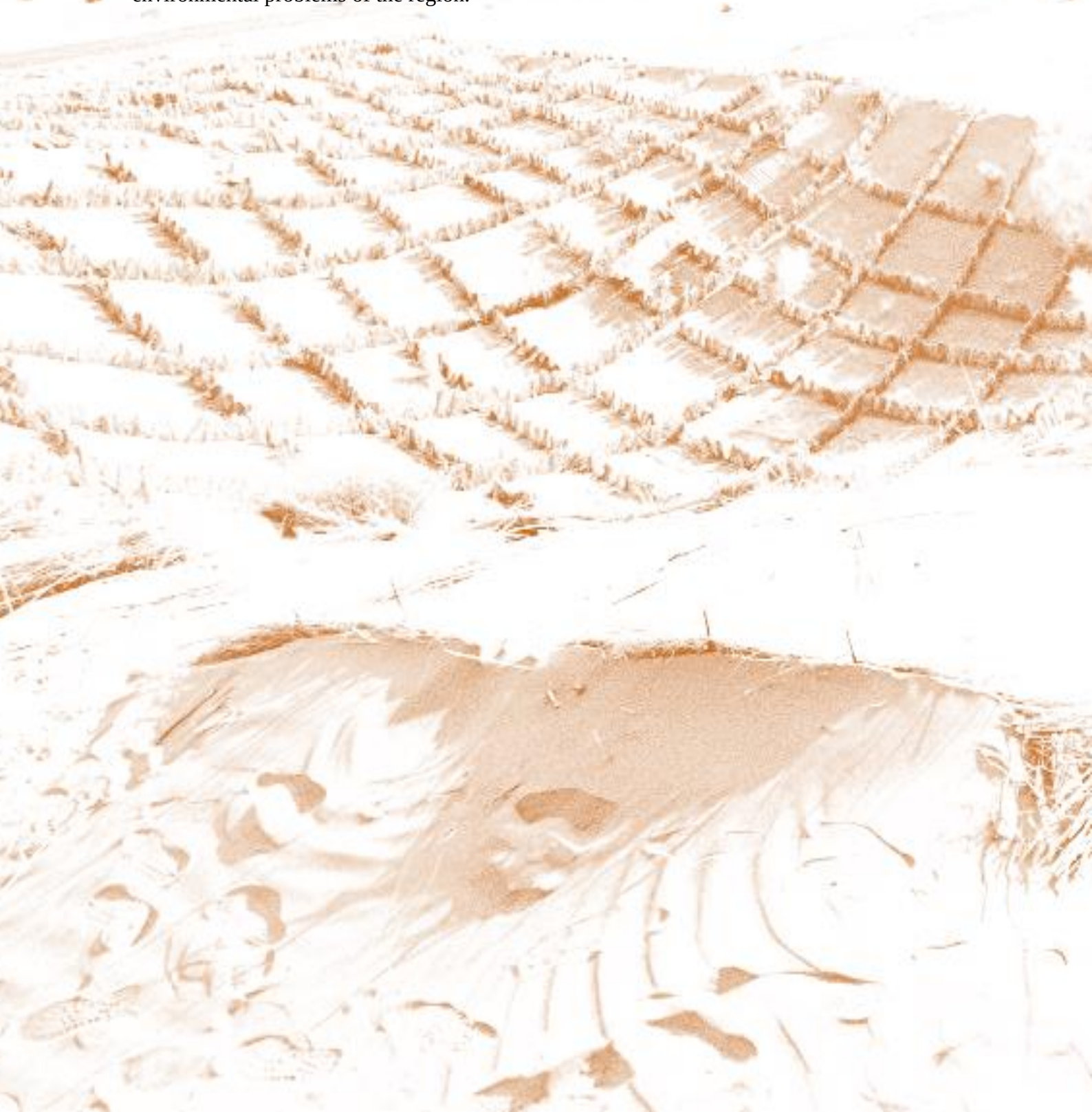
The analysis and assessment of key vulnerabilities and risks affecting water, energy and food security, main sectors of economy and vulnerable groups in the context of institutional and political frameworks in the five Central Asian countries point to the need for joint, comprehensive and coordinated actions to achieve the set national objectives for socio-economic development.

The following priority areas identified for the Regional Strategy for Drought Risk Management and Mitigation in Central Asia for 2021-2030 are also recommended for inclusion to the *REP4SD-CA*:

[1] *For more details, please refer to the "Materials" section of the Project webpage at: https://carececo.org/en/main/activity/projects/droughtSDS/*

- Area 1: Building the Monitoring, Risk Assessment and Drought Prevention Capacities;
- Area 2: Drought Mitigation, Development of Plans to Address Water Scarcity and Data Dissemination;
- Area 3: Capacity Building and Awareness Raising;
- Area 4: Regional Integration.

This Regional Strategy will contribute to strengthening the existing mechanisms of regional cooperation, capacity building and opportunities for data exchange on agroclimatic and hydrometeorological indicators, coordination of drought monitoring and forecasting processes, provided that the governments of Central Asian countries, regional and international development institutions are actively involved and support it. Formation of joint proactive measures to reduce anthropogenic impacts on ecosystems and promotion of UNCCD initiatives aimed at reducing the negative consequences of desertification, land degradation and droughts is the only solution of the environmental problems of the region.



INTRODUCTION

Drought is a complex natural phenomenon which requires comprehensive and integrated approaches and solutions. Since gaining their sovereignty, five countries of Central Asia developed and adopted laws on environment protection, as well as water, land and forestry codes, strategic plans for agricultural development and joined most international conventions and agreements.

Rooted in a traditional perception of drought as a natural part of climate, **there is no official definition of drought in any regulatory or legal documents of the Central Asian countries.** However, there is shared understanding and international classification (mainly by the Food and Agricultural Organization (FAO) and the World Meteorological Organization (WMO) – used by the countries as a deviation indicator of available water for a specific region or territory.

During the 2013 High-Level Meeting on National Drought Policy, the Global Water Partnership (GWP) and the World Meteorological Organization (WMO) initiated the Integrated Drought Management Program to provide assistance to regions and countries in developing national policies in the area of drought management and introducing preventive measures and more efficient tools for drought forecast and control (WMO and GWP, 2014). At the same time, implementation of the Sendai Framework for Disaster Risk Reduction (2015-2030) began, and since then, all CA countries have been actively involved in the drought management process.

The objectives of the new UNCCD 2018-2030 Strategic Framework pay special attention to drought. The strategic objectives 3 calls "*to mitigate, adapt to, and manage the effects of drought in order to enhance resilience of vulnerable populations and ecosystems*" (UNCCD, 2017). Noting this, the Regional Strategy developers were guided by three pillars of drought preparedness offered in the UNCCD Drought Tool Box: (i) monitoring and early warning, (ii) vulnerability and risk assessment, and (iii) risk mitigation measures.[2]

The Intergovernmental Panel on Climate Change (IPCC) reports that the hydrological regime of rivers will change in the future, and some of the smallest rivers will dry up altogether (Zoï, 2018)**.** River runoff anomalies will be progressing every year, and the oncoming decades will see drought and flood cycles. In Central Asia, droughts and transboundary river water supply are closely coupled. Integration of drought management and mitigation measures into the transboundary disaster management system would increase their efficiency, reduce environmental and social tension caused by Aral Sea desiccation and thus strengthen the capacity of the whole Central Asian region (WB, 2006).

Recognizing the transboundary nature of drought impacts, planning for coherent and complementary actions to reduce risks and vulnerabilities at the regional level should be done collaboratively, and data sharing, monitoring and forecasting should be supported at national levels. This requires interdisciplinary strategic planning, which is possible only with collaboration and participation of all stakeholders (hydrologists, agronomists, farmers, climatologists, soil scientists, engineers, sociologists, economists, politicians, local communities and the international community). A common region-wide concept, *One Region - One Ecosystem*, should become a long-standing goal of the region's countries in their drought management efforts. This will be instrumental for integration of national and regional drought and water shortage prevention actions in potentially risky areas.

An Overview of the Region

Central Asia (CA) is located in the heart of Eurasia and includes five independent countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan). Its total area is 400.8 million hectares, and the population exceeds 73.8 million. Statistically, the region can be classified as sparsely populated, as there are approximately 17 people per 1 km^2. However, most of this population

[2] *https://knowledge.unccd.int/drought-toolbox*

lives in the Aral Sea basin (formed by the Amu Darya and Syrdarya rivers) and is engaged in agriculture.

The region's aggregate GDP is about USD 300 billion, and agriculture is the main driver of economic development in most countries of the region, with over 50% of the population engaged in agriculture and related sectors. Considering direct correlation between soil productivity, anthropogenic factors, drought, water scarcity and agriculture, there is a need in proactive national and regional approaches for drought mitigation and prevention.

Figure 1: GDP of CA Countries in 2010 and 2019

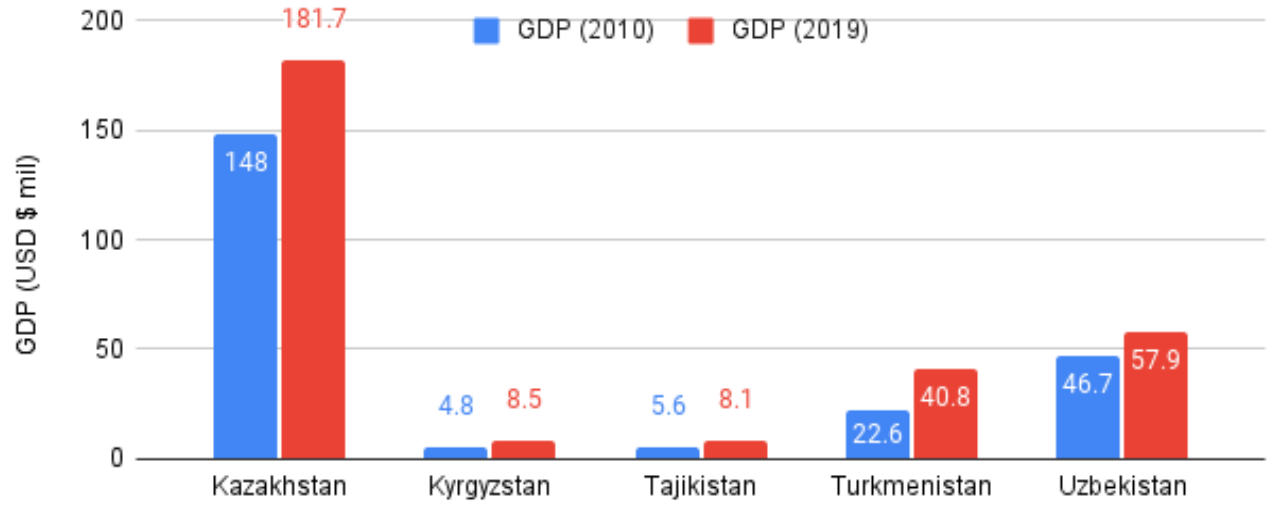
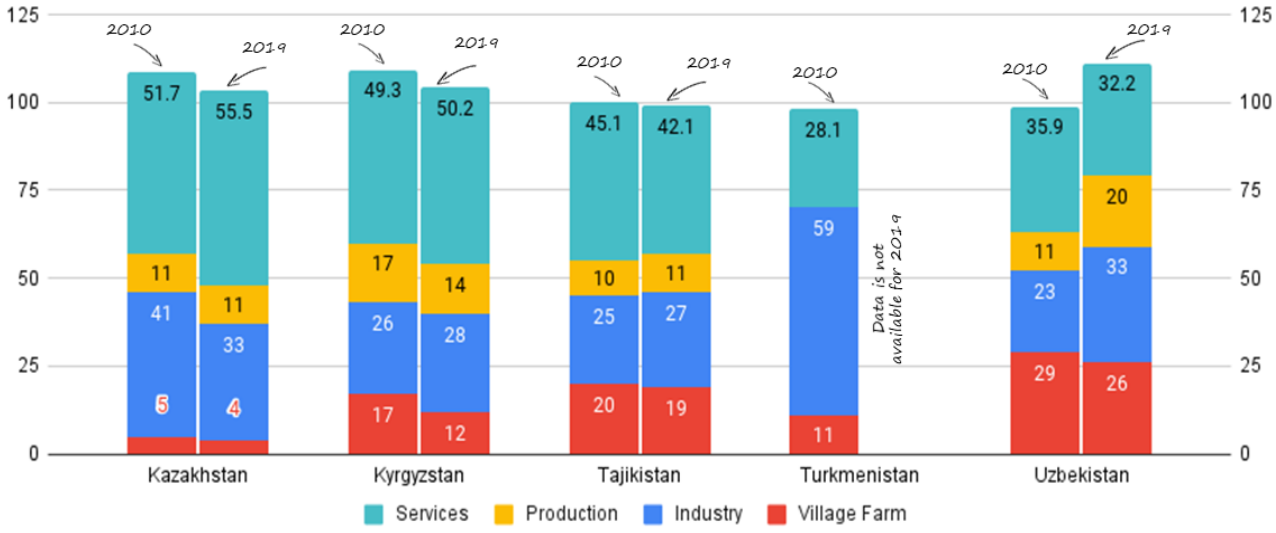


