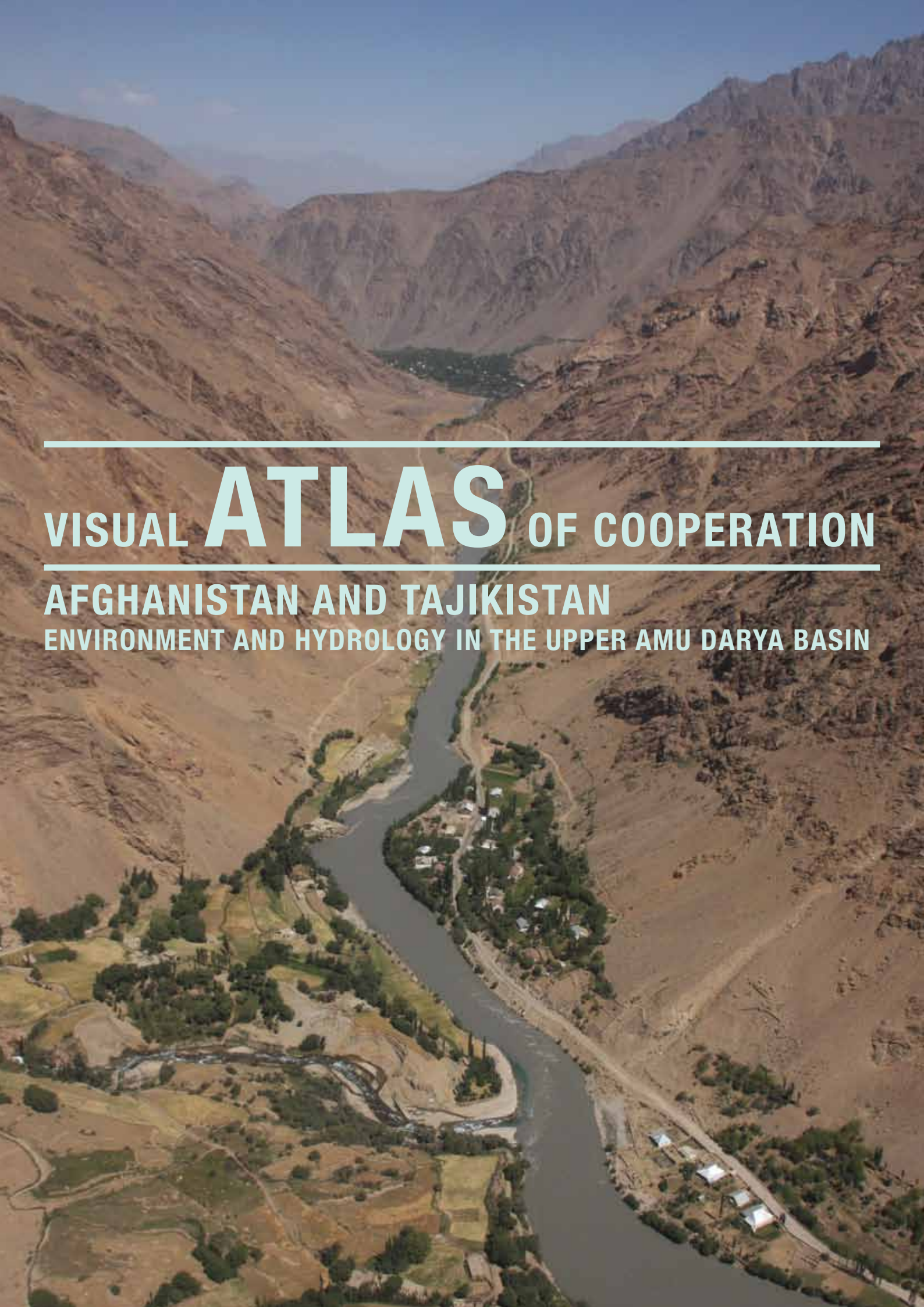

VISUAL ATLAS OF COOPERATION

AFGHANISTAN AND TAJIKISTAN

ENVIRONMENT AND HYDROLOGY IN THE UPPER AMU DARYA BASIN

Published in association with UNECE

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Cover photo: Panj River © Martin Mergili
While the Panj River separates Afghanistan from Tajikistan, it is also bringing the countries together in transboundary cooperation on environmental and hydrological issues of mutual concern.

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ACKNOWLEDGEMENTS

Preparation and production of the atlas involved the review of a broad range of information sources and GIS data, and the engagement of local and foreign experts in fields stretching from foreign policy to hydrometeorology. It would not have been possible to gather the wealth of information and photography for the Atlas without the input of the more than 30 contributors.

Presentations and other materials from the bilateral meetings, “Environment and Hydrology Cooperation between Afghanistan and Tajikistan”, held in Dushanbe and Kabul in 2012 and 2013, and other data collected under the UNECE project, “Strengthening Cooperation on Hydrology and Environment between Afghanistan and Tajikistan in the Upper Amu Darya River Basin”, have been used extensively in the preparation of the atlas.

The producers of the atlas thank all contributors and their organizations in the two countries of the Upper Amu Darya basin for providing their time and expertise. In Afghanistan the Ministry of Foreign Affairs, the Ministry of Energy and Water, the Ministry of Agriculture, Irrigation and Livestock, the National Environmental Protection Agency participated in consultation and review of the atlas. In Tajikistan, inputs and comments to the atlas were provided by the Ministry of Foreign Affairs, the Committee on Environmental Protection and Forestry under the Government of the Republic of Tajikistan and its Hydromet Service, the Tajik Biosafety and Biodiversity Centre, the Ministry of Water Economy and Land Melioration, Tajikistan’s IFAS branch, NGO “Nature Protection Team” and others.

Special thanks are due to senior officials and members of the Afghan-Tajik workgroup, who have monitored the atlas production and provided advice from a professional perspective.

At the UNECE Secretariat, supervision was provided by Bo Libert and Andrey Vasilyev, and draft atlas sections were reviewed by Marton Krasznai, Batyr Hajiyev and Iulia Trombitcaia.

Firuza Illarionova and Anvar Khomidov coordinated the review process of the various drafts and guided local contributions and inputs.

Matthias Beilstein, Emmanuelle Bournay and Viktor Novikov at Zoï Environment Network worked long and hard on the research and preparation of the atlas’s maps and graphics. Maria Libert made the atlas visually appealing and Geoff Hughes aided in a team effort to make the atlas easy to read.

Thanks for the contribution of the outstanding photographs to: Martin Mergili, Lawrence Hislop, Oleg Shipin (photos taken under the DelPHE programme on environment in Northern and Central Afghanistan), Laurie Ashely, Stefan Michel, Vlad Ushakov, Sergey Illarionov, Anvar Khomidov, Neimatullo Safarov, Viktor Novikov (see p. 89 for photo credits). Three satellite images (dust storm in northern Afghanistan, Fedchenko glacier and Medveji glacier) are sourced from NASA Visible Earth.

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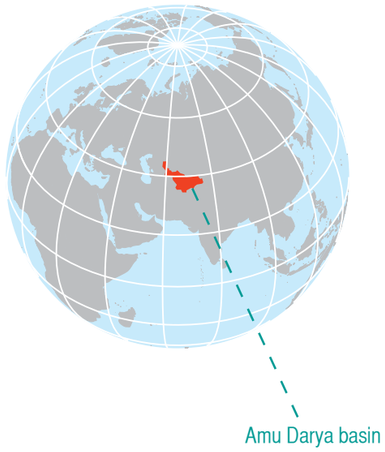


FOREWORD

Economic development and natural resource management are top priorities for cooperation between the Islamic Republic of Afghanistan and the Republic of Tajikistan. For both countries the adequate knowledge and sharing of information about natural resources and hazards are important.

Afghanistan shares the Aral Sea basin with the other Central Asian countries – Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. While water and environmental cooperation is established among the latter countries, there is limited cooperation with Afghanistan. The Upper Amu Darya basin is shared by Afghanistan and Tajikistan and efforts of the two countries to develop cooperation on hydrology and environment are much welcomed.

The United Nations Economic Commission for Europe (UNECE) decided in 2011 to initiate a project within the framework of the United Nations Special Programme for the Economies of Central Asia to support the cooperation between Afghanistan and Tajikistan on environment and water issues. The project builds on the principles of the UNECE Convention on Protection and Use of Transboundary Watercourses and International Lakes and other UNECE environmental conventions. Funding was kindly made available by the Government of the Russian Federation.

The UNECE Water Convention is currently the only international legal framework in force governing the management of transboundary water resources. The implementation of the convention has led to significant improvement in transboundary water management in the UNECE region, making it the most advanced in this respect worldwide. The Parties amended the convention in 2003 to open it up to non-ECE countries. It is expected that non-UNECE countries such as Afghanistan will be able to accede to the convention at the end of 2013. Neither Afghanistan nor Tajikistan is a Party, but some of the core principles of the convention are applied in the UNECE project to support bilateral cooperation.

Zoï Environment Network, a nongovernmental nonprofit association based in Switzerland, has contributed to UNECE water assessments and helped facilitate implementation of UNECE and United Nations conventions in Central Asia. Based on this work and Zoï's previous work with Afghanistan, the organization was invited to assist in the facilitation of the Afghan-Tajik cooperation process. In the development of this atlas, Zoï's special talents for presenting environmental issues visually have been of particular value.

A bilateral meeting was organized in March 2012 in Dushanbe to discuss common priorities and the institutional platform for cooperation. The lack of broadly available information on water and the environment was identified as an impediment. It was decided to develop an atlas with contributions from the two countries to provide an accessible, substantive background for the further development of bilateral cooperation.