Figure 2: Sectors of Economy, % of the GDP

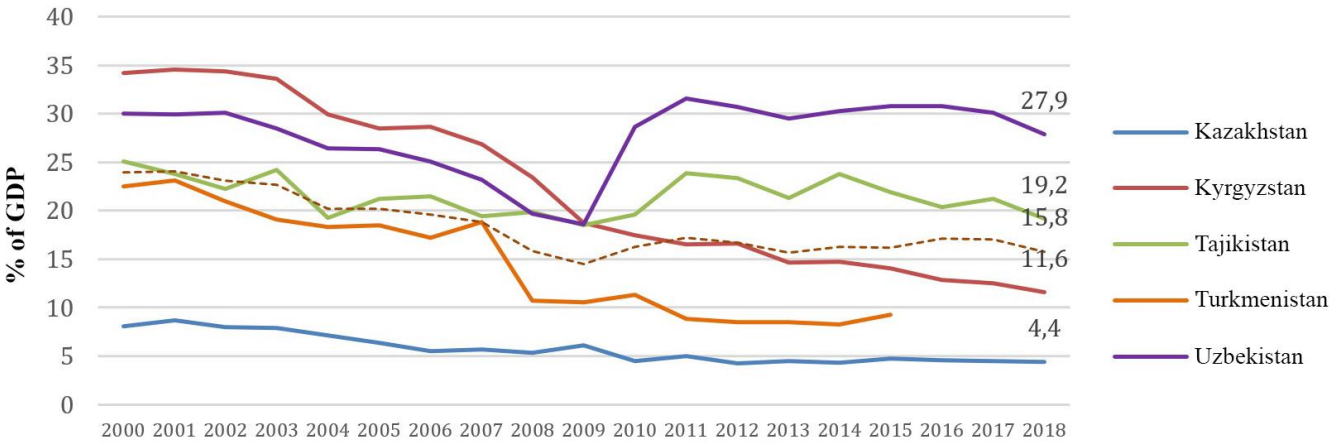


Source: World Development Indicators, The World Bank

According to the United Nations, 40% of the global population are currently facing the shortage of fresh water (UN, 2021). **About 60% of Central Asia's population is directly dependent on agriculture as their primary source of income, and the drought poses a serious threat to their well-being.** There is a direct and strong correlation between drought, fresh water availability and agriculture, especially in the Central Asian context. The existing water consumption technology operates at a 50-60% efficiency. A large volume of fresh water is lost in the hydrotechnical systems, in the irrigated fields, in industry and municipal utilities. Meanwhile, the rapid growth of the population, the expansion of irrigated land areas, the development of a complex of industrial and communal enterprises necessitates the search for additional fresh water sources, and they are none existent in the region. As over 90% of agricultural products in Central Asia come from irrigated

agriculture, it becomes quite obvious that the shortage caused by misuse of fresh water jeopardizes the food security in the region.

Figure 3: The Value-Added Ratio in Agriculture, Forestry and Fishery (% of the GDP)



Source: https://data.worldbank.org/indicator/

Roughly 80% of Central Asia is used for pastoralism, with all year-round livestock grazing. To date, up to 50% of the region's rangelands are supplied with water. Lack of access to watering points reduce mobility of herders causing overgrazing of pastures near settlements and undergrazing of remote areas. Uneven grazing contributes to the formation of anthropogenic sources of sand and dust storms, which further leads to a deterioration in the state of soils and a decrease in the biological activity of vegetation (Kerven *et al.*, 2011). This can be partially solved by organizing the use of alternative traditional water retention technologies – surface runoff in *takyrs* (salt flats), underground freshwater lenses, and saline water conversion.

Climate change in Central Asia will significantly exacerbate pasture degradation, especially in the foothills of Kyrgyzstan and Tajikistan, where livestock mobility and quantity exceed normal rates of ecological restoration. Although climate change forecasts associated with warmer and drier summers are of great importance for agriculture, extreme high temperatures play a significant role both for the vegetation cover of grasslands and also for the animals which are especially sensitive to drought (Kerven *et al.*, 2012).

Table 1: General Information on Areas, by Country

Country	Farmlands (mln. ha)	Degraded Lands	Pastures (mln. ha)	Areas under salinization (mln. ha)	Sand and Desert Areas (mln. ha)
Kazakhstan	221.6	80.2	186.4	35.8	112.1
Kyrgyzstan	6.7	0.67	9.0	0.05	0
Tajikistan	4.0	3.9	3.6	0.1	0.2
Turkmenistan	40.5	0.45	38	0.9	40.7
Uzbekistan	20.2	1.2	11.0	1.5	31.0

Note:

- *Kyrgyzstan:* 0.67 mln. ha of degraded lands is included into the 1.2 mln. ha of croplands; 0.05 mln. ha of saline lands is included into the 1.02 mln. ha of irrigated lands. Source: reports by the State Agency for Water Resources, 2019.

The power industry in Central Asia is relatively well developed. Kazakhstan generates over 94.7 billion kWh, Uzbekistan – 63 billion kWh (Podarilove, n.d.), Turkmenistan – 24 billion kWh (Trapeznikov, 2017), Tajikistan – 20.6 billion kWh (Popov, 2018), and Kyrgyzstan – 15-15.5 billion kWh (Regnum.ru, 2018). However, global warming (changes in the hydrological cycle) and population growth (water and food security) negatively affect the level of risks associated with

hydropower generation, directly affecting the availability of water resources in the vegetation period in downstream countries and the winter period in upstream countries.

Table 2: International Environmental Conventions and Treaties of CA

	KAZ	KGZ	TAJ	TKM	UZB
The United Nations Framework Convention on Climate Change (UNFCCC)[3]	+	+	+	+	+
The Convention on Biological Diversity (CBD)	+	+	+	+	+
The United Nations Convention to Combat Desertification (UNCCD)	+	+	+	+	+
International Convention for the Safety of Life at Sea (SOLAS)	+			+	
The Convention on Environmental Impact Assessment in a Transboundary Context	+	+			
The Convention on the Protection and Use of Transboundary Watercourses and International Lakes	+			+	+
The Convention on Long-Range Transboundary Air Pollution	+	+			
The Stockholm Convention on Persistent Organic Pollutants	+	+	+		+

Source: http://www.mkurca.org/documenty/international_agreements/
More information: https://treaties.un.org/Pages/Home.aspx?clang=_en

All countries of the region are now Parties to the United Nations Convention to Combat Desertification (UNCCD) and some of them are also members of other International Environmental Conventions and Treaties. Over the years, activities within the UNCCD included the preparation of national action programmes (NAPs) to combat desertification, setting the Land Degradation Neutrality (LDN) targets, development of the national drought policies in Tajikistan, Turkmenistan and Uzbekistan, and preparation of the Nationally Appropriate Mitigation Actions (NAMAs) in the context of sustainable development and climate change related actions. The countries recognize the necessity for the regional cooperation to encompass not only the NAPs, but other national action plans and national development priority documents to improve socio-economic and ecological situations of the region.

The current environmental risks and unsustainable use of natural resources, being integral factors of agricultural productivity in Central Asia, may turn into sources of conflicts both within and between the countries. The political and socio-economic stability of the region depends to a large extent on the availability and quality of fresh water. Droughts and degradation of economically productive lands, in turn, can lead to increased poverty, higher levels of environmental migration, and lower development rates in the region unless proactive and collective actions are taken to address the causes that lead to these negative natural phenomena.

[3] *All five CA countries are Non-Annex I Party to this Convention.*

Understanding Drought

The Regional Strategy addresses three main types of droughts: 1) **Meteorological**, when the amount of precipitation in the region is significantly lower than expected; 2) **Agricultural**, when the available water reserves are not able to meet agricultural needs; 3) **Hydrological**, when a shortage of precipitation persists over a long period of time, resulting in the depletion of surface and groundwater reserves. Socio-economic drought is the result of the impact by the aforesaid types of droughts, and a factor that affects human life and its interaction with the environment.

Droughts are a natural phenomenon, however, in the last few decades, anthropogenic activities and the drying up of the Aral Sea have affected the nature and intensity of droughts in Central Asia. The main causes of drought in the region follow below:

- **Natural causes:** cyclical weather conditions of ecosystems:
  - *Ocean temperature fluctuations* – minor changes in ocean temperatures affect global weather conditions (El Niño and La Niña) and moisture in the air;
  - *Land temperature changes* – changes in land surface temperatures affect the nature of air circulation in internal ecosystems thus changing the precipitation pattern;
  - *Soil moisture decrease* affects cloud formation and leads to excessive dryness of the land in the absence of precipitation;
  - *Water shortage* – deviance of the available water amount from the norm for a certain area, which affects irrigated agriculture and hydropower industry.

- **Anthropogenic causes:** agricultural activities, unsustainable use of water resources, and greenhouse gas emissions:
  - *Climate change* – global warming makes humid regions more humid, and dry regions even drier. It also exacerbates natural causes of droughts creating the cause-effect cyclicity;
  - *Overconsumption of water* – growing populations demand more food, which leads to farming intensification; this results in an increased load on ecosystems and natural resources;
  - *Land degradation* – stronger winds result in soil erosion, decreased soil moisture content and weaker heat regulation and moisture retention capacity.

Monitoring and Early Warning

In accordance with the joint action plan on implementation of the Concept of Hydrometeorological Security of the Commonwealth of Independent States (CIS) member countries (CIS Council of Heads of States, 2004), all countries of the region cooperate in the exchange of information on dangerous hydrometeorological events. As members of the World Meteorological Organization (WMO), the national hydrometeorological services provide the international hydrometeorological community with access to data generated by national meteorological monitoring networks.

In recent years, the technical capacity of hydrometeorological services of CA and their employees, including expansion of the data exchange network, has been enhanced through a number of international programs and projects. The upgrades of forecasting systems made it possible to increase the accuracy of river runoff forecasts by 20-50% and the accuracy of weather forecasts by 5-20% (CESDRR, 2020).

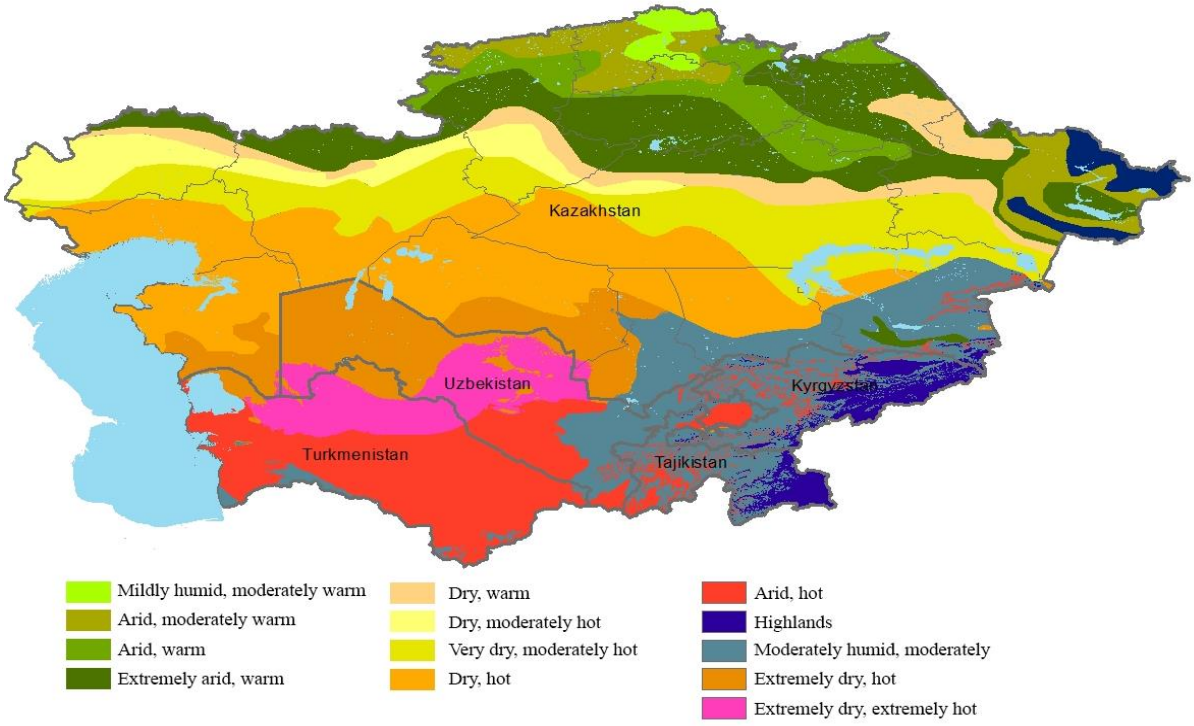
Nevertheless, not all countries enjoy the same level of technological and professional equipment. At present, no national hydrometeorological service in the region is equipped with all necessary material and technical base for full coverage of the entire territory of the country and fulfillment of its tasks. This affects the quality and accessibility of services for all, and especially for agricultural producers, as they often do not have available funds to obtain fee-based meteorological forecasts.

Drought cannot be avoided, but thanks to growing technological innovations, it can be predicted – in some cases even a month in advance. Likewise, with the right policy instruments available, droughts can be efficiently mitigated.

As found through the Situational Analysis of drought in Central Asia current research related to climate variability and conditions affecting the formation of extreme weather events in the CA region is insufficiently developed. Consequently, complex studies on drought dynamics based on analysis of ocean-atmosphere-land-cryosphere system are needed in the region. An integrated approach using hydrodynamic, statistical and synoptic methods might serve as one of the most viable options to solve socio-economic challenges related to drought. **To address drought forecast, EWS and mitigation measures at the regional level, a common regional drought indices system is required.**

Although there are currently no established drought indicators and indices, calculation and forecasting systems in CA countries, specialists use the combined methods described in the *Handbook of Drought Indicators and Indices*, prepared by the WMO and the GWP (WMO and GWP, 2016). The region faces certain challenges with the access to baseline information required for drought monitoring and modeling. The situation with soil moisture data is especially difficult. In most cases, such data are sporadic. Systematic observations of other processes of heat and moisture exchange in the near-surface layer are not available either, in particular, observations of evaporation from the soil surface and the water surface (CESDRR, 2020).

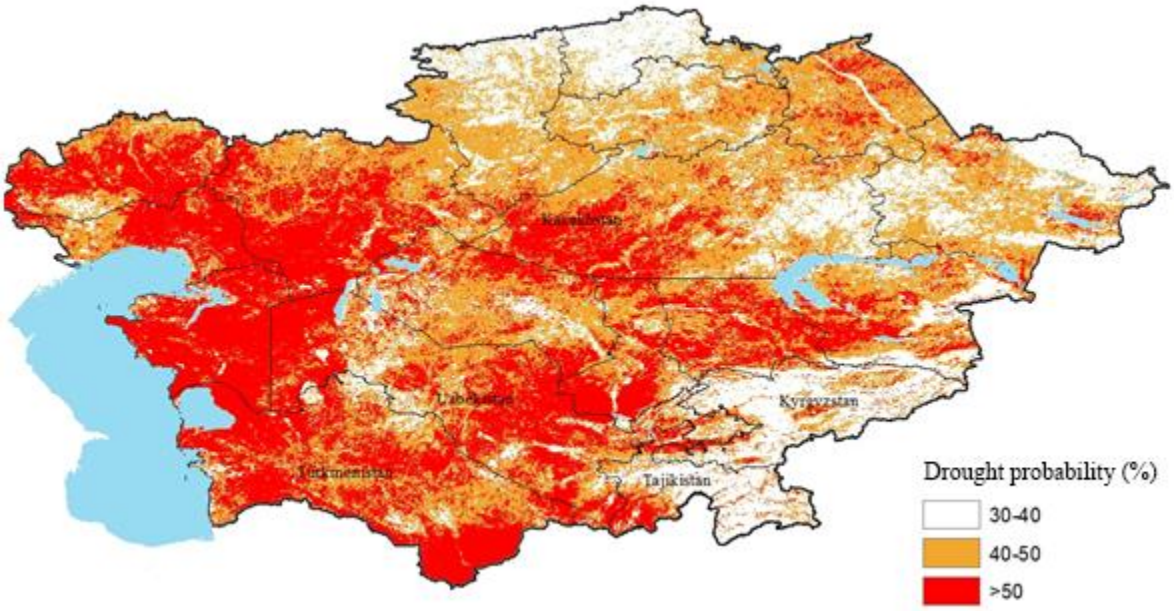
Figure 4: The Map of Agroclimatic Zoning of CA



As an example of estimating drought probability using Selyaninov's hydrothermal coefficient, the contours characterizing possibility and probability of drought formation depending on latitudinal climatic zonation, longitudinal sectorality and altitude zonation are illustrated in Figure 4. By its design it fully coincides with the existing maps of agroclimatic zoning of Kazakhstan, Turkmenistan and Uzbekistan. Within the framework of this document the existing maps of agroclimatic zoning of CA countries were combined, as well as the projection was built for those countries where such maps are absent (Kyrgyzstan and Tajikistan). Analysis of drought conditions from satellite data was based on calculated Vegetation Health Index (VHI) values, from May to August, for the territory of five countries. VHI (derived from AVHRR - Advance Very High-Resolution Radiometer) is a vegetation index based on the reflectance of the visible light by vegetation cover, characterizing the health of crops, which is used by FAO to assess drought conditions.

To calibrate the satellite information, an assessment and analysis of terrestrial drought conditions was made for the territory of the Republic of Kazakhstan with further extrapolation to the entire study area. The drought probability was based on the scale used by FAO.

Figure 5: Assessment of Drought-Afflicted Conditions in Central Asia within the Last 10 Years, Satellite Data



Based on the outcomes of the calculations, almost 30% of the region's territory falls under the zones with the drought probability of 50% or more. Droughts in the northern part of Central Asia are associated with atmospheric air circulation systems in the Arctic, Siberia and the Atlantic, while in the southern regions they may be caused by a number of factors. According to the expert panel on climate risks, the global warming of 1.0-1.5°C in Uzbekistan will by the middle of the century lead to an increase in the number of dry days in the region by 15-18%. Kyrgyzstan and Tajikistan have enough water to meet their needs even during droughts and in dry years, but their energy security will decrease due to their heavy dependence on hydropower engineering and water inflows. Turkmenistan and Uzbekistan cultivate vast irrigated lands and depend heavily on external water sources; these countries are particularly affected by droughts and water shortage (OSCE, 2017).

Table 3: Drought Probability in the Central Asian Region

Country	Drought Probability					
	30-40%		40-50%		50% or more	
	%	mln. ha	%	mln. ha	%	mln. ha
Kazakhstan	21.3	57.7	28.5	79.2	26.2	70.9
Kyrgyzstan	24.7	4.9	13.2	2.6	4.5	0.9
Tajikistan	19.3	2.7	12.1	1.8	15.5	2.2
Turkmenistan	10.1	4.8	22.8	10.6	55.1	26.5
Uzbekistan	19.8	8.9	29.5	13.2	40.1	18
Total		**79**		**107.4**		**118.5**

As of 2021-2022 national reporting and review process under the UNCCD, the Central Asian countries, alongside with the UNCCD country Parties, will be invited to build capacity and report on (i) Trends in the share of drought-prone lands in the total land area; (ii) Trends in the share of drought-prone population in the total population; and (iii) Trends in vulnerability to drought. Based on common indicators and reporting methodologies, Central Asian countries might consider organizing

an exchange of expertise and data, as well as data entry into a regional database or any other platforms designed for knowledge collection and share (Barker, 2021).

The analysis shows that none of the countries in the region covers the full range of stakeholders interested in drought related topics. Countries with relative potential conduct such analysis either on a for-fee basis or at the request of the government. In countries where systems are being piloted, such a forecast covers only part of the country's territory.

The countries in the region are currently engaged to different extend in a number of global meteorological data exchange agreements and environmental and climate observation initiatives. These agreements may become the basis for further regional actions and formation of a regional database of hydrometeorological and climate data. For example:

- The WMO Sand and Dust Storm Project was initiated in 2004, and its **Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS)** was launched by the Fifteenth World Meteorological Congress in 2007. The SDS-WAS enhances the countries' ability to deliver timely and high-quality sand and dust storm forecasts, observations, information and knowledge to users through international partnerships between research and operational communities. It operates through the Global SDS-WAS Steering Committee and three regional nodes. To date, Kazakhstan is the region's only country to be part of the WMO SDS-WAS Regional Center for Asia (WMO, n.d.).
- **The Sendai Framework** – development of a regional program for CA and the drought status.
- In accordance with the joint action plan on implementation of the **Concept of Hydrometeorological Security of the CIS member countries**, all countries of the region support cooperation in the exchange of information on dangerous hydrometeorological events. This plan specifies that dust storms, alongside with a list of other natural phenomena, are dangerous hydrometeorological and heliogeophysical phenomena. Some aspects of regional and global cooperation between hydrometeorological services from the region's countries are regulated by the joint action plan on implementation of the Concept of Hydrometeorological Security of the CIS member countries. The countries exchange information on dangerous and natural hydrometeorological phenomena, as well as send climate warnings to neighboring countries. And yet, there is no uniform database thus far (CIS Council of Heads of States, 2004).
- As members of the **World Meteorological Organization (WMO)**, national hydrometeorological services of the region's countries provide the international hydrometeorological community with access to data generated by national meteorological monitoring networks.

Considering the needs and opportunities mentioned above, the Regional Strategy prioritizes the development of a drought monitoring and early warning system based on the use of remote sensing and open climatic and hydrometeorological data.

Given the complexity and multi-faceted nature of drought forecasting and early warning system, the success of the drought management strategy will depend largely on the willingness of the countries in the region to share meteorological data and integrate monitoring and forecasting efforts at the national level.

Vulnerability and Risk Assessment

Regionally acceptable and dynamic impact monitoring system is a prerequisite for effective communication of drought social, economic and environmental impact. For the time, the region only has prototypes of such systems, and drought vulnerability assessments are either absent or based on the *"shortfall in profits"* data, with no data on loss and damage in a monetary value. There is a high demand in introducing evidence-based data to inform about adverse natural phenomena that have a social and economic impact.

Risks for Agriculture

A. Irrigated Lands

Despite the frequent occurrence of droughts in Central Asia the cases are rarely registered officially. For instance, droughts make up a mere 2-3% of the total amount of registered disasters in CA (UNESCAP, 2017). But even in this case economic losses are huge. According to the Emergency Events Database (EM-DAT) data, in 2000-2016, economic losses from droughts in CA exceeded USD 2 billion, most of them in the agrarian sector. The drought probability, in combination with the soil type, allows forecast of potential economic risks when those areas are used for agricultural activities.

The efficiency of the irrigation system in the region does not exceed 50-60%. Water in the Central Asian countries is mainly used for irrigation; hence the total water consumption is very high. Uzbekistan and Turkmenistan are the largest water consumers. Countries in this region are also major agricultural producers, cultivating water-intensive crops such as cotton and rice. Since precipitation becomes scarce and risky, the agricultural producers have to revert to using the irrigation water. The total area of irrigated lands in the five countries is about 100,000 km^2 – three times the size of Belgium. This requires significant amounts of irrigation water. Due to the large amounts of water used for irrigation, agriculture is the largest water consumer in Central Asia (Russell, 2018).

Figure 6: Use of Water by Sectors (% of Total Consumption)[4]

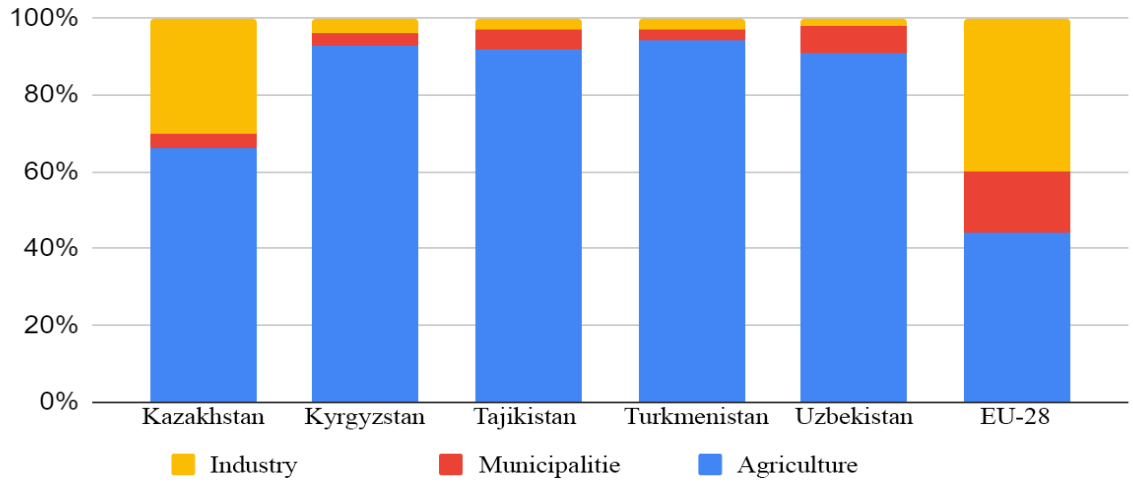
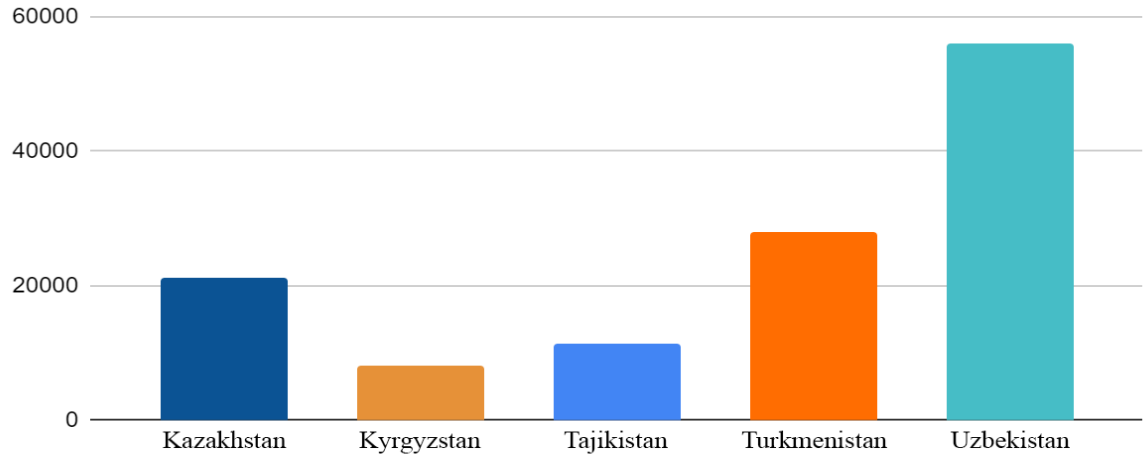


Figure 7: Total Water Consumption (mln. m3/year)[5]



[4] *Source: https://www.eea.europa.eu/*
[5] *Source: https://www.eea.europa.eu/*

The losses incurred by droughts, even in the short-term, are alarming and necessitate proactive actions that could mitigate the impact of drought on people (WB, 2005).