With 100 photos and 50 maps and graphics based on official sources and original research, this well-illustrated atlas presents information at the river basin – as opposed to the national – level, and portrays challenges from the regional rather than the country perspective. With the objective of supplementing information already available in each of the countries, the atlas is designed to help local policymakers and experts as well as readers outside the region, donors and the international community understand the basin's natural resources, common needs and priorities. It starts with brief introductions to the countries, illustrates the Amu Darya River basin as a part of the Aral Sea basin and provides details on the Upper Amu Darya.

ABOUT THIS ATLAS

Maps, graphics and photographs are a rich and effective way of depicting the environment and ongoing ecological changes, but such visual presentations can tend to make the environment seem a bit simpler or more ideal than it may really be. This atlas makes no claim for either completeness or objectivity: something is always omitted and someone – photographer, cartographer, analyst, writer and editor – always makes a decision about what to include or exclude. But while this atlas may be unavoidably subjective in some respects, it strives to be accurate and useful.

Physical and social geographers, water scientists, policymakers and practitioners define the borders of the Amu Darya River basin according to different criteria. This atlas uses a combined approach that fits several of the definitions. Geographically, the beginning of the Amu Darya River is the confluence of Vakhsh and Panj rivers, and all areas above this point belong to the Upper Amu Darya. At the same time, the river basin definition in Afghanistan considers the Kunduz River as part of the Upper Amu Darya so the atlas takes this into account. While the Kofarnihon River in Tajikistan and the Khulm and Balkab rivers in Afghanistan have many common environmental and social characteristics with the Upper Amu Darya basin, they are not part of it in the context of this atlas and therefore not covered in detail.

Ride a donkey on breathtaking mountain trails or take a boat down rapid rivers in the Upper Amu Darya basin and you will hear the same valley, river or place called by different names. The spelling of geographic names (rivers, lakes, mountains, settlements, places of interest) in this atlas generally follows the internationally accepted and well-known names, and reflects local names in common usage in both countries, based on reviewers' comments.

The atlas includes several two-page illustrations, some with maps coupled with graphics, diagrams, photographs and text captions to create a compelling and visual presentation of information, and to provide readers a broader understanding of the priority environmental issues and trends in a geographic context. Maps with photographs are visualized narratives of selected atlas themes, such as land cover, climate change or natural disasters.

Many maps have shaded-relief backgrounds to provide a sense of terrain. Selected features (mountain summits and chains, main rivers, cities and villages) are labelled. Rivers, lakes and wetlands are mainly shown in blue, but sometimes in gray or another colour to fit the overall design. Within a map, featured places and issues are illustrated in colour, while adjacent areas are shown in little detail. In most cases a vertical header gives the title of the map.

The original maps were designed mainly for standard-sized A4 (210 x 297 mm) and A3 (297 x 420 mm) formats, although the digital version of the atlas allows readers to zoom to print the desired size. The scale and size of all maps correspond to the amount or complexity of the information shown on the maps or the visuals within the maps. Detailed references for all maps and other data used in the atlas are provided in the Reference section. Suggestions or comments regarding the atlas contents and its further evolution and improvements are welcome.

PREFACE – THE ISLAMIC REPUBLIC OF AFGHANISTAN

Most people in Afghanistan depend on natural resources as the backbone to their livelihoods. Therefore, protection and proper management of natural resources, water being the most valuable, is key for job creation, the improvement of people's livelihoods and poverty alleviation.

Afghanistan is an upstream country of the Amu Darya River basin. After Tajikistan, Afghanistan produces the second-largest quantity of water flowing into the basin from its highland areas. However, due to the past three decades of war, Afghanistan has not had the opportunity to manage its water resources properly, which explains why Afghanistan uses the least water from this basin. Concurrently, due to global warming, climate change and inconsistent patterns of rainfall, the region has experienced seasonal floods and droughts that have caused widespread damage across the region in recent years. Similarly, devastation of vegetation cover in the basin, especially in the upstream areas, is also one of the main factors leading to increased flood occurrences, causing catastrophic destruction of the environment and infrastructure in Afghanistan. Therefore, the restoration of vegetation cover in the Upper Panj-Amu Darya River basin is one of our main priorities.

Furthermore, due to the decades of war, the hydrological network of the country has been completely destroyed and thus we are faced with a shortfall of the hydrological data necessary for hydrologic studies and analyses. This issue has created problems in the planning and management of water resources and is a serious limiting factor in flood and drought forecasting and warning systems. In order to address this problem, the rehabilitation of a number of hydrological networks and activities, including the renovation of some hydrological stations, has resumed after a long suspension from 1980 to 2007. We hope that with data exchange between Tajikistan and Afghanistan, we will be able to develop and implement flood and drought warning systems. Together through our mutual cooperation efforts, we can work to decrease the negative impacts on our countries.

Afghanistan has deep historical and cultural ties with Tajikistan. The Panj-Amu Darya River basin forms the geographical border between the countries, and it has been a border of friendship and brotherhood throughout history.

Presently, both countries are faced with major challenges resulting from negative impacts of climate change, loss of important ecosystems and biodiversity, exponential population growth and the resultant increased demand for water and energy by the upstream communities of the Amu Darya River basin on both sides of this shared water boundary. We need to address these problems jointly.

The inhabitants of the mountainous areas that form the upper parts of the basin have inherited the land and water resources from past generations who have lived and worked in these areas for hundreds of years, guaranteeing a sound and sustainable subsistence-based economic situation and environmental sustainability. Therefore, it is the responsibility of both our nations to continue to protect our natural resources properly against the threats of climate change and population growth, through joint cooperation, and to make sure that we use our natural resources sustainably so that future generations can also use and benefit from them as we are doing now. This is why we support the expansion of our cooperation efforts with Tajikistan in the field of natural resources protection, especially in the Upper Panj-Amu Darya River basin. Fortunately, based on several previous meetings, both sides have expressed a strong interest and belief in this joint cooperation.

The joint development of the Upper Panj-Amu Darya River basin atlas is tangible evidence of this cooperation between our two countries in the areas of environmental protection and hydrological data improvement. And we hope that this cooperation will be further expanded in the future, and that both countries will take the next steps for cooperation with other regional partners in the Panj-Amu Darya River basin.

The Afghan side would like to express its gratitude to the United Nations Economic Commission for Europe (UNECE) and other supporting international institutions for their efforts in facilitating joint cooperation between Tajikistan and Afghanistan regarding environmental protection, hydrological monitoring and rehabilitation and sustainable development of the Upper Panj-Amu Darya River basin. We hope for the continuation of such support and cooperation of the UNECE for both countries.

Eng. Shojauddin ZIAIE
Deputy Minister for Water Sector, Ministry of Energy and Water

PREFACE – THE REPUBLIC OF TAJIKISTAN

The United Nations General Assembly declared 2013 the United Nations International Year of Water Cooperation. To mark the year, Tajikistan will host an international conference in Dushanbe. The timely release of this atlas of cooperation, which demonstrates the complexities of transboundary water issues, adds to the celebration. As the country responsible for most of the water in the Amu Darya basin, Tajikistan appreciates the international approach to the use and monitoring of international rivers.

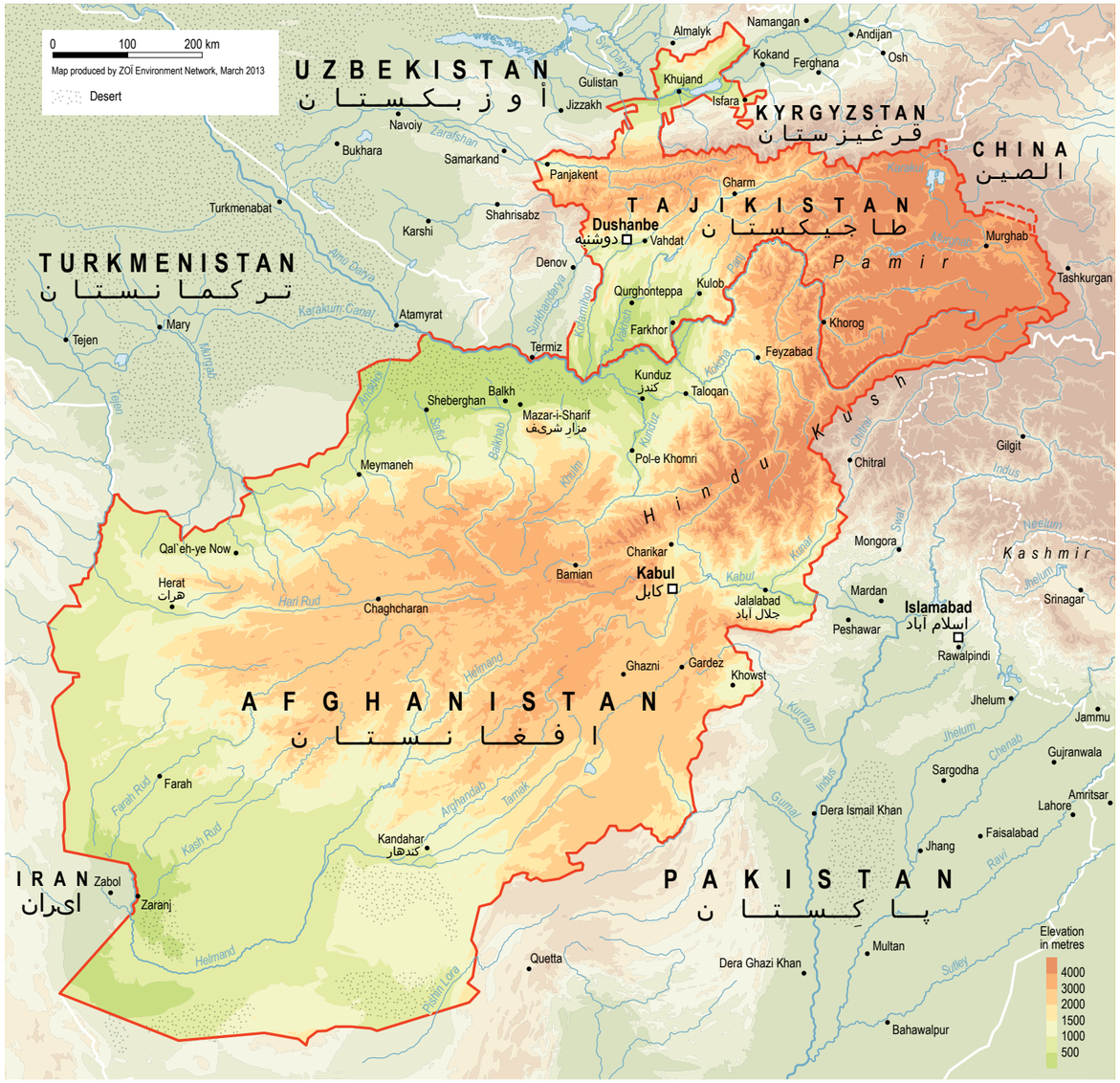
Warm neighbourly relations in the greater Central Asia region are essential to the security, stability and development of the region. A new era of Afghan-Tajik relations builds on the connections established through energy, roads and communications. Both countries can reinforce these trends through cooperation on environmental issues.