In summer 2021, Central Asian countries have faced an abnormal rise in temperature. In some regions of Tajikistan, the air warmed up to 48 degrees Celsius, in Uzbekistan – up to 44 degrees, in Kazakhstan – up to 40 degrees, and in Kyrgyzstan – up to 37 degrees (Chikunov, 2021).

In Turkestan Region of **Kazakhstan** in 2012, all of the wheat and barley harvest on seven thousand hectares was lost due to the drought (Cawater-info.net, 2012). In 2019 in the north of the country, crop losses amounted to 2.9 million tons due to a three-month-long drought and other problems (Raisova, 2019). Kostanai Region, Kazakhstan's main breadbasket, was hit by the 2019 drought much harder than any other region. Even advanced farms harvested only 4 to 5 hundred kilograms of grain per hectare, which is three times below the average. The rest was lost due to the lack of rain for most of the summer. As a result of the 2020 harvesting campaign, 20.839 million tons of cereal and leguminous crops were harvested in Kazakhstan. These were harvested from 15.79 million hectares with an average yield of 13.2 hundred kilograms per hectare. These are the final data released by the State Inspection Committee in the Agro-Industrial Complex of the Ministry of Agriculture of Kazakhstan (MoA RK, 2020).

The 2021 drought affected crops with a total area of over **11 million hectares**, while farmers' losses were reimbursed for only 190 million tenge.

Region	Affected Area (hectares)	Payout (tenge)
Pavlodar Region	17,577	131,759,182
Kostanai Region	11,065	38,547,842
Akmola Region	8,980	17,429,665
Eastern Kazakhstan Region	1,398	2,007,651
Northern Kazakhstan Region	477	734,825
Total	**39,497**	**190,479,165**

Source: https://agroqogam.kz/?p=5026

According to the official information resource of the Prime Minister of the Republic of Kazakhstan, following recommendations by the Republican Headquarters for Monitoring and Prompt Resolution of Issues on Providing Fodder to Farms under the Government of Kazakhstan, 1.9 billion tenge (as of July 2021) have already been allocated to compensate the losses incurred by the 2021 drought. Funds were used for partial reimbursement of the cost of fodder for the breeding stock of animals (in Mangistau Region only). On the instructions of the Prime Minister, additional funds will be allocated for the formation of a stabilization fund to purchase and deliver the harvested hay in the volume of 114.7 thousand tons to farms, at affordable prices, and also to purchase feed (bran) in the amount of 56.3 thousand tons through Food Contract Corporation JSC (PM RK, 2021).

A total of 6,069 hectares of grain crops were affected in the south of **Kyrgyzstan** due to the 2011 drought, 78% of those was wheat. In 2014, the gross agricultural output in Kyrgyzstan decreased by 25% (UN OCHA, 2014). In animal husbandry, following the 2012 water shortage, the average yearly milk yield per one cow fell by 50% and continued to fall for a few more years, because biologically the recovery of animals takes a long time. The 2016 water shortage resulted in a fall of the milk yield down to 1,978 kg (NSC KR, 2016). There are risks of the appearance of new types of pests and emerging infections of plants and animals, which are not inherent in our region. There is also a risk of an increased frequency of climate-dependent emergencies, which can cause a USD 70 million worth annual damage to agriculture.

The Ministry of Agriculture, Water Resources and Regional Development of Kyrgyzstan has submitted a draft for public discussion that calls for a ban on the export of certain food products outside the customs area of the Eurasian Economic Union, excluding re-export, transit and humanitarian aid. This recommendation is based on the fact that in 2020 there was a snowy winter and a late spring disrupted some technological processes of spring field work in 2021. Based on Kyrgyzhydromet data, it is expected that the summer will be dry, which will have a negative impact on agricultural production and food security (SNG Today, 2021).

The 2000-2001 drought in **Tajikistan** and neighboring countries turned out to be the most significant natural disaster. At a rough estimate, 89-90% of the economic damage caused by all natural disasters over the years are attributed to droughts. Drought accounts for USD 5.4 million and earthquakes, USD 3.3 million (Saidov, 2021).

Given that drought affects countries in the region differently because of flow formation, the 2021 drought that negatively affected Kazakhstan was a positive factor in supplying equipment and fuel and lubricants to Tajikistan in exchange for 315 million cubic meters of water from the Kayrakkum (Bakhri Tojik) reservoir to irrigate rice due to water shortages in the Syrdarya (Sputnik News Tajikistan, 2021).

Severe droughts in **Turkmenistan** in 2000-2001, 2005-2006 and 2008, led to a drastic reduction in the grassland yield, and as a result, to a decrease in the number of livestock. In dry years, shepherds had to sell about 20-40% of their sheep, 17-34% of goats and 10-13% of camels. The drought also damaged agriculture, resulting in a decrease in crop yields. During the drought period, transhumance (on which the well-being of residents of deserts and remote settlements depends) becomes a vulnerable sector of the country's economy. In different years, the yield on the pastures of the entire lowland area ranges from 20 to 480 kg/ha. As a result of crop growing on degraded and saline lands, direct economic damages in 2001 amounted to about USD 140 million.[6]

According to the World Bank's regional assessment, financial losses from the 2000-2001 drought in **Uzbekistan** reached USD 130 million (WB, 2005). Other sources estimate the damage at USD 38-40 million. Scientists from Uzbekistan say the fallout of salts from the atmosphere reduces the bioproductivity of farmlands by 5-10%, and that of pastures by 20-30% (GDHCM RU, 1999).

A total of 70% of Uzbekistan's territory (31.4 million hectares) currently include arid and semi-arid areas subject to natural salinization, the spread of quicksands, dust storms and dry winds. Therefore, drought and SDS management is at the forefront of ensuring the country's sustainable development. The Aral disaster has resulted in the formation of the Aralkum Desert with an area of over 5.5 million hectares. About 10 million hectares of pastures are in need of reclamation. Overgrazing, forest clearance for fuel and other activities have led to a significant reduction of tree

[6] Defined as the sum of the products under-received.

and shrubbery vegetation in the desert zone. The total forest area has decreased by half, as compared with 1965.

Since 2018, the amount of work aimed at restoring forest landscapes has increased by almost 10-fold. So, if before 2018, the area of reforestation of the dried bed of the Aral Sea annually amounted to 16-18 thousand hectares, in 2019 - more than 500 thousand hectares, and in 2020 it is planned to reforest 700 thousand hectares. All in all, from 2011 to 2020, the republic's forestry agencies have rehabilitated forest landscapes on the area of more than 1,560 thousand hectares (GWF, 2021).

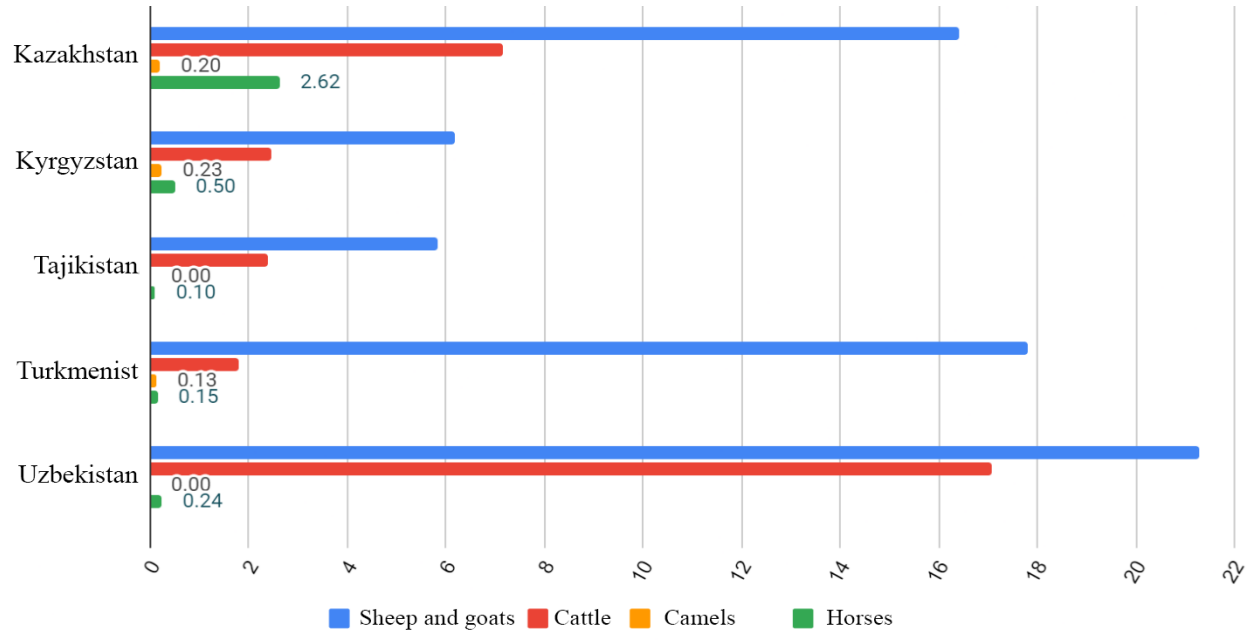
B. Pastures

About 250 million hectares of rangelands are located in Central Asia, including Russia, Mongolia and China. In Kazakhstan, Uzbekistan, Tajikistan and Kyrgyzstan they occupy more than half of the countries' territory, and pastoralism is the main activity for the majority of the population (FAO, n.d.). The semi-desert, northern and southern desert areas of Central Asia have been traditionally used as natural rangelands which proves to be more drought resistant. Air droughts hardly affect the vegetation of sandy plains and sands. Therefore, it is only the ephemerethumous part of vegetation that reacts to drought in landscapes with sandy soils and sands. Plants with medium and deep root bedding are provided with moisture even in drought.

With frequent recurrence and duration of droughts, the vegetation on pastures cannot remain productive enough for full-fledged transhumance. For example, in Turkmenistan, intense and long droughts in 1997-2006 reduced the pasture performance by an average of 35-45 kg/ha, which is 22-34% of long-term observations (Nurberdiyev, 2009).

Sheep breeding in the region holds leading positions in animal husbandry. To a great extent, this applies to Kazakhstan, Kyrgyzstan, Uzbekistan and Turkmenistan. Cattle breeding is typical for suburban areas and densely populated oases of Central Asia (BRIF Research Group, n.d.). Overgrazing is the key factor in the pasture degradation process. According to experts, rational organization of the use of vegetation will retain its productivity, while irrational use (overstocking, disrupted seasonality of grazing, etc.) will result in its degradation and, subsequently, in desertification of the landscape. Excessive anthropogenic impact on natural vegetation results in more intense processes of xerophytization, areas of plant species and their complete disappearance. A clear manifestation of the degradation of pasture vegetation is observed around wells and settlements, where the species composition of plants is decreasing (http://www.cawater-info.net/).

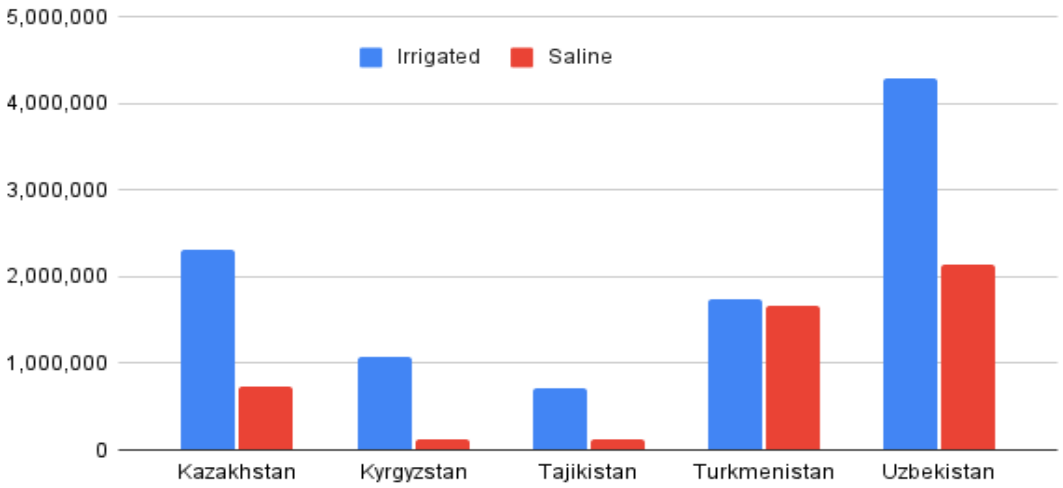
Figure 8: Livestock Population in CA Countries, as of 2018 (mln. animals)



C. Soil Salinization

An arid climate and droughts exacerbate soil salinization process, which is an extremely negative factor leading to loss of land productivity and desertification. Today, the total area of irrigated lands in the region has reached 8 million hectares, of which more than 60% are salinized to varying degrees. Salinization areas in Central Asian countries vary, and salinization covers not only arable land but also pastures and undistributed lands.

Figure 9: Saline Areas in CA



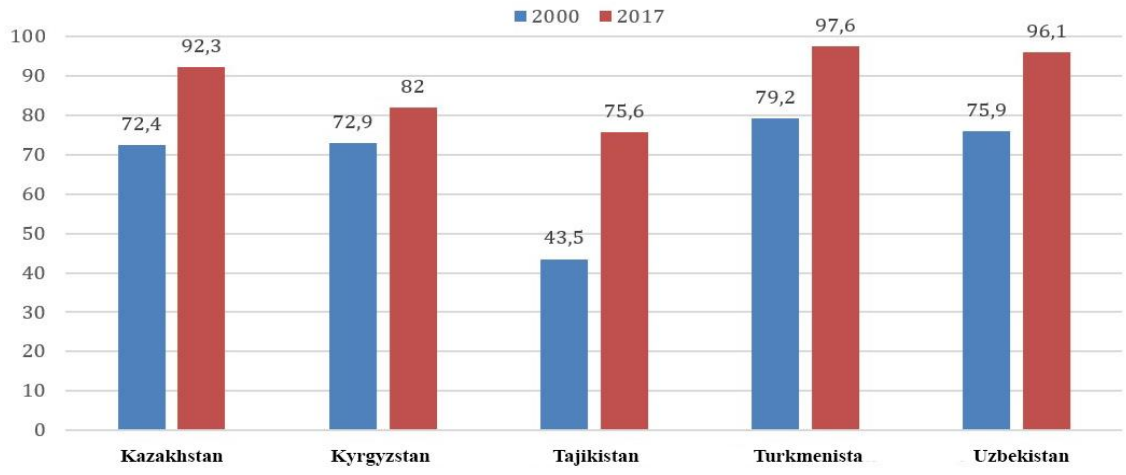
Source: http://www.worldbank.org/eca/environment

D. Population

From the very beginning of agricultural development, the people of Central Asia have adapted their livelihoods to arid conditions and droughts. The wealth of traditional knowledge in housing construction, agricultural practices, water storage and livestock breeding are reputable and well documented. However, with sedentarization and agricultural intensification, both in farming and livestock raising, many traditional practices have been abandoned.

Social assessments conducted by the World Bank (2002) and the Asian Development Bank (2005) note the high need for local communities to improve the quality of drinking water and water for cooking and sanitation during periods of severe drought. These communities are forced to spend a significant portion of their income on the purchase and storage of drinking water. In addition to the monetary costs, the population bears significant social costs in the form of serious health risks, poor nutrition, and other costs.

Figure 10: Percentage of Rural Population with Access to Clean Drinking Water



Note: *Based on JMP data for 2000-2017*

In Central Asia, around 12 million people live in the areas with high drought probability which covers about 40 million hectares. The overlay of zones with a population density of more than 25 people per km^2 and a map of the drought probability in CA results in a composite of areas socially vulnerable to droughts, or "hot spots". Most of them are located in the foothill areas at the source of the Amudarya and Syrdarya deltas; they also stretch over to the transboundary areas of the Aral Sea region. This provides with a basis for identifying areas where the government has to bolster social support for people, since residents of these areas are exposed to high drought risks to avoid potential conflicts over water and other resources. Long-standing manifestations of drought may expose the population to high risks of morbidity and mortality; also, some parts of the population may become environmental migrants, which will have an adverse effect on social stability in these areas. These include delta areas of the Aral Sea basin, foothills, highlands, and semi-desert areas in CA.

Figure 11: Areas Socially Vulnerable to Droughts

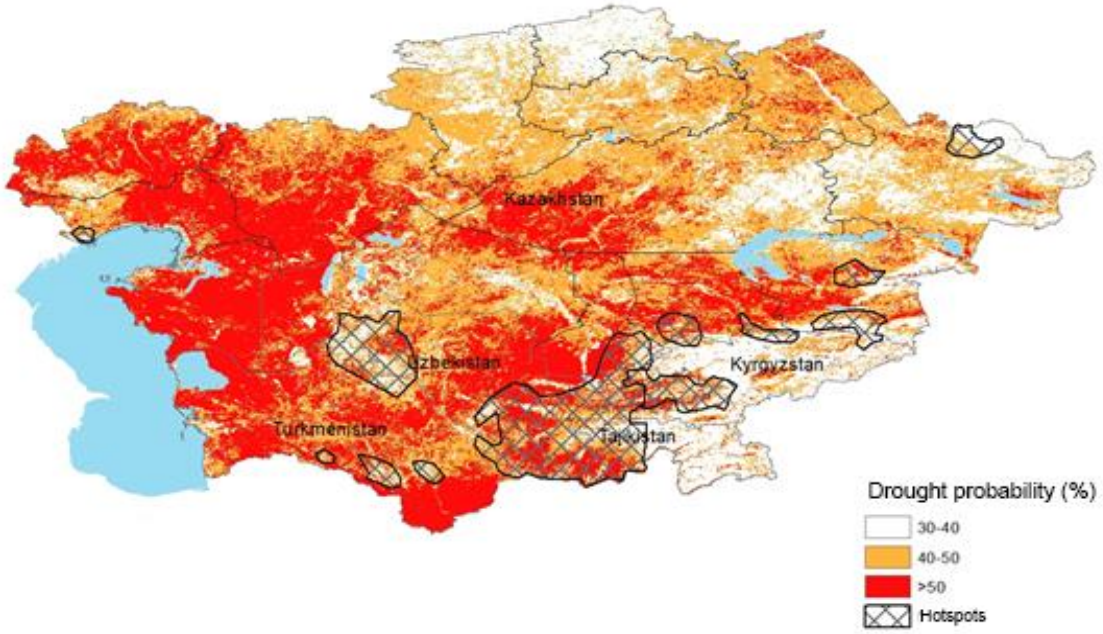


Table 4: An Analysis of Areas Socially Vulnerable to Droughts

Country	Share of employment in agriculture, %*	Rural population, %*	Drought probability of 40 or more, %	Persons/km^2 living in hot spots	Area of hot spots, %.	Area of hot spots, mln. ha	People living in hot spots
Kazakhstan	14.8	42.5	54.7	42.3	2.8	7.4	467,821
Kyrgyzstan	26.3	63.6	17.7	37.8	15.2	3.0	280,576
Tajikistan	44.9	72.8	27.6	66.5	42.9	6.1	5,148,563
Turkmenistan	22.6	48.4	77.9	50.6	13.4	6.3	751,612
Uzbekistan	33.2	49.5	69.6	58.9	38.4	17.1	5,064,944
Total:						**39.9**	**11,713,516**

Analyses show that each country in the region is socially vulnerable to the risks of droughts. Apart from direct impact of drought on agriculture and the rural population, adverse effects will also be felt by the urban population. With food price setting taken into account, the effects of drought can be felt even outside a country or a region. Therefore, the problem of droughts should not be ignored. The effects of drought lead to significant economic damages and losses in social sectors such as education, public health, housing, social protection, water supply and sanitation, as well as livelihood sectors such as agriculture, livestock breeding, fisheries, etc. This will eventually increase wealth disparity and may even increase of poverty.

Women and Other Vulnerable Groups

Rural women in Central Asia are exposed to natural disasters and climate change. The relatively difficult social situation in rural areas is also manifested in the low level and underdevelopment of social and technical infrastructure, as well as limited access to safe drinking water.

Involving vulnerable groups in the action planning process will help mitigate their vulnerability, increase livelihood resilience in the face of climate change and natural disaster risks, and will contribute to the sustainable development of the affected areas. Workshops, round tables and trainings for rural residents of remote rural areas will have a positive cumulative effect.

One of the main principles of the 2030 Agenda for Sustainable Development is to ensure the participation of all groups of the population and their equal treatment (Ogawa, 2018). So far, national environmental, climate change and disaster risk management policies across the region lack specific gender priorities or the interest of vulnerable populations as well as gender-disaggregated data on climate change impacts (Fillo, 2020).

At the political level, all Central Asian countries have included gender issues in their legislative documents. The region demonstrates moderate levels of gender inequality and is included in the groups of countries with a high and/or medium level of human development. The educational level of women in the region is remarkably high, and women's health protection has improved over time. Nevertheless, all countries in the region still have to address many challenges to meet the core commitments of the Beijing Platform and the 2030 Agenda for Sustainable Development.

Figure 12: Gender Inequality Index[7]

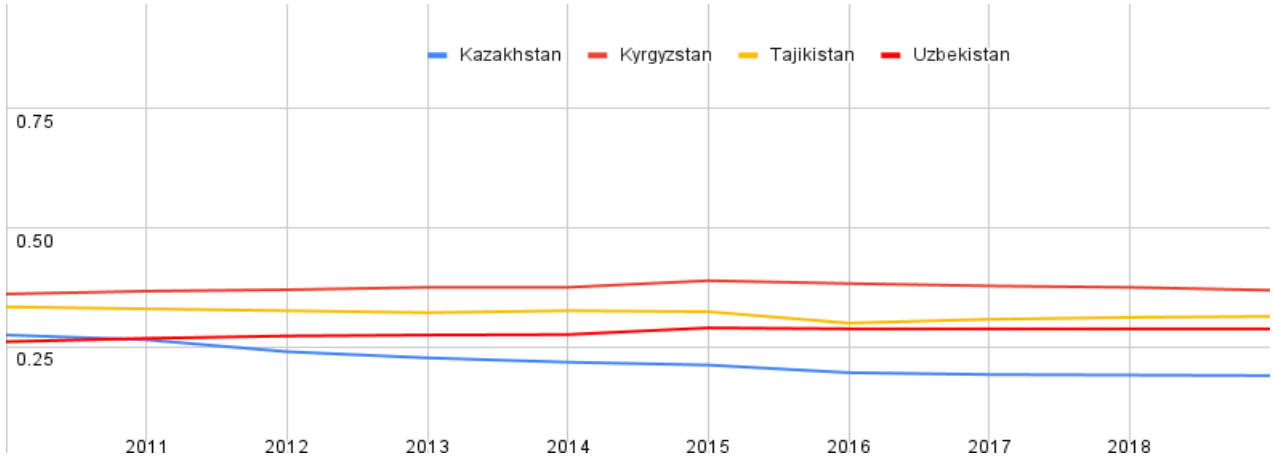
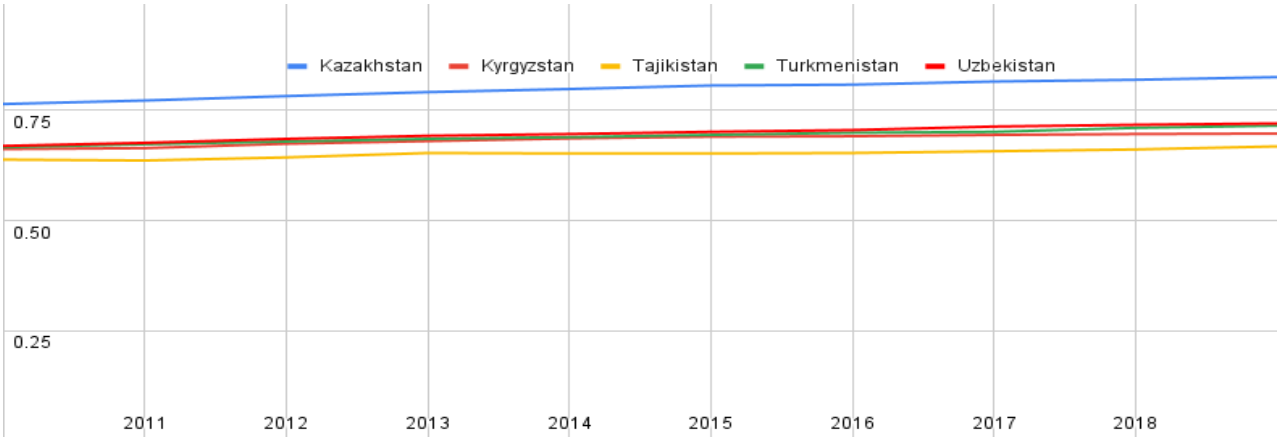


Figure 13: Human Development Index[8]



[7] *Human Development Report, UNDP 2020*
[8] *Ibid.*

Regardless of the fact that in all countries of the region, men and women have equal rights by law, they are affected differently as they have different social roles in public and private spheres. As a rule, such differences are most prominent among rural communities. Rural women who are engaged in rural activities and household chores are most vulnerable to climate change, land degradation and desertification due to challenges that result from male labor migration. At the same time, women increasingly recognize their capacity for more pro-active community involvement (Stulina, 2012).

Table 5: Coverage with Technical and Vocational Education, total (thousand), and Percentage of Women, as of 2010

Country	Total Coverage (thousand)	% of Women
Kazakhstan	113	30
Kyrgyzstan	23	27
Tajikistan	22	15
Turkmenistan	-	-
Uzbekistan	1,623	48

Source: UNESCO. 2012. Youth and skills: putting education to work. Education For All Global Monitoring Report. Paris, France

Ensuring gender equality is a Sustainable Development Goal (SDG), and all Central Asian countries have committed to achieve it. 2019 UN Human Development Report also recognized other vulnerable groups in Central Asia such as young workers, migrants, long-term unemployed persons, disabled people, historically vulnerable communities and residents of rural and remote areas. Along with other vulnerable groups, gender equality is also directly related to the achievement of the rest of the SDGs.