Tajikistan has a well-developed network of protected areas, some of which are on the border with Afghanistan where migratory species move between the countries. Biodiversity conservation is one of several areas that will only improve through cross-border cooperation. Hydrological knowledge and observations will improve through strengthened cooperation on water resources, as will the responses to natural disasters and the planning for climate change adaptation.

The agreement on cooperation on the development and management of water resources of the Panj and Amu Darya Rivers, signed on 25th October 2010 by the Ministers of Foreign Affairs in the presence of the Presidents of the Republic of Tajikistan and the Islamic Republic of Afghanistan, represents an important milestone of cooperation between the two countries. Now, Tajikistan is increasingly engaging with Afghanistan on more practical matters – bilateral meetings, the exchange of knowledge and the establishment of task forces and expert groups on environmental and hydrology issues. The countries are currently discussing matters of biodiversity, climate change, and energy. We have shared this common river border for centuries. Together we now see our common interests in economic and environmental cooperation, and can envision such cooperation extended throughout Central Asia.

We welcome all readers to participate in whatever ways they can to support the cooperation between the countries, and we look forward to a bright, shared future.

Dr. Talbak SALIMOV
Chairman of the Committee on Environmental Protection under the Government of the Republic of Tajikistan



Ancient crossroads from India and China to Europe and the Middle East pass through the Afghan-Tajik region of the Amu Darya. The populations here are ancient, too, and mainly rural. The mountain areas are still home to numerous sub-ethnic groups with their own languages and traditions. Problems common to both countries include poverty, energy deficits, vulnerability to natural disasters, and environmental stress and the scarcity of natural resources due to growing populations. Cooperation between the countries can reveal common solutions.

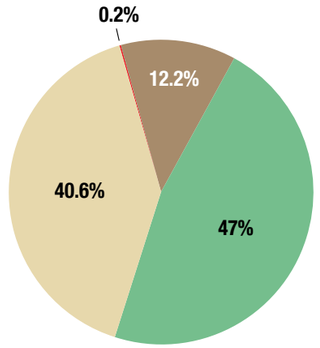
Afghanistan

Tajikistan

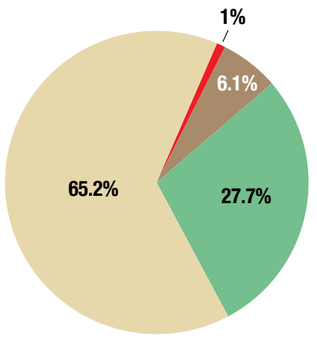
Land use

Pastures
Arable land
Permanent crops
Other land

Source: FAOSTAT (faostat3.fao.org), data for 2011



Land area: 65 223 thousand ha

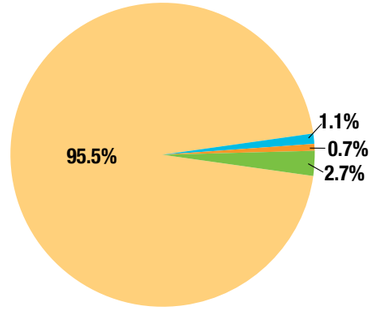


Land area: 13 996 thousand ha

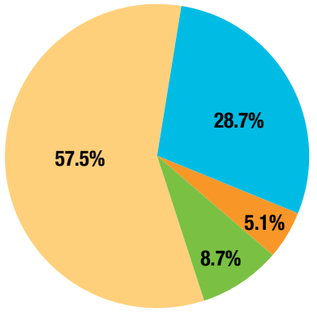
Main crops

Cereals (inc. rice)
Fibre
Roots and tubers
Vegetables

Source: FAOSTAT (faostat3.fao.org), data for 2011



Area occupied by main crops: 2 950 thousand ha



Area occupied by main crops: 715 thousand ha

Arable land, hectare per capita

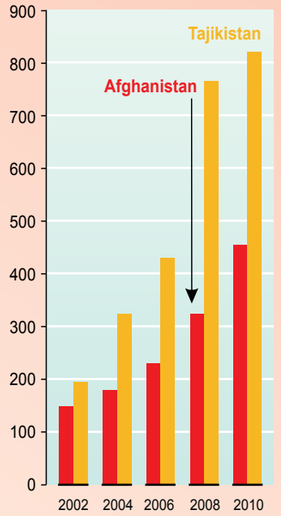
Source: WB World Development Indicators, data for 2010

0.23

0.11

Gross Domestic Product

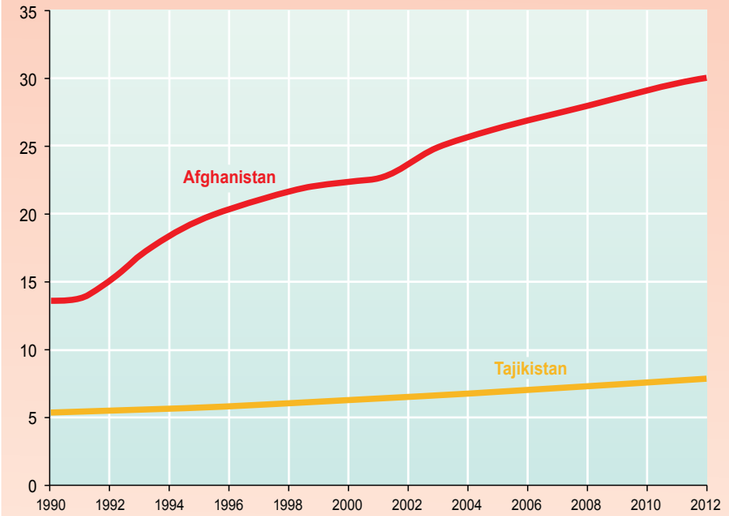
current U.S. dollars per capita



Source: WB World Development Indicators

Population Growth

persons, million

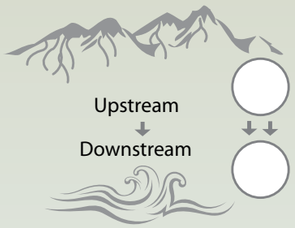


Source: U.S. Census Bureau (www.census.gov/population/international/data/idb/)

Water resources of the Aral Sea basin

Map produced by ZOÏ Environment Network, November 2010
Source: CA Water Info (→ www.cawater-info.net)

Effects of water uses on quantity, quality, timing and sediments



Quantity	Upstream diversion schemes and large dams on downstream irrigation	Water harvesting (or small tanks) on a downstream dam	Cities on irrigation wells (out-pumping)	Deep water wells on shallow water wells
Quality	Cities, industries and large-scale irrigation on public health and farming in downstream regions	Diffuse pollution from agriculture and waste on drinking water supply	Cities on groundwater used in pumping irrigation (contaminating)	Diffuse agricultural pollution on village groundwater-based water supply
Timing	Large-scale hydropower on large-scale irrigation and natural ecosystems	Small tanks on onset of seasonal floods and natural ecosystems	Hydropower generation on wetland ecosystems	Water harvesting on runoff and downstream groundwater recharge
Sediments	Large-scale deforestation on the main rivers and reservoirs	Overgrazing and erosion on reservoirs (siltation)	Dams retaining silt on fertilization of downstream floodplains	Diffuse deforestation on silt load in the rivers and delta alterations

Point, large-scale user or intervention

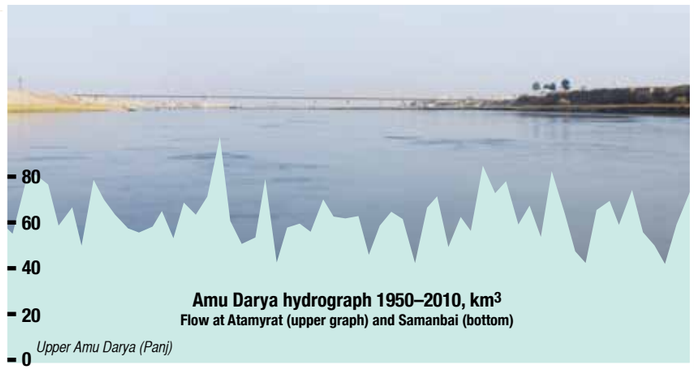
Diffuse, small-scale, scattered users or interventions