The elderly rural population is yet another potentially vulnerable group. In 2012-2017, the share of over-60 population had increased by 1-2% in all countries. Rapid ageing of the population is also expected in Kazakhstan, Turkmenistan and Uzbekistan, where the share of over-60 population will exceed 20% (Ogawa, 2018). Migrant workers are, too, another potentially vulnerable group. Labor migration is the result of high unemployment rates which come from the inability to cultivate agricultural fields due to land degradation, climate change and related factors. To a certain extent, migrant workers from Central Asia can be classified as environmental migrants (IOM, 2004).

According to research data, the year 2012 saw about 700,000 migrants from Kyrgyzstan (NISS KR, 2016), 744,000 migrants from Tajikistan, and about 2,000,000 migrants from Uzbekistan (Poletaev, 2014). Most of them leave to work in Russia and occasionally in foreign countries outside the CIS. In the 2000s, Kazakhstan's status had changed as it became the labor migrant hub in CA (Sadovskaya, 2013). Yet, the emigration flow from Kazakhstan still persists, albeit to a smaller extent, as compared with other countries in the region. According to statistical data, it is mostly the rural residents who leave, as it becomes more and more difficult for them to feed their families. This largely owes to land degradation, higher risks of natural disasters due to climate change, deficiency of water resources for agricultural development, and lack (or low affordability) of state-of-the-art water saving technologies.

In view of growing unemployment and economic stagnation, migration has become the most effective strategy for women and men in Eastern Europe and Central Asia to support their families, mainly through remittances. According to official data, in 2010 remittances to Tajikistan amounted to 41% of the country's GDP - the highest rank in the world. Migration from three Central Asian countries (Kyrgyzstan, Tajikistan and Uzbekistan) in 2010 exceeded 50% of the total official migration flow to Russia (Rocca *et al.*, 2015).

According to UNEP forecasts, droughts induced by climate change may become more intense, regular and longer in nature. This will have a major effect on rainfed areas, which will become more arid and less productive. Such forecasts are primarily typical for the northern regions of Central Asia, and in particular, for the north of Kazakhstan. The higher risk of soil aridity in this region may lead to a decreased crop yield (by 30-50%), which, in turn, may affect bread prices and undermine food security in Kazakhstan and other countries in the region. This risk will mostly exacerbate the situation of vulnerable groups: women, elderly population, rural residents, workers and environmental migrants. Drought affecting food production and particular subsistence farming and nutrition has increasingly adverse impact on all the vulnerable groups of population. For example, in Tajikistan, a country with the lowest level of food security in Central Asia, the problem of scarcity in terms of calories received and the variety of products consumed is especially acute for children, women and the poor (OSCE, 2017).

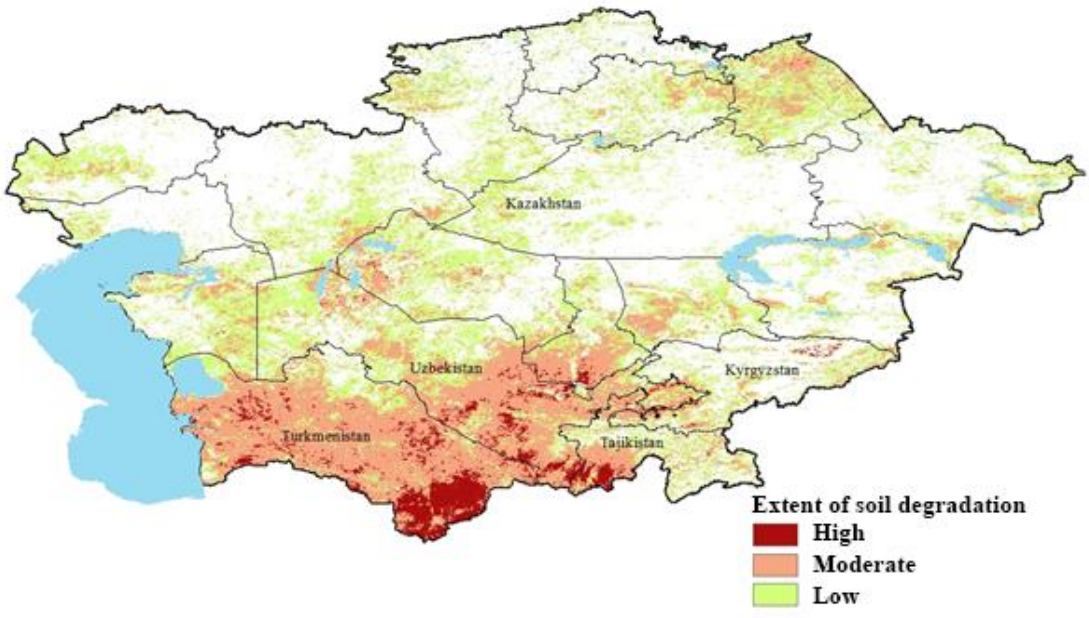
Given the vulnerability of rural populations (especially women and girls) to the effects of adverse climate events, raising awareness and gaining hands-on knowledge, both in agriculture and in housekeeping, becomes a top priority. To solve these problems, proactive efforts by all CA countries are a must, since the social, cultural and historical basis of our countries allows for application of similar actions in all countries, while the regional context will ensure the universal achievement of *SDG 3 "Ensure healthy lives and promote well-being for all at all ages"*, and *SDG 5 "Achieve gender* equality and empower all women and girls" in all CA countries.

Droughts and Degradation of Natural Ecosystems, Including Biodiversity

Climate change, drought and powerful anthropogenic effects are among the main drivers of ecosystem degradation and loss of biodiversity throughout the region. Over the past 50 years, the population of the five Central Asian countries has tripled; it is now estimated at 72 million, with about 50% of the population dependent on agriculture for their livelihoods (FAO, 2018). Central Asia is characterized by a high degree of soil degradation due to the biophysical conditions of the region, including mountainous terrain and an arid climate. Key factors of soil degradation include population growth (in the deltas of the main river basins) and climate change (aridization).

The total area affected by water erosion in Central Asia is over 30 million hectares, and by wind erosion – about 67 million hectares. In Uzbekistan, up to 80% of agricultural lands are affected by water erosion, and in Tajikistan, according to various sources, this level ranges from 60% to 97% (CACILM, 2006).

Figure 14: Degree of Vegetation Cover and Topsoil Degradation



The nominal disposable incomes of rural residents make up about half of all incomes of urban residents. Therefore, most rural residents rely not only on cash earnings from agricultural products but also on incomes in kind from their land plots and on the use of natural resources such as fish, game and firewood. Land degradation processes affect the overall productivity of crops and livestock.

The mountain ranges of the Pamir, Urals and Tien Shan are sources of the main rivers in Central Asia, and a home to thousands of species of flora and fauna. In addition to climate change, more intense melting of glaciers and permafrost may change the structure of water flows (as noted above) and affect the stability of ecosystems and biodiversity. More than 60% of water resources in the Central Asian region are formed by high-mountain glaciers in Kyrgyzstan and Tajikistan. Two-thirds of terrestrial vertebrates in Turkmenistan live in the mountains and foothills, while species such as the snow leopard and the saiga antelope are on the verge of extinction. Besides, changes in the temperature profile and precipitation patterns will affect the habitats of animals and plants, as well as the structure and density of mountain forests. However, it is also worth noting that some wild species show a high level of adaptability to a wide range of climatic conditions and diseases, which may lead to their proliferation.

Diverse forest ecosystems in Central Asia, with a large number of varieties of broad-leaved fruit and nut species, taiga forests and shrub bogs, are the basis for the ecosystem vitality. Changes in climatic and seasonal parameters will lead to higher temperatures and decreased vegetation productivity, and will result in an increase in the number of wildfires. Forest degradation has intensified in the past decade, and this trend is expected to further increase due to warmer temperatures, more intense droughts and potential changes in wind patterns. Wildfires threaten the lands used for agricultural production, as well as human health, due to higher smoke concentrations.

The Sendai Framework for Disaster Risk Reduction (2015-2030) is a successor instrument of the Kyoto Framework for Action 2005-2015; it contributes to enhance the nations' and communities' resilience to disasters. CA countries worked to advance the Sendai Framework guidance on review and revision of national plans for disaster risk reduction, updated their legislation, enhanced institutional and coordination mechanisms for disaster risk assessment, and increased their disaster preparedness. At the national level, this Framework promotes the design and implementation of plans on the development of rural areas and, in particular, mountainous regions, river basins, coastal floodplains, drylands, wetlands, and all other areas prone to drought and flooding. This involves identification of areas that are safe for human settlement and at the same time preserve ecosystem functions that help reduce risks (UNISDR, 2016).

Drought Mitigation and Adaptation Measures

Crop diversification through the introduction and integration of various agricultural practices in saline and degraded lands contributes to increased agricultural productivity. This can significantly increase the farmers' incomes. Mobilization and introduction of high-yielding, salt-, drought- and frost-resistant varieties of cereals, legumes, industrial and other crops is a rather efficient way to improve the reclamative properties of saline soils and increase their productivity.

Achieving Land Degradation Neutrality through the targets and measures which help to avoid and, where possible, revers land degradation processes play an important role in the region's sustainable development. Measures to increase the productivity of agricultural lands and introduce economic mechanisms to combat land degradation and drought may rather effectively reduce the poverty level and raise the standards of living of the population in CA.

The analysis shows that almost all countries in the region are taking similar measures to counter droughts and water shortage, and reduce their impact on agricultural producers. These measures depend on the level of facilities and resources, as well as laws and regulations of each country. In general, main actions taken by countries are as follows:

Proactive Actions:

- Climate change adaptation measures under national programs and projects by international development partners, aimed to restore the forest-steppe zone, upgrade irrigation systems, introduce advanced energy-efficient technologies and improve the regulatory environment.
- Forest restoration and afforestation, consolidation of sandy areas.
- Creation of storage and drainage lakes (oases).
- Streamlining of international financing and public-private partnership (PPP) in food production and marketing.
- Providing subsidies and incentives for the purchase of equipment, seeds, fertilizers and water saving systems.
- Forecasting climatic deviations in the countries.

Post-drought Actions:

- Insurance for all sectors of agriculture (not in every CA country).
- Monitoring of climatic phenomena by national hydrometeorological services.
- Programs and projects to support farmers and agricultural producers affected by adverse natural phenomena.

While acknowledging the government involvement in the support of agricultural producers, it should also be noted that not all countries are capable of or ready to provide both reactive and proactive countermeasures. Given that neither country takes direct and indirect losses from droughts and water scarcity into account, promotion of proactive actions related to drought management and mitigation is quite complex.

Currently, the IFAS and its structures have an interstate mandate to strengthen a region-wide inter-sectoral dialogue on environmental protection and sustainable development, as well as rational use of water resources. The region therefore has an institutional capacity to build a dialogue and establish a framework for drought risk management and mitigation.

It should be especially noted that all CA countries are prone to droughts and annually suffer direct and indirect losses and economic damages. Droughts, in a successive manner, undermine the economic, environmental and social foundations of the five countries' well-being, and hinder their social and economic growth. Being closely interrelated within common river basins, markets, border regions, migration flows, historical and cultural ties, the countries of the region join forces for projective and coordinated action to counter DLDD and minimize economic and social problems.

REGIONAL DROUGHT RISK MANAGEMENT AND MITIGATION STRATEGY IN CA FOR THE PERIOD 2021-2030 AND MID-TERM ACTION PLAN FOR THE PERIOD 2021-2026

Vision: Countries achieve their long-term social, economic, technical and institutional development goals for effective and sustainable drought management and improve their capabilities to address other natural hazards, especially those arising from anthropogenic factors contributing to desertification, land degradation and drought through regional cooperation and collaborative action.

Strategic Goal: increase the region's resilience to drought and water shortage periods, based on the transition from a reactive to a preventive approach and regional integration.

Focus Areas

Based on the situation analysis, the following directions are proposed to help reduce the risks and consequences of drought and water shortage periods in the context of the region, and serve as a basis for working out the tasks reflected in the REP4SD-CA in the context of droughts and in the UNCCD supported activities.

Area 1: Building Capacity for Monitoring, Risk Assessment and Drought Prevention

As monitoring and forecasting of hydroclimatic and meteorological phenomena is the domain of hydrometeorological services in the region, **it is necessary to upgrade the material and technical capabilities of national hydrometeorological services in each country and implement innovative solutions for drought monitoring and forecasting.** In its initial stage, this could be based on publicly available databases, and involve calibration and testing in pilot areas, but should be supported by national and regional hydroclimatic and meteorological data. Development of a drought monitoring and early warning system for Central Asia, will improve decision-making in the planning and risk management with regards to drought impacts on food and water security in the region.

Data sharing has to be established between data collectors, academia, experts and government, because preparedness for drought and water shortage periods would means that risk mitigation and institutional actions are taken before the onset of droughts takes place to effectively address its impacts and minimize its negative effects on the population, economy and environment. These measures are consistent with the country's objectives, provided that there are data available and the best practices and advanced technologies are used.

The governments usually are reluctant in committing funds for such measures unless there is a reliable information on costs and losses resulting from inaction. A political decision to monitor the impacts (both indirect and direct) from droughts and water shortage periods in each country should become a key indicator that would trigger a chain reaction. Common approach and methodology should be applied across the region to communicate on the drought impact, including gender responsive drought impact analysis.