Graph adapted from UNESCO's 3rd World Water Development Report (2009)

Map produced by ZOÏ Environment Network, March 2013

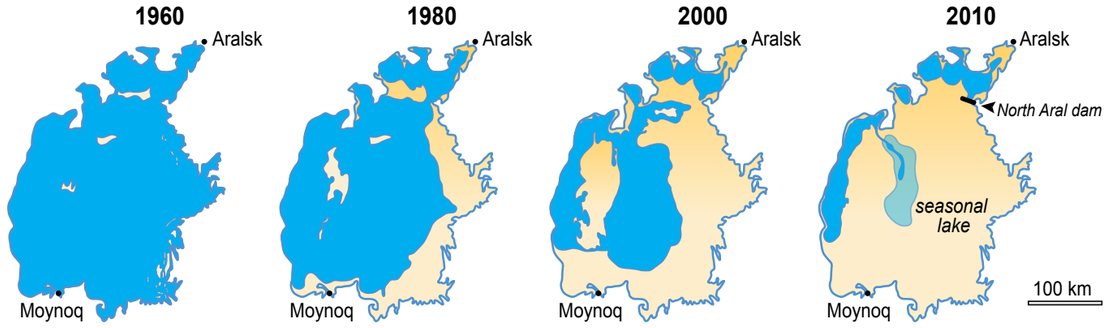
At almost 2 500 km long, the Amu Darya is the longest river in Central Asia, and is shared by five countries. Less than 1 000 km of the river's length is in the Upper Amu Darya where too much water and periodic flooding are problems, while the lower Amu Darya typically has too little water. On average, the main river carries a volume of 62 km³ annually. The total water resource – including all the streams in the river basin – comes to 75 km³ of surface water and 25 km³ of groundwater, but the water volume varies considerably year to year. The hydrographic area covered by the Amu Darya basin is 500 000 km², but when all of the canals are included, the size more than doubles.

Humans interfered little in the Amu Darya before the 1950s when massive irrigated agriculture began in the region. Now, irrigated land in the larger basin covers more than 5 million hectares – 4 million in Turkmenistan and Uzbekistan, and 1 million in Afghanistan and Tajikistan. The expansion of irrigation led to significant diversions of water and a dramatic reduction in the river flow. Since the 1980s the Amu Darya has occasionally stopped flowing into the Aral Sea, causing a creeping ecological disaster that included the dying out of fisheries and increased environmental stress.



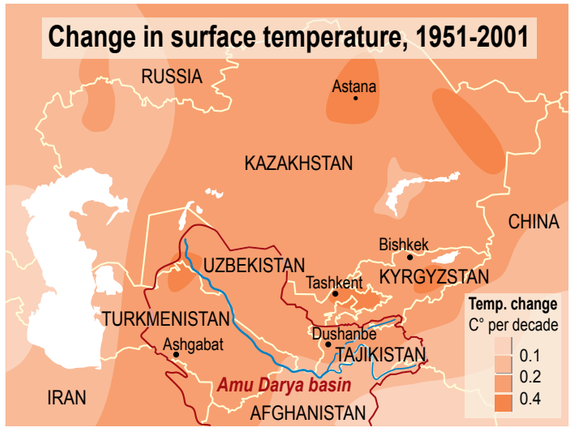
Amu Darya hydrograph 1950–2010, km³
Flow at Atamyrat (upper graph) and Samanbai (bottom)

The shrinking Aral Sea

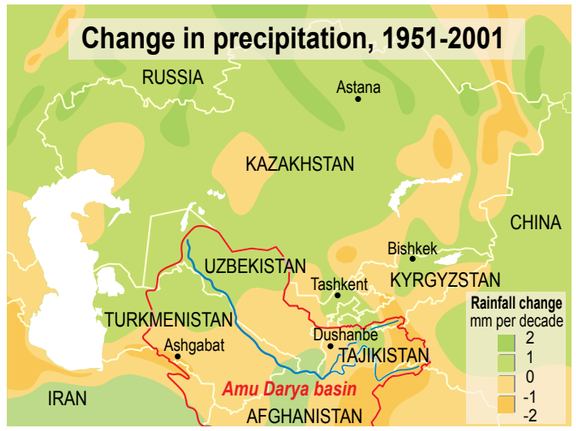


Source: http://earthobservatory.nasa.gov/Features/WorldOfChange/aral_sea.php; Climate Change Central Asia: a visual synthesis report (2009)

Change in surface temperature, 1951-2001



Change in precipitation, 1951-2001

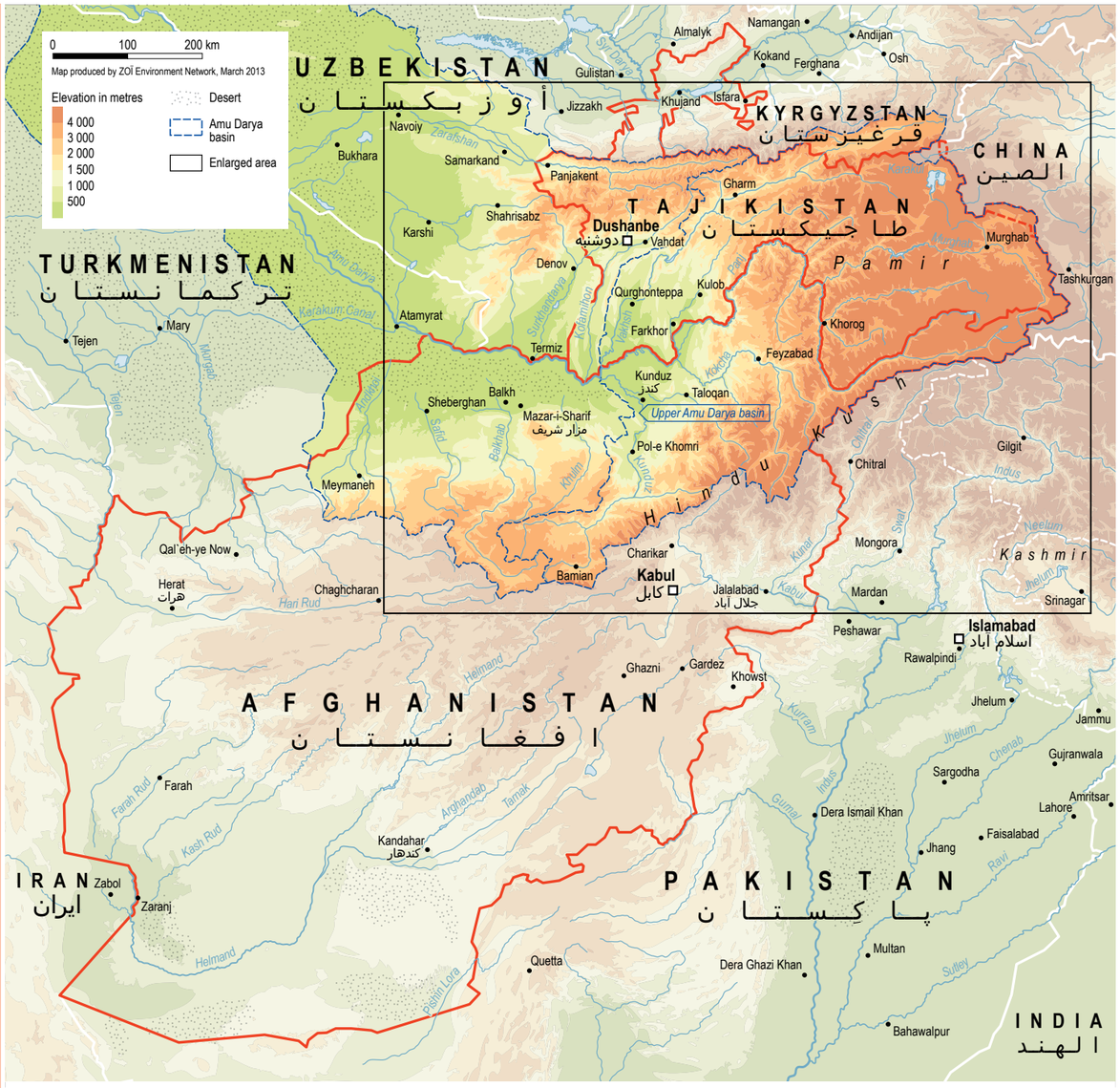


The Aral Sea *is a major victim of irrational water resource use over the years. The population of the Amu Darya delta has suffered from this environmental catastrophe as the sea has turned into a desert.*

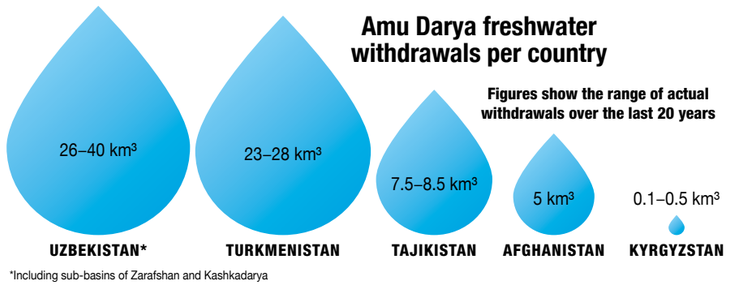
- Land degradation impacts
- Salinisation of irrigated lands
- Water-logging
- Depletion of forests and shrubs
- Forest and soil rehabilitation efforts
- Areas above 2 000 metres
- Flood plain forests (Tugai forests)
- Major regional sources of dust, aggravated by human activities
- Salt and dust particles carried by wind storms and affecting human health, agriculture and infrastructure
- High mineralization of river water
- Moderate mineralization of river water
- Agricultural runoff with high water mineralization into deserts
- Agricultural runoff with high water mineralization back into rivers

In the Upper Amu Darya, water quality is not a major issue, but in the lower basin a doubling of salt concentrations has caused a notable deterioration in water quality.