Furthermore, the countries are already fully engaged in implementation of priority areas set forth in the Sendai Framework for Disaster Risk Reduction (2015-2030), Action Plan of the Regional Environment Programme for Sustainable Development in Central Asia (REP4SD-CA), and in the achievement of the SDGs.

Area 2: Drought Mitigation, Development of Plans to Address Water Scarcity and Data Dissemination

Due to variability in precipitation patterns and dynamics, as well as reduced flows of glacial meltwater, climate change and increasingly extreme weather events are expected to have an adverse impact on the capability of the existing drinking water infrastructure to provide a stable water supply.

Further promotion of introduction of drought-tolerant crop varieties and water-saving irrigation technologies, as well as institutionalization of Integrated Water Resources Management (IWRM) concepts will contribute to increasing knowledge and changing traditional farming and ranching practices. The interest of the scientific community in the drought and climate change topic leads us to believe that research work in the field of breeding and seed production, as well as breeding of climate-resistant crops with high yields in laboratories and nurseries can become the basis for addressing the negative impacts of DLDD and climate change, and facilitate the exchange of best practices with neighboring countries.

Alongside with drought and water resources management plans (which are heavily dependent on the availability of funds), special emphasis should be made on supporting agricultural producers to

provide meteorological and climate-sensitive data at no cost, and raise their awareness regarding alternative crops and innovative drought management solutions.

Financial solutions for drought preparedness should be explored such as drought insurance which would protect farmers from financial losses.

Area 3: Capacity Building and Awareness Raising

It is important to raise awareness of the rural population (including women) on climate change adaptation and efficient farming practices. It is important to increase their involvement and participation in decision-making processes for area development, as they play an important role in passing on the knowledge gained to their children. In the long run, this may lead to behavioral changes both in specific rural communities and in the whole region.

Consideration should also be given to conducting awareness-raising activities on combating desertification and land degradation, especially in arid regions. These activities may involve local and national media, as well as accessible social communication channels. This will also help enhance regional integration and drought management, because the border area population will have enough information to understand the importance of joint action.

Given the context and the core group of beneficiaries, implementation of this task may be supported, both financially and thematically, by international development partners possessing extensive experience in this area.

Concurrently, it is necessary to integrate the issue of increasing the institutional capacity of academic and research institutions dealing with climate change and forecasting water shortage periods and droughts in the region. Development of facilities and methodologies for DLDD research in the region should be one of the most important areas of focus.

Area 4: Regional Cooperation

Given the transboundary nature of drought impacts, cooperation between the countries of the region is critical not only to reduce the pressure on the environment and minimize factors affecting security and stability of the region, but also to carry out proactive joint actions on climate change adaptation and management of adverse natural phenomena associated with climate change.

Measures taken by the Central Asian countries' governments at the regional level to introduce the principles of rational and sustainable use of natural resources, restore degraded lands, combat desertification and preserve biological diversity must be enhanced. Implementation of such measures may involve integration of priority projects of the 4th Aral Sea Basin Program (ASBP-4) and REP4SD-CA objectives, with a special emphasis on mitigating the drought impact on Central Asian economies, into projects and initiatives of international development partners. Special consideration should be given to monitoring, forecasting and countering droughts, dry winds and water shortage periods.

Coordination Mechanism of the Strategy

In 2019, the ICSD members approved the REP4SD-CA for the period of 2021-2030. This Program aims at regional cooperation in the area of environmental protection in Central Asia through coordination of national priorities and country development programs in transboundary and related areas.

It is suggested that the priority activities of the Regional Strategy are integrated in the REP4SD-CA and are further coordinated through the policy advocacy and partnership building. Drought agenda will be consistently included in the messages and presented at the High-level meetings organized

within the framework of ICSD where activities within the REP4SD-CA are reported back to the countries and donor community.

It is important that ICSD and other international partners working within the framework of the priority areas identified in the Regional Strategy collaborate with the UNCCD, UNFCCC and UNDRR to ensure proper climate, DLDD and DRR related synergetic activities.

MID-TERM ACTION PLAN FOR THE PERIOD 2021-2026

Objective	Actions	Expected Outcomes	SDGs Affected
Area 1: Building Capacity for the Monitoring, Risk Assessment and Drought Prevention s			
Institutional reforms	Consider inclusion of drought and dust transfer issues in the Central Asian countries' by-laws to enhance the potential for regional integration	- More attention is paid to drought issues at the government level; - Conditions are provided for data exchange and planning of joint actions; - The tasks and problems of each country are approached to from a regional standpoint.	SDG 9, SDG 10, SDG 13, SDG 14
	Prioritize climate change and drought issues at the national level through assessments of damages incurred by droughts and inaction		
	Promote regional integration to ensure joint action on drought and water shortage periods prevention and mitigation		
Transfer of technology and establishment of a drought monitoring and early warning system	Expand gauging stations (each agroclimatic zone to have several stations) – contingent upon equipment capabilities of hydrometeorological services in each country	- The government and end users will receive more accurate data and timely forecasts; - Timely dissemination of high-quality forecasts will enable the population and agricultural producers to improve their preparedness and enhance their resilience to droughts and water shortage periods; - The basis for the development of environmental and food security plans will be provided.	SDG 9, SDG 11, SDG 13
	Information and early warning Forecast and warn of droughts and water shortage periods		
	Enhance data exchange and interaction between hydrometeorological services and emergency agencies, as well as expert communities in CA countries		
Development of instructional guides and tools for the profiling of climate risks and adaptation measures	Identify and adapt the best practices for drought monitoring and prevention	- Development of methodological manuals and recommendations with a unified approach to data collection and analysis; - Facilitating the data exchange between countries; - Capacity building and knowledge improvement; - Access to international data in the context of the region, with appropriate indicators.	SDG 5, SDG 6, SDG 9, SDG 11, SDG 13
	Document and disseminate lessons learned and good practices to support future learning and provide information support for policies, strategies and programs		
	Integrate publicly available and internationally recognized tools and information sources into the "regional database of hydrometeorological and climate indicators"[9]		
Enhancing collaboration between the expert community, government	Develop uniform standards, monitoring indicators and mechanisms for the economic assessment of drought losses, and put them into practice at the national level	- The data obtained are used to promote pro-active approaches;	SDG 5, SDG 6, SDG 11, SDG 13

[9] *DroughtToolBox, WOCAT, NASA, FAO, ICARDA, WMO*

Objective	Actions	Expected Outcomes	SDGs Affected
agencies and hydrometric service providers	Develop/adapt and test mechanisms and tools for drought management and preparedness	- Indicators are used to develop national action plans; - Reports on international framework conventions are supported with ample statistical and factual data; - Improved interaction between all responsible services; - The best practices in drought preparedness and management help reduce risks and losses from droughts and water shortage periods.	
	Design a data collection and analysis algorithm to make reports and memoranda		
	Disseminate the data obtained and test them in CA		
Area 2: Drought Mitigation, Development of Plans to Address Water Scarcity and Data Dissemination			
Integration of innovative solutions into national plans on drought and water shortage periods management and mitigation, and on IWRM	Update and finalize national emergency plans and drought and water shortage periods management plans, with innovative and adapted practices taken into account	- Integration processes are based on universal and adapted methods of drought and water shortage periods management; - Commitments under international agreements correspond to the countries' objectives and are contemporized.	SDG 5, SDG 6, SDG 7, SDG 8, SDG 9, SDG 11, SDG 13
	Learn the know-hows and integrate the results obtained into global databases to share the best practices		
	Sync up objectives and activities under the UNCCD and UNFCCC NAPs, SDGs and other national development plans, as well as global commitments		
	Set up watering points for wild animals and birds on their migration routes		
	Ensure sustainable functioning of wetlands		
	Improve the regional IWRM system to level peak loads during seasonal water use		
Increasing the resilience of agriculture to climate change and diversification of agricultural practices and climate resilient plants	Identify key vulnerable areas and economic sectors related to agriculture and food security	- Using hydrometeorological data and a science-based approach, agricultural producers have the opportunity to plan their crops and take actions to mitigate the impact of adverse natural phenomena.	SDG 5, SDG 7, SDG 8, SDG 9, SDG 11
	Identify available financial resources		
	Identify the best alternative agricultural practices		
	Propagate sustainable agricultural practices through educational and government programs		
	Reuse low-salt drainage effluents for the cultivation of salt-tolerant plants and the development of transhumance		
Raising public awareness and that of agricultural producers about droughts, management measures and planning techniques	Forecast and warn of drought probability	- The population is enabled to respond to potential droughts and water shortage periods, and has financial protection capabilities.	SDG 5, SDG 6, SDG 9, SDG 13
	Provide farmers with assistance in reaching out to new food markets		

Objective	Actions	Expected Outcomes	SDGs Affected
	Provide access to agricultural insurance against drought and water shortage periods risks		
	Set up a network of watering points in natural pastures using solar and wind energy		
	Carry out an extensive public awareness campaign on measures suggested for drought mitigation, land, pasture and hayfield management, as well as management of other natural resources		
Enhancing the social protection systems within drought management	Involve local self-government bodies in the use of natural resources and development of environmental and adaptation messages	- Local communities are more involved in environmental protection and aware of the opportunities and risks associated with drought and climate change.	SDG 5, SDG 6, SDG 9, SDG 13
Area 3: Capacity Building and Awareness Raising			
Building the capacity of women, local communities, national academic institutions and decision-makers to monitor, evaluate and understand direct and indirect impacts of drought on the social and economic development	Improve material and technical capacities of hydrometeorological services in CA countries through updating, upgrading and expanding the monitoring station networks; Prepare information about alternative crops and innovative water saving solutions; Involve women and community elders for advocacy work.	- Hydrometeorological services are capable of making high-accuracy forecasts; - Data are collected and processed in accordance with international standards; - A basis for the exchange of data, experience and knowledge has been established at the regional level; - Hydrometeorological services promptly and efficiently provide accurate climate-related data and analyses to stakeholder ministries; - Local communities are able to understand the provided data and make educated decision about their agricultural practices.	SDG 6, SDG 9, SDG 10
	Enhance professional capacities of hydrometeorological services in CA countries through workshops, sharing of experience and application of the world's best practices; Stimulate top-down and down-top information exchange for better decision making and adaptation measures.		
Improving the knowledge of persons making decisions on climate change and drought, and on their impact on various economic sectors	Arrange workshops and study tours for representatives of European countries to exchange experiences in implementation of pro-active approaches at the national level, with science-based facts and data taken into account; Support local women via Woman Forums in making their voices heard.	- Decision makers understand the relationship and impact of drought on different economic sectors; - Environmental protection, climate change adaptation and anthropogenic impact on ecosystems are addressed at the regional level.	SDG 6, SDG 8, SDG 9, SDG 10, SDG 15
Establishing strong collaborative partnerships between providers and users of hydrometeorological services, regional and national government agencies and the private sector	Assess the drought impact on key economic sectors (water, energy, food export) in monetary terms, and disseminate these data at all levels	- Monetary expression of economic losses facilitates pro-active approaches in drought and water shortage periods management; - Sectoral ministries have begun to advocate for drought prevention efforts; - Local communities are involved in collecting and sharing data with hydrometeorological services; - Practices of sustainable and rational use of natural resources are conveyed to a broad range of stakeholders.	SDG 5, SDG 6, SDG 17
	Set up a data exchange channel between agricultural producers and analytical centers as part of the digitalization process in the agricultural sector		
	Provide especially vulnerable groups with an opportunity to receive hydrometeorological information without impediment		
	Involve local communities (especially those residing in remote mountain areas) in climate monitoring		

Objective	Actions	Expected Outcomes	SDGs Affected
Joint actions on gender-sensitive and youth-centered approaches to drought management (social integration)	Involve local communities and NGOs working on youth issues and women's rights in project implementation at the national and regional levels; Local media are engaged in information sharing.	- Coherent actions may help reach an understanding of the needs for regional integration and joint actions related to environmental issues at the transboundary level.	SDG 5, SDG 7, SDG 8, SDG 9, SDG 11
Institutionalizing coordination, communication and partnerships in countries	Determine the basis for regional cooperation at the national level through public authorities and local government bodies. Promote the establishment of transboundary cells to address local issues related to drought and climate change through the exchange of experiences and knowledge.	- Drought and climate change issues take on a national character, but their solution contributes to regional stability and integration.	SDG 17
Area 4: Regional Integration			
Establishing a regional database of agrometeorological and hydroclimatic indicators	Prepare a complete analysis of regulatory norms in order to establish a regional database of agrometeorological and hydroclimatic indicators	- The regional database of agrometeorological and hydroclimatic indicators helps reduce drought vulnerability and risks	SDG 9, SDG 11, SDG 13, SDG 14, SDG 15, SDG 17
	Establish a regulatory framework for regional data exchange		
	Analyze the readiness of hydrometeorological service systems to exchange data		
	Develop an electronic cadaster of drought occurrence and distribution in the Central Asian region, taking drought frequency, duration and strength into account		
	Initiate a pilot project		
Integration into the Regional Environment Programme for Sustainable Development in Central Asia (REP4SD-CA)	- Coordinate actions and propagate objectives - Implement joint actions - Mobilize resources	- Drought management and mitigation proposed in the Regional Strategy for Drought Risk Management and Mitigation in Central Asia are being implemented	SDG 6, SDG 9, SDG 14, SDG 15, SDG 16, SDG 17
Establishing the information message "One Region, One Ecosystem"	- Jointly with the UNCCD NC and the UNFCCC, develop a message to shape the region's common vision on climate change, drought, and land degradation - Coordinate actions and propagate objectives	- Each country's challenges, issues and opportunities are viewed as regional objectives and presented globally as uniform objectives	SDG 6, SDG 8, SDG 9, SDG 10, SDG 13, SDG 14, SDG 15, SDG 16, SDG 17
Strengthening integrated planning for the management of natural resources, including water, natural resources, land (pastures, plantations, etc.) and energy, i.e. including the WEF Nexus	- Hold multi-sectoral and multi-level discussions and decision-making, taking the needs and capabilities of economic sectors hit hardest into account - Discuss objectives on regional and international platforms	- The region works in sync and takes both costs and benefits of joint coordinated actions into account	SDG 17

BIBLIOGRAPHY

Barker, L.J., Rickards, N.J., Sarkar, S., Hannaford, J., King-Okumu, C., Rees, G. (2021). *Good Practice Guidance for National Reporting on UNCCD Strategic Objective 3*. United Nations Convention to Combat Desertification (UNCCD), Bonn, Germany.