- Rivers with intense water use and increased stress from climatic and hydrological changes
- Large river deltas with increased environmental stress
- Potential spread of invasive species, locusts and vector-borne diseases
- Increased heat stress for rural workers in agricultural fields
- Impact on regional climate and dust storms due to shrinkage of the Aral Sea
- Increased risk of climate-related hazards in the mountains; increase in surface run-off due to more intense glacier melt and hydrological cycle disruptions
- Increased risk of drought on agricultural lands; decrease in surface run-off due to drier climate conditions
- Desert
- Areas above 2 000 metres
- Significant historical earthquakes
- Major recent floods
- Risk of glacial lake outburst floods

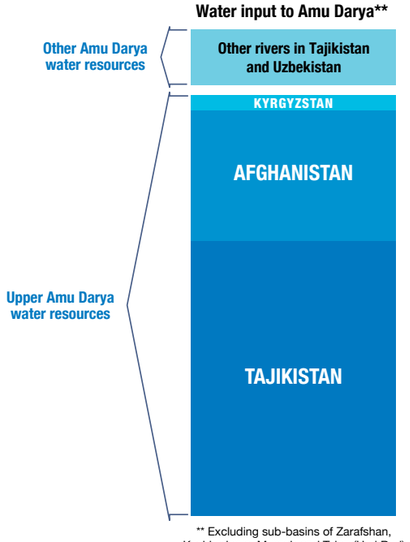


Geographically, the confluence of the Panj and Vakhsh Rivers marks the beginning of the Amu Darya. These two rivers contribute more than 80% of the Amy Darya flow. The 3 500 m average elevation of the Panj and Vakhsh defines the character and hydrology of the Amu Darya, which on average deposits 200 million tonnes of silt or suspended sediments downriver annually. These fertile sediments provide a good basis for agriculture in the downstream flood plains. In the Upper Amu Darya basin, the rivers are rapid and narrow with flood plains only a few dozens or hundreds of metres wide, but the downstream flood plains can range from 5 to 20 km across. The main water use along the course of the river is irrigation for agriculture.

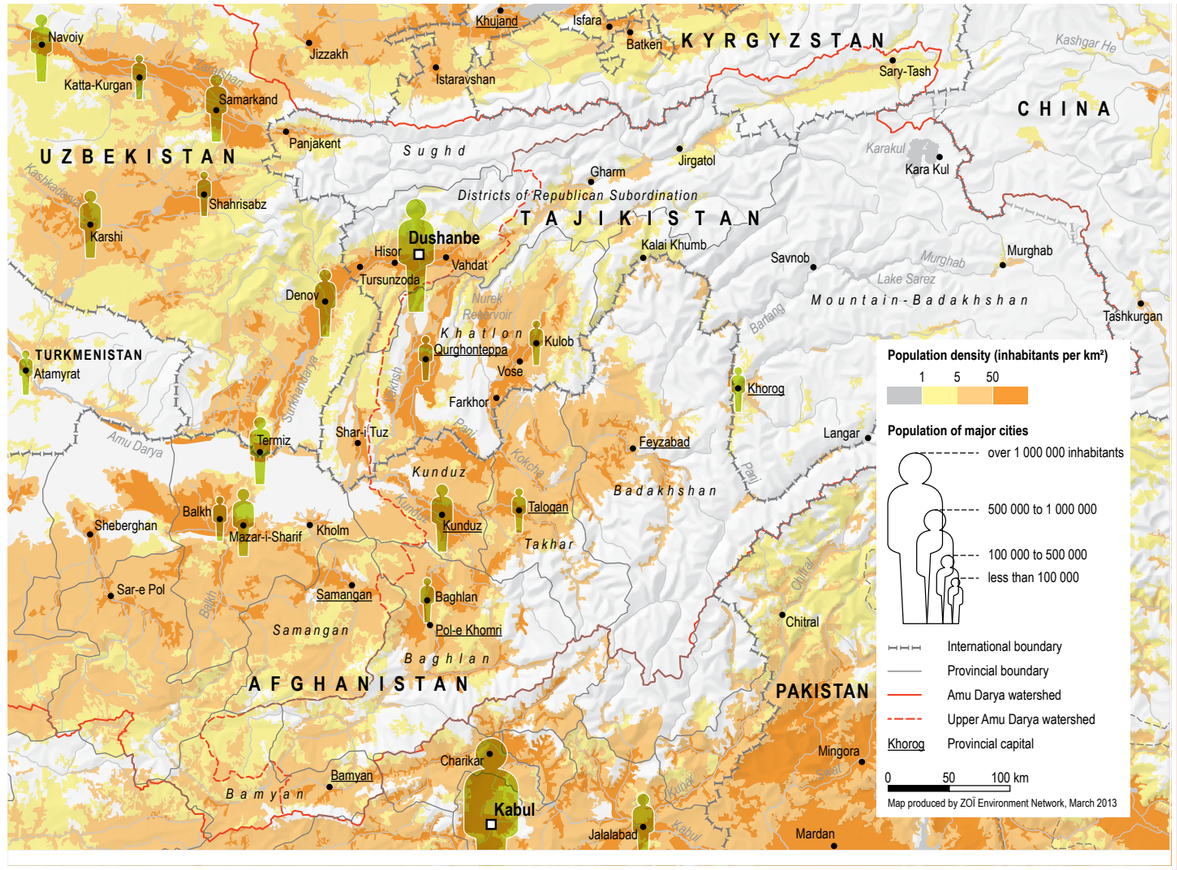


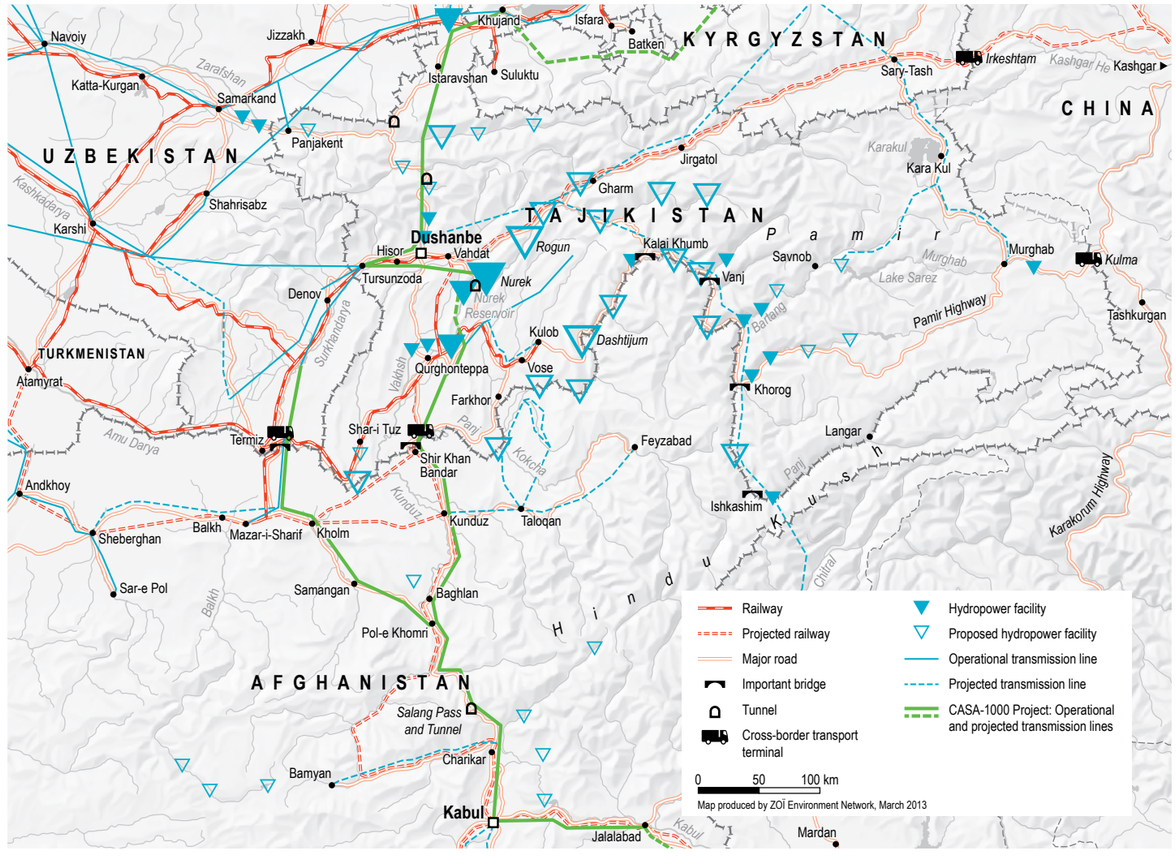
*Including sub-basins of Zarafshan and Kashkadarya

Source: CA Water Info (→ www.cawater-info.net)



** Excluding sub-basins of Zarafshan, Kashkadarya, Murgab and Tejen (Hari Rud)





The Amu Darya rises in the Pamir, Alai and Hindu Kush mountains at an elevation of 4 500 m. Snow cover and glaciers in the mountains play a crucial role in the behaviour of the river.

As rivers flow down from the mountains in the Upper Amu Darya basin, they form spectacular alluvial fans where mountain villages appear. From the air, a village in Afghanistan looks like one in Tajikistan, and both take the same approach to the use of land and water resources.

Agriculture in the mountains often appears to be an idealized existence where people live in perfect harmony with nature.

The mountains are spectacular in winter, but life there is hard. With little to do agriculturally, the people shift their focus to domestic activities and trade, but the huge quantity and high quality of snow offers the prospect of adding economic diversity to the region in the form of national and international winter sports tourism, assuming that secure conditions can be provided.

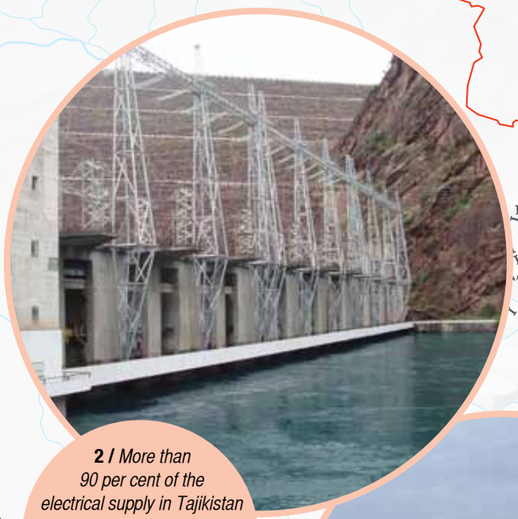
Some 700 km downstream from the river's mountain sources, the terrain opens up, and the river gets wider and begins to meander. Here the environmental conditions are not as challenging, there is room for more people and their animals, and pistachio forests grow.

In its next stage, the river flows through mostly sandy desert and empties into the Aral Sea.

Archaic houses and mountain trails fit only for donkeys and fearless trekkers reflect a lifestyle that has changed little over the centuries. The people in this most remote mountain area of the Amu Darya basin live as their ancestors lived. Literacy rates are low, and access is difficult.

In other parts of the river basin, the social contrast is as noticeable as the physical – the practice of large-scale agriculture and year-round electricity supply signifies greater development, and here the children receive an education.

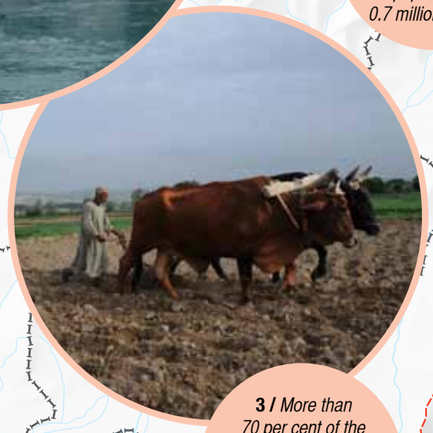
The river gives the people of the Amu Darya basin the means for sustaining life – food; hydropower; communication and trade through river traffic; and water for irrigation.



2 / *More than 90 per cent of the electrical supply in Tajikistan is produced by* **hydropower**. *The Upper Amu Darya basin has great potential for further hydropower development.*

1 / *Founded in the 1920s,* **Dushanbe** *is the capital city of Tajikistan, and has a population of 0.7 million people.*

8 / *Over the past 20 years, new* **roads to China** *have been planned and opened. Railroad companies are now investigating the prospects for development.*



3 / *More than 70 per cent of the people in both countries reside in* **rural areas**, *and many are engaged in agriculture.*

4 / *For the people of the region,* **trade** *has been as important as agriculture, and the modern Silk Road is as much a part of modern trade as the old Silk Road was in its day.*

5 / *More than 3 500 years old,* **Kabul** *is one of the fastest-growing cities in the world, and has a population of more than 3 million people.*

6 / *Over the past few years, five new bridges were built between the countries, and now facilitate trade and movement.*

7 / **Tourism** *is not yet well developed, but the sector has major potential for sports activities and medical and cultural travel.*

CHINA

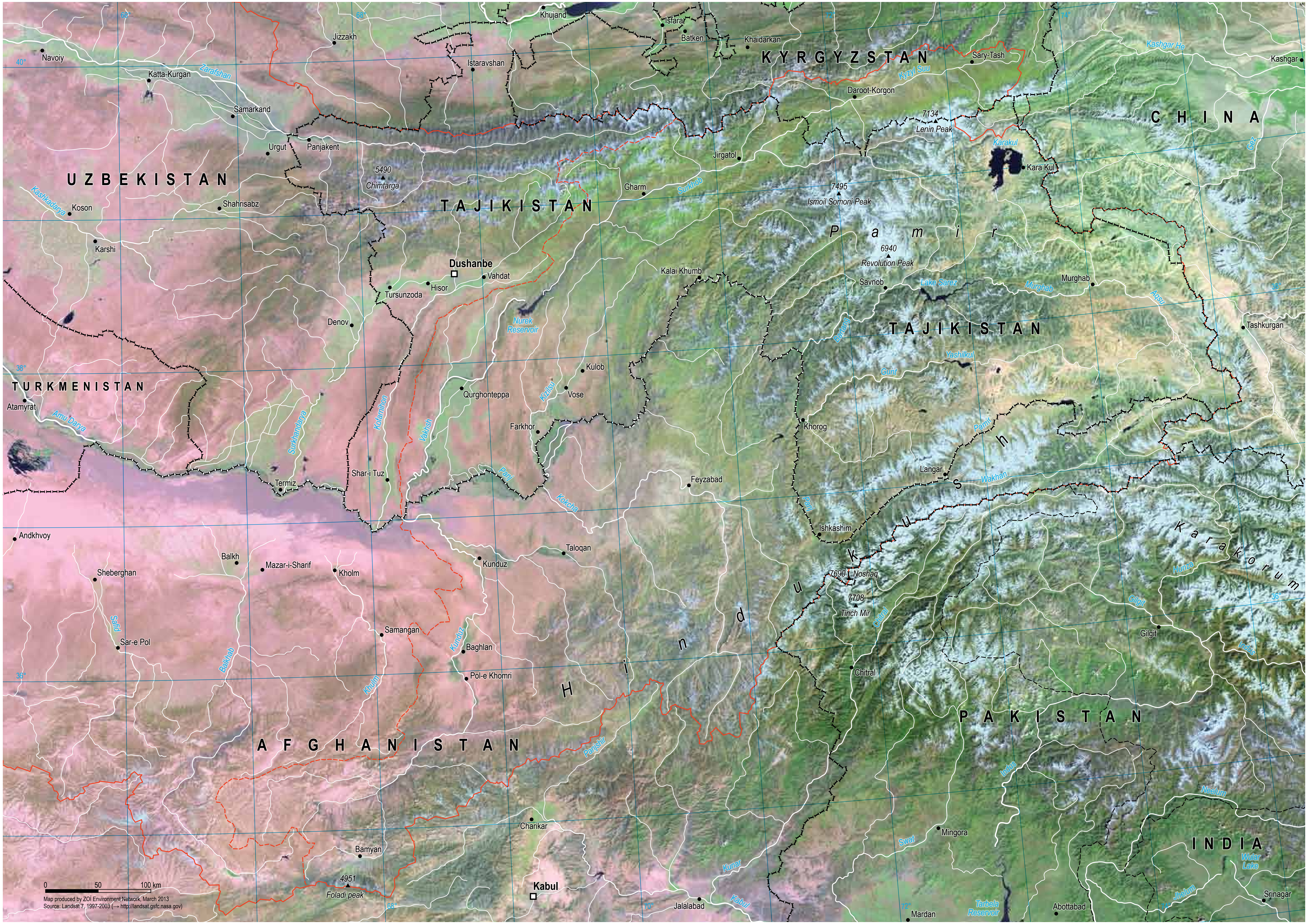
TAJIKISTAN

AFGHANISTAN

Dushanbe
1

Jirgatol
Gharm
Surkhob
Kara Kul
Kalai Khumb
Savnob
Lake Sarez
Murghab
Murghab
8
Nurek Reservoir
2
Bartang
Yashilkul
7
Kulob
3
Qurghonteppa
Kizilsu
Vose
Gunt
6
Khorog
Farkhor
Vakhsh
Panj
Kokcha
Pamir
Langar
Wakhan
Feyzabad
Panj
Ishkashim
Taloqan
Kunduz
4
4951
Foladi peak
Kabul
5

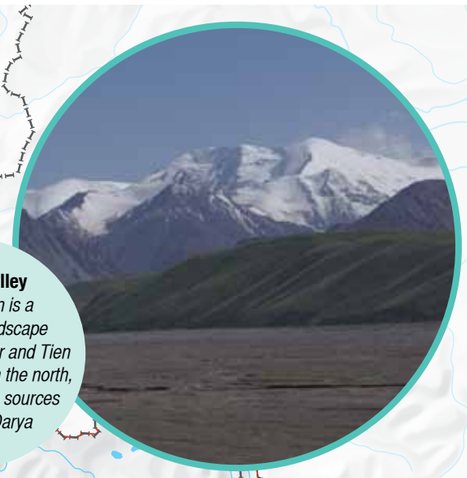
LANDSAT IMAGE OF THE UPPER AMU DARYA BASIN FROM SPACE



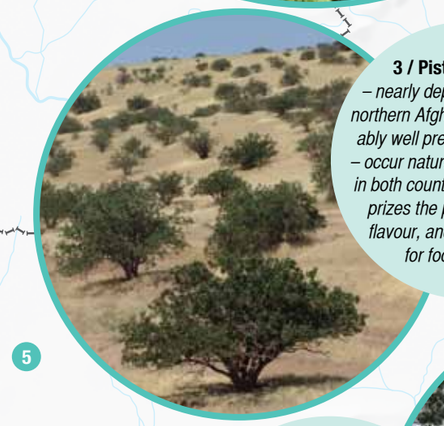
2 / Broad-leaved forests *occur mainly in central Tajikistan. They are rich in biodiversity, with wild fruit and nut trees such as apples, walnuts and pears.*