BRIF Research Group (n.d.). *The Central Asian Economy*. URL: https://www.brif.kz/blog/?p=3338

Cawater-info.net (2012). National Action Program to Combat Desertification in the Republic of Kazakhstan. Astana. URL: http://www.cawater-info.net/bk/water_land_resources_use/russian_ver/pdf/kazakstan-rus2001.pdf

Central Asia Initiative for Land Management (CACILM) (2006). *Republic of Tajikistan National Programming Framework*. Prepared by UNCCD National Working Group of the Republic of Tajikistan. URL: http://www.adb.org/Project/CACILM/Documents.asp

Center for Emergency Situations and Disaster Risk Reduction (CESDRR) (2020). *Drought assessment study and drought monitoring models in Central Asia*. Almaty: CESDRR. URL: https://cesdrr.org/uploads/projects/2.10.%20%D0%98%D1%81%D1%81%D0%BB%D0%B5%D0%B4%D0%BE%D0%B2%D0%B0%D0%BD%D0%B8%D0%B5%20%D0%BF%D0%BE%20%D0%BF%D1%80%D0%BE%D0%B1%D0%BB%D0%B5%D0%BC%D0%B0%D0%BC%20%D0%B7%D0%B0%D1%81%D1%83%D1%85%20%D0%B2%20%D0%A6%D0%90.pdf

Chikunov, N. (2021). Not to be left in the desert: what can save Kazakhstan from drought? Sputnik Kazakhstan. URL: https://ru.sputnik.kz/Asia/20210715/17616453/kazakhstan-zasukha-voda-problemy.html

CIS Council of Heads of States (2004). *Decision of the CIS Council of Heads of States On the Concept of Hydrometeorological Security of the Member States of the Commonwealth of Independent States*. URL: http://docs.cntd.ru/document/902212911

Fillo, G., & Negruta, A. (2020). *KEEP THE PROMISE, ACCELERATE THE CHANGE: Taking stock of gender equality in Europe and Central Asia 25 years after Beijing*. UN Women. URL: https://www2.unwomen.org/-/media/field%20office%20eca/attachments/publications/2020/10/beijing%20report-min.pdf?la=en&vs=313

Food and Agriculture Organization of the United Nations (FAO) (n.d.). Central Asia: Pastoralist Knowledge Hub. URL: http://www.fao.org/pastoralist-knowledge-hub/pastoralist-networks/regional-networks/central-asia/en/

General Directorate of Hydrometeorology under the Cabinet of Ministers of the Republic of Uzbekistan (GDHCM RU) (1999). *National Action Programme to Combat Desertification in the Republic of Uzbekistan*. UNCCD. URL: https://knowledge.unccd.int/sites/default/files/naps/uzbekistan-rus1999.pdf

Green World Future (GWF) (2021). *National Action Plan on SDS Prevention and Mitigation in the Republic of Uzbekistan*. Prepared within the framework of UNCCD-financed regional pilot project "Regional Approached in Combationg Sand and Dust Storms and Droughts". Tashkent.

Hijioka, Y., E. Lin, J.J. Pereira, R.T. Corlett, X. Cui, G.E. Insarov, R.D. Lasco, E. Lindgren, and A. Surjan (2014). *Asia. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1327-1370.

International Organization for Migration (IOM) (2004). *International migration law*. Geneva: IOM International Organization for Migration. URL: https://publications.iom.int/books/international-migration-law-ndeg34-glossary-migration

Kerven, C., B. Steimann, L. Ashley, C. Dear, I. Rahim (2011). *Pastoralism and Farming in Central Asia's Mountains: A Research Review*. MSRC Background Paper No. 1. URL: http://www.ucentralasia.org/downloads/pastoralism_and_farming_in_central_asia_mountains

Kerven, C., B. Steimann, L. Ashley, C. Dear (2012). *Researching the Future of Pastoralism in Central Asia's Mountains: Examining Development Orthodoxies*. Mountain Research and Development, 32(3), 368-377. URL: http://www.jstor.org/stable/mounresedeve.32.3.368

Ministry of Agriculture of the Republic of Kazakhstan (MoA RK) (2020). *The Committee of State Inspection in the agro-industrial complex recapped the results of work in 2020*. URL: https://www.gov.kz/memleket/entities/agroindust/press/news/details/140059?lang=ru

National Institute for Strategic Studies of the Kyrgyz Republic (NISS KR) (2016). *Kyrgyzstan: Extended Migration Profile 2010-2015*. Bishkek, Kyrgyzstan: International Organization for Migration. URL: https://kyrgyzstan.un.org/sites/default/files/2020-02/Migration-Profile-Extended-Kyrgyzstan-Eng-2010-2015_0.pdf

National Statistical Committee of the Kyrgyz Republic (NSC KR) (2016). *Kyrgyzstan in Numbers*. Statistical Digest. National Statistical Committee of the Kyrgyz Republic. URL: http://stat.kg/media/publicationarchive/b40aaf45-f887-467a-8b7d-ca3943392999.pdf

Nurberdiyev M., Bekiyeva G.S., Mamedov B.K., Orlovskaya L.G. (2009). *Drought and Yielding Capacity of Pastures in Lowland Turkmenistan // Arid Ecosystems.* #37. URL: https://cyberleninka.ru/article/n/zasuha-i-urozhaynost-pastbisch-ravninnogo-turkmenistana

Ogawa, H. (2018). *Inequality in the era of the 2030 Agenda for Sustainable Development: North and Central Asia*. Almaty, Kazakhstan: United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP). URL: https://www.unescap.org/sites/default/d8files/knowledge-products/Inequality%20in%20the%20era%20of%20the%202030%20Agenda%20for%20Sustainable%20Development%20North%20and%20Central%20Asia_EN.pdf

Organization for Security and Co-operation in Europe (OSCE) (2017). *Regional Assessment: Climate Change and Security in Central Asia*. URL: https://www.osce.org/files/f/documents/6/7/332001.pdf

Podarilove (n.d.). *Analysis of resource potentials of central asia countries.* Natural Resources of Central Asia Fuel Resources of Central Asian Countries. URL: https://podarilove.ru/analiz-resursnyh-potencialov-stran-centralnoi-azii-prirodnye-resursy/

Poletaev, D. (2014). *Working Paper: Migration and Skills in North and Central Asia*. United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP). URL: https://www.unescap.org/sites/default/d8files/knowledge-products/2%20Migration%20and%20Skills%20Eng%20report%20v3-4-E.pdf

Popov, V. (2018). Oil, Water, Biofuels: Tajikistan's Future in Energy Sources. URL: https://tj.sputniknews.ru/20181005/neft-voda-biotoplivo-istochniki-energii-tajikistan-1026983198.html

Raisova, Z. (2019). *Central Asia may suffer massive losses due to climate change*. URL: https://newtimes.kz/obshchestvo/92640-tsentralnaya-aziya-mozhet-ponesti-masshtabnye-poteri-iz-za-izmeneniya-klimata-vsemirnyj-bank

Regnum.ru (2018). The deterioration of Kyrgyz electricity networks reaches 70%. URL: https://regnum.ru/news/economy/2510424.html

Rocca, V., Bosciani, J., & Giuseppe, S. (2015). *Rural Women in Eastern Europe and Central Asia - The Gender Gap in Agriculture*. FAO. URL: http://www.fao.org/3/i3840r/i3840r.pdf

Russell, M. (2018). *BRIEFING: Water in Central Asia: An increasingly scarce resource*. European Parliamentary Research Service. URL: https://www.europarl.europa.eu/RegData/etudes/BRIE/2018/625181/EPRS_BRI(2018)625181_EN.pdf

Sadovskaya, E. (2013). *International Labor Migration in Central Asia at the Beginning of the 21st Century (Case Study of the Republic of Kazakhstan)*. Moscow, Russian Federation: Vostochnaya kniga.

Saidov, M. (2021). *National Action Plan on SDS Prevention and Mitigation in the Republic of Tajikistan*. Prepared within the framework of UNCCD-financed regional pilot project "Regional Approached in Combationg Sand and Dust Storms and Droughts". Dushanbe.

SNG Today (2021). *The Ministry of Agriculture of the Kyrgyz Republic proposed a ban on the export of food products due to the drought.* URL: https://sng.today/bishkek/17456-minselhoz-kirgizii-predlozhil-vvesti-zapret-na-vyvoz-produktov-pitanija-iz-za-zasuhi.html

Sputnik News Tajikistan (2021). *Profitable Drought: Tajikistan Ready to Exchange Water for Fuel from Kazakhstan.* Sputnik News Tajikistan. URL: https://tj.sputniknews.ru/20210609/tajikistan-kazakhstan-syrdarya-voda-toplivo-obmen-1040114550.html

Stulina, G. (2012). *Results of a Gender Survey under IWRM Implementation in the Ferghana Valley*. Tashkent, Uzbekistan. URL: http://www.gender.cawater-info.net/publications/pdf/gender_and_water_en.pdf

The official news resource of the Prime Minister of the Republic of Kazakhstan (PM RK) (2021). *Head of the Government instructed to provide assistance to farms affected by the drought in Mangistau region.* URL: https://primeminister.kz/ru/news/glava-pravitelstva-poruchil-okazat-pomoshch-fermerskim-hozyaystvam-postradavshim-ot-zasuhi-v-mangistauskoy-oblasti-216454

Trapeznikov, V. (2017). *Electric Power Industry of Turkmenistan: Achievements and Development Prospects.* URL: https://turkmenportal.com/blog/11652/elektroenergetika-turkmenistana-dostizheniya-i-perspektivy-razvitiya

United Nations (2021). *Water.* URL: https://www.unsecretariat.net/sections/issues-depth/water/index.html

United Nations Convention to Combat Desertification (UNCCD) (2017). *ICCD/COP(13)/L.18: The future strategic framework of the Convention*. Ordos, China.

United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) (2017). *The 1st Expert Group Meeting on Development of Decision-making Tools for Geo-drought Monitoring and Early Warning in Central Asia.* URL: https://www.unescap.org/events/1st-expert-group-meeting-development-decision-making-tools-geo-drought-monitoring-and-early

United Nations Office for the Coordination of Humanitarian Affairs (UN OCHA) (2014). *GIEWS Update Kyrgyzstan: Severe drought in northern parts affects 2014 wheat production - Kyrgyzstan.* URL: https://reliefweb.int/report/kyrgyzstan/giews-update-kyrgyzstan-severe-drought-northern-parts-affects-2014-wheat

United Nations Office for Disaster Risk Reduction (UNISDR) (2016). *Action Plan for the Implementation of the Sendai Framework for Disaster Risk Reduction 2015-2030 in the Central Asia and South Caucasus Region*. UNISDR. URL: https://www.preventionweb.net/files/57668_cascplanofactionforsendaiframeworki%5B1%5D.pdf

World Bank (WB) (2005). *Drought: Management and Mitigation Assessment for Central Asia and the Caucasus*. World Bank. URL: https://documents1.worldbank.org/curated/en/642911468023643404/pdf/319980RUSSIAN01over0p0801481PUBLIC1.pdf

World Bank (WB) (2006). *Drought: Management and Mitigation Assessment for Central Asia and the Caucasus.* Regional and Country Profiles and Strategies.

World Meteorological Organization (WMO) (n.d.). *Sand and Dust Storm Warning Advisory and Assessment System (Forecast Maps)*. URL: https://public.wmo.int/en/our-mandate/focus-areas/environment/SDS/warnings

World Meteorological Organization (WMO) and Global Water Partnership (GWP) (2014). *National Drought Management Policy Guidelines: A Template for Action* (D.A. Wilhite). Integrated Drought Management Programme (IDMP) Tools and Guidelines Series 1. WMO, Geneva, Switzerland, and GWP, Stockholm, Sweden.

World Meteorological Organization (WMO) and Global Water Partnership (GWP) (2016). *Handbook of Drought Indicators and Indices* (M. Svoboda and B.A. Fuchs). Integrated Drought Management Programme (IDMP), Integrated Drought Management Tools and Guidelines Series 2. Geneva.

Zoï Environment Network (2018). *Regional assessment: Republic of Kazakhstan, Kyrgyz Republic, Republic of Tajikistan, Turkmenistan, and Republic of Uzbekistan.* Climate Change and Security in Central Asia. URL: https://zoinet.org/wp-content/uploads/2018/02/climsec_CA_report_RU.pdf