1 / Juniper forests *are slow growing, but well adapted to extreme mountain climate conditions. They occur mainly in northern Tajikistan and Afghanistan, with some trees that are 1 000 years old.*

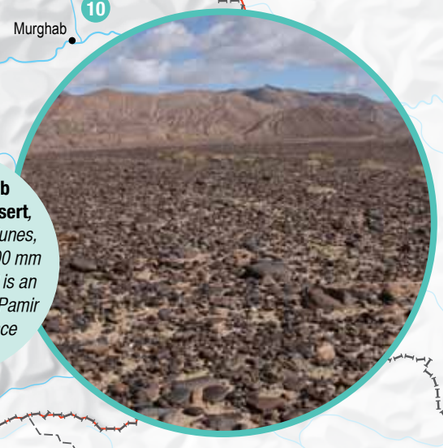
12 / The dynamic geology *of the region makes for an interesting landscape. The geologic uplifting that began millions of years ago continues today, and together with ice, water and wind defines the details of the landscape.*



11 / The Alai Valley *of Kyrgyzstan is a connecting landscape between the Pamir and Tien Shan mountains in the north, and is one of the sources of the Amu Darya River.*



3 / Pistachio forests *– nearly depleted by conflict in northern Afghanistan, but reasonably well preserved in Tajikistan – occur naturally and by plantings in both countries. The population prizes the pistachios for their flavour, and collects the nuts for food and trade.*

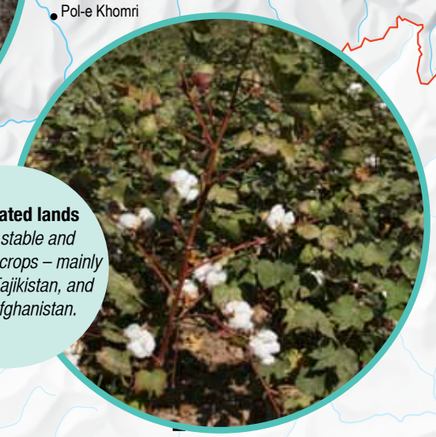


10 / The Murgab high-mountain desert, *as dry as the sand dunes, receives less than 100 mm of rain per year, and is an example of how the Pamir Mountains influence the climate.*

4 / Tugai forests *full of willows and poplars are found primarily in the flood plains of rivers, and play an essential role in erosion and flood control. These jungle-like forests with high biodiversity have shrunk dramatically as a result of development.*

9 / The Pamir and Hindu Kush Mountains *rise to 7 000 m of bare rocks. They act as a barrier to air masses, and thus largely determine the climate of the region.*

5 / Sand dunes *measuring 200 km long by 20 km wide provide the raw material for the sand storms that affect both countries.*



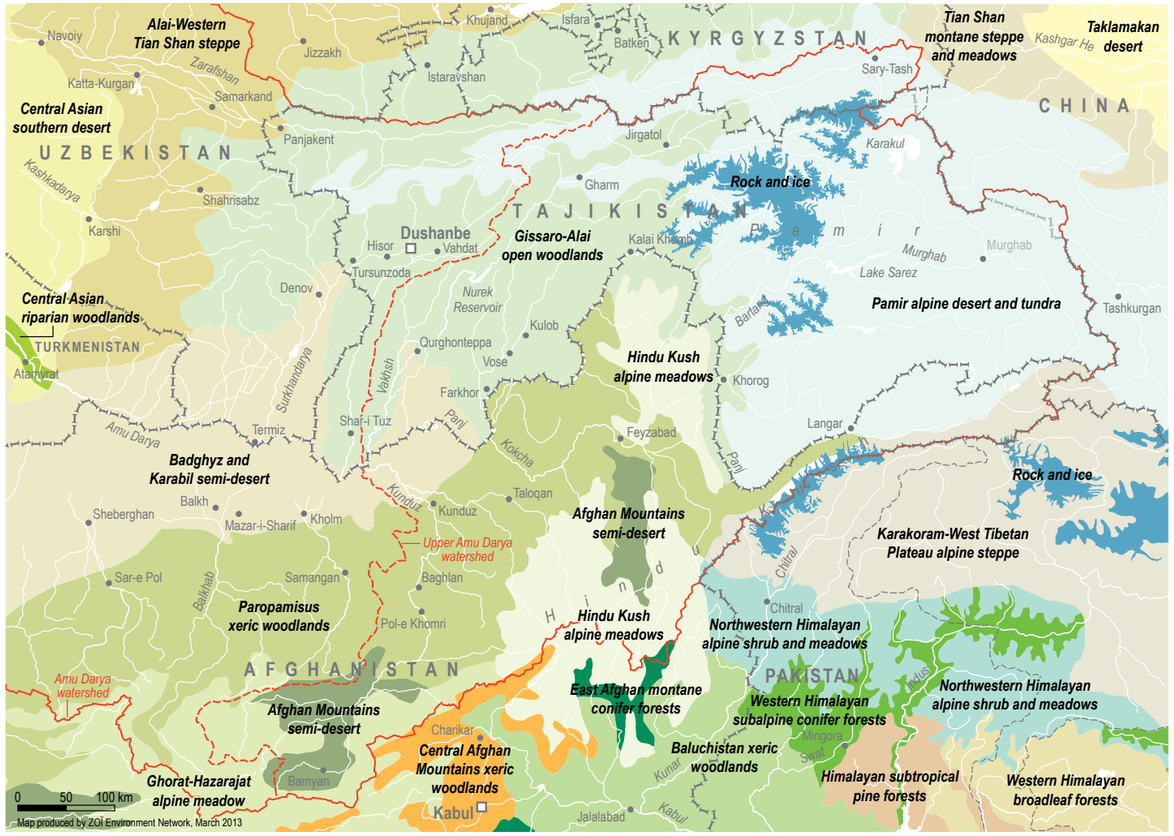
6 / Irrigated lands *provide stable and predictable crops – mainly cotton in Tajikistan, and rice in Afghanistan.*

7 / Rain-fed croplands *produce cereals, other field crops and garden fruits and vegetables. Afghanistan has already converted many lands to rain-fed croplands, while Tajikistan has more potential for such development.*

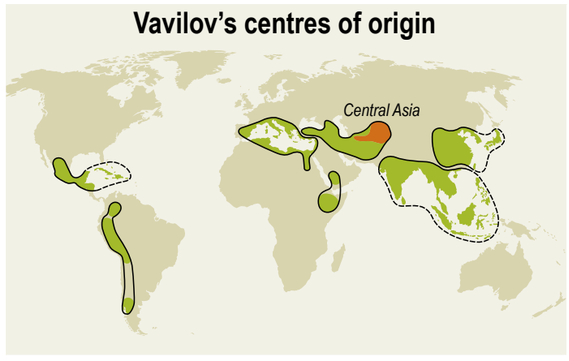
8 / Rangelands *– essentially any lands that are not croplands – experience a variety of conditions depending on climate and traditional use.*

Dushanbe
Gharm
Kalai Khumb
Savnob
Murghab
Kulob
Qurghonteppa
Vose
Farkhor
Khorog
Feyzabad
Langar
Ishkashim
Taloqan
Kunduz
Baghlan
Pol-e Khomri
Bamyan
7134
Lenin Peak
4951
Foladi peak
Kyzyl Suu
Surkhob
Nurek Reservoir
Kizilsu
Vakhsh
Panj
Kokcha
Bartang
Gunt
Yashilkul
Lake Sarez
Murghab
Wakhan
TAJIKISTAN
AFGHANISTAN

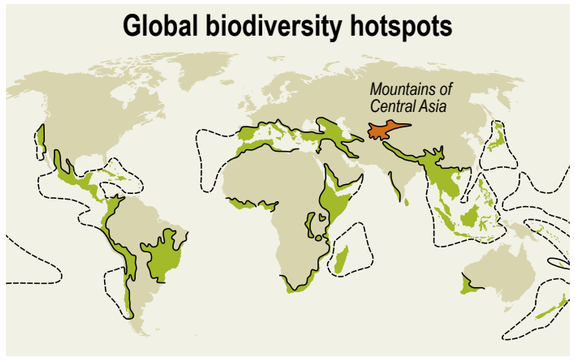

UZBEKISTAN
TAJIKISTAN
KYRGYZSTAN
CHINA
TURKMENISTAN
AFGHANISTAN
PAKISTAN
Pamir
Hindu Kush
Karakorum
Navoiy
Katta-Kurgan
Jizzakh
Khujand
Istaravshan
Isfara
Batken
Khaidarkan
Sary-Tash
Kashgar
Kashgar He
Samarkand
Urgut
Panjakent
Daroot-Korgon
7134
Lenin Peak
Karakul
Kara Kul
5490
Chimtarga
Jirgatol
Gharm
7495
Ismoil Somoni Peak
Koson
Shahrisabz
Karshi
Dushanbe
Hisor
Vahdat
Tursunzoda
Kalai Khumb
Savnob
Lake Sarez
Murghab
Tashkurgan
Denov
Nurek Reservoir
Kulob
Vose
Qurghonteppa
Farkhor
Atamyrat
Khorog
Langar
Shar-i-Tuz
Termiz
Feyzabad
Ishkashim
Andkhvoy
Balkh
Mazar-i-Sharif
Kholm
Kunduz
Taloqan
Sheberghan
7690
Noshaq
7708
Tirich Mir
Samangan
Baghlan
Sar-e Pol
Pol-e Khomri
Gilgit
Chitral
Charikar
Mingora
Bamyan
4951
Foladi peak
Kabul
Jalalabad
Mardan
Abbottabad
Irrigated cropland
Mosaic of vegetation (cropland, forest, shrub, grassland); Afghanistan: cropland
Forest
Pasture and grassland
Glaciers
Sand dunes
Badlands
0
50
100 km
Map produced by ZOÏ Environment Network, March 2013



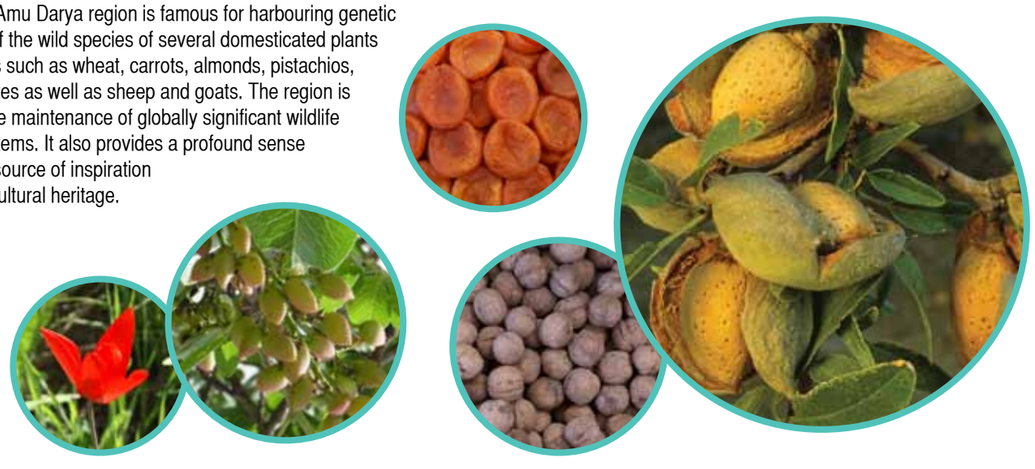
Vavilov's centres of origin



Global biodiversity hotspots

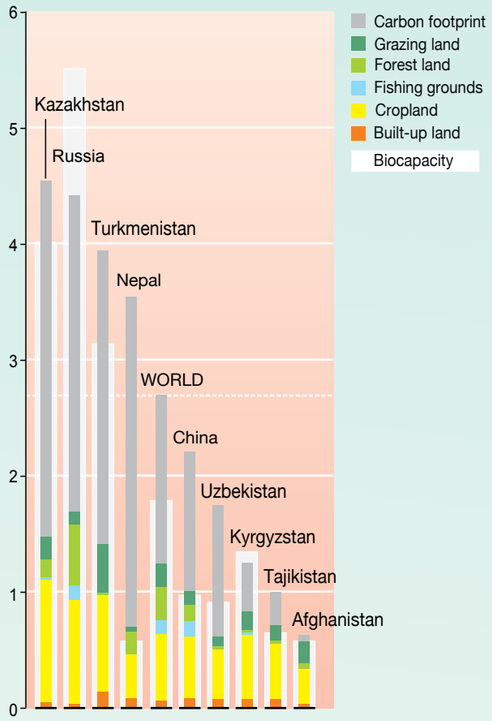


The Upper Amu Darya region is famous for harbouring genetic resources of the wild species of several domesticated plants and animals such as wheat, carrots, almonds, pistachios, pomegranates as well as sheep and goats. The region is crucial to the maintenance of globally significant wildlife and ecosystems. It also provides a profound sense of place, a source of inspiration and a rich cultural heritage.



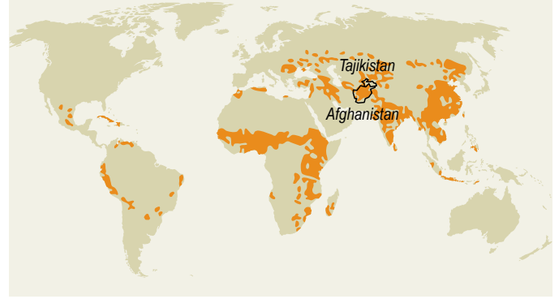
Ecological Footprint and Biocapacity

Global hectares per person



Source: Ecological Footprint Atlas 2010, data for 2007

High threats to human water security

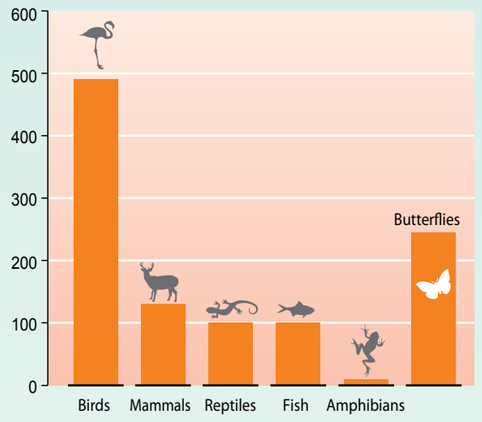


The sources of degradation of freshwater resources and river ecosystems are the same around the world – agricultural runoff, pollution, river fragmentation, invasive species and climate change. Wealthy countries, however, employ highly engineered solutions that treat the symptoms of degradation or depletion, and that are cost-prohibitive for poorer nations. The map shows priority regions with high threats to water security. The relative absence of water security hotspots in developed countries reflects the presence of technical solutions.

The ecological footprint measures the human demands on planetary ecosystems against the primary natural resources (cropland, forests, grazing land, water and fisheries) needed to supply human consumption and to cope with the resulting waste, given current technology and management practices. Biocapacity estimates how much of the Earth is needed to support the human population at a particular lifestyle. The productivity of ecosystems varies across countries. Afghanistan and Tajikistan have two of the smallest footprints at the regional and global levels, but the countries' biological capacity has dramatically declined over the years.

Fauna Diversity in Afghanistan

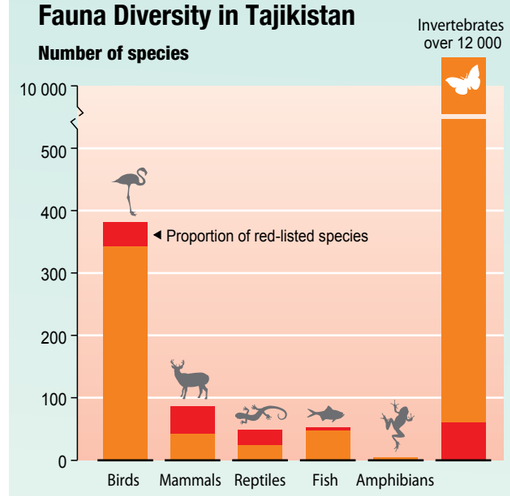
Number of species



Source: Afghanistan's Biodiversity Profile (2008)

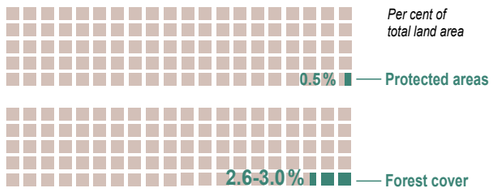
Fauna Diversity in Tajikistan

Number of species

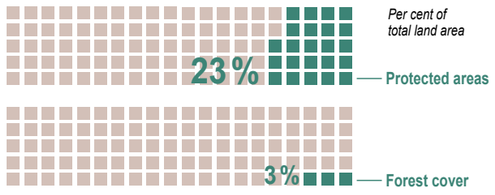


Source: Tajikistan's Fourth National Report for the UN Convention Biodiversity (2010)

Biodiversity conservation areas in Afghanistan



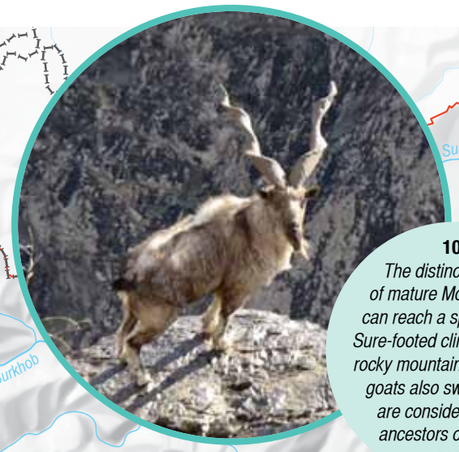
Biodiversity conservation areas in Tajikistan



The world recognizes these iconic species as belonging to the region. Some of the species shown here are endemic, and all are red-listed. Many are migratory and move between the two countries and beyond.

2 / *Historically hunted by royalty,* **Bukhara** *(tugai) deer inhabit a shrinking habitat of flood plains where the tugai forests once flourished. Only about 500 tugai deer remain in the wild.*

1 / *Bukhara mountain sheep, or* **the urial**, *prefer mountain grasslands and light forests at elevations of 1 000–2 500 m, and move in small groups.*



10 / *The distinctive horns of mature Morkhur goats can reach a span of 1.5 m. Sure-footed climbers in steep rocky mountain terrain, these goats also swim well, and are considered among ancestors of domestic goats.*

9 / *One of largest wild sheep in world,* **the argali**, *or* Marco Polo *sheep, lives only in high mountains. Its big horns make it a prized hunting trophy, and authorities issue a few permits each year to take old or sick animals.*

3 / Gazelles *are specialists in survival in desert conditions, able to drink salty water and eat most desert vegetation. Moving in groups and migrating seasonally, gazelles jump vertically and then start running – up to 60 km per hour – when frightened.*

8 / *Birds of prey –* **falcons, eagles and hawks** *– are present in any habitat in the region. Many migrate as far as Africa. Rare globally and in the region, these birds are prized by the people, and treated with respect.*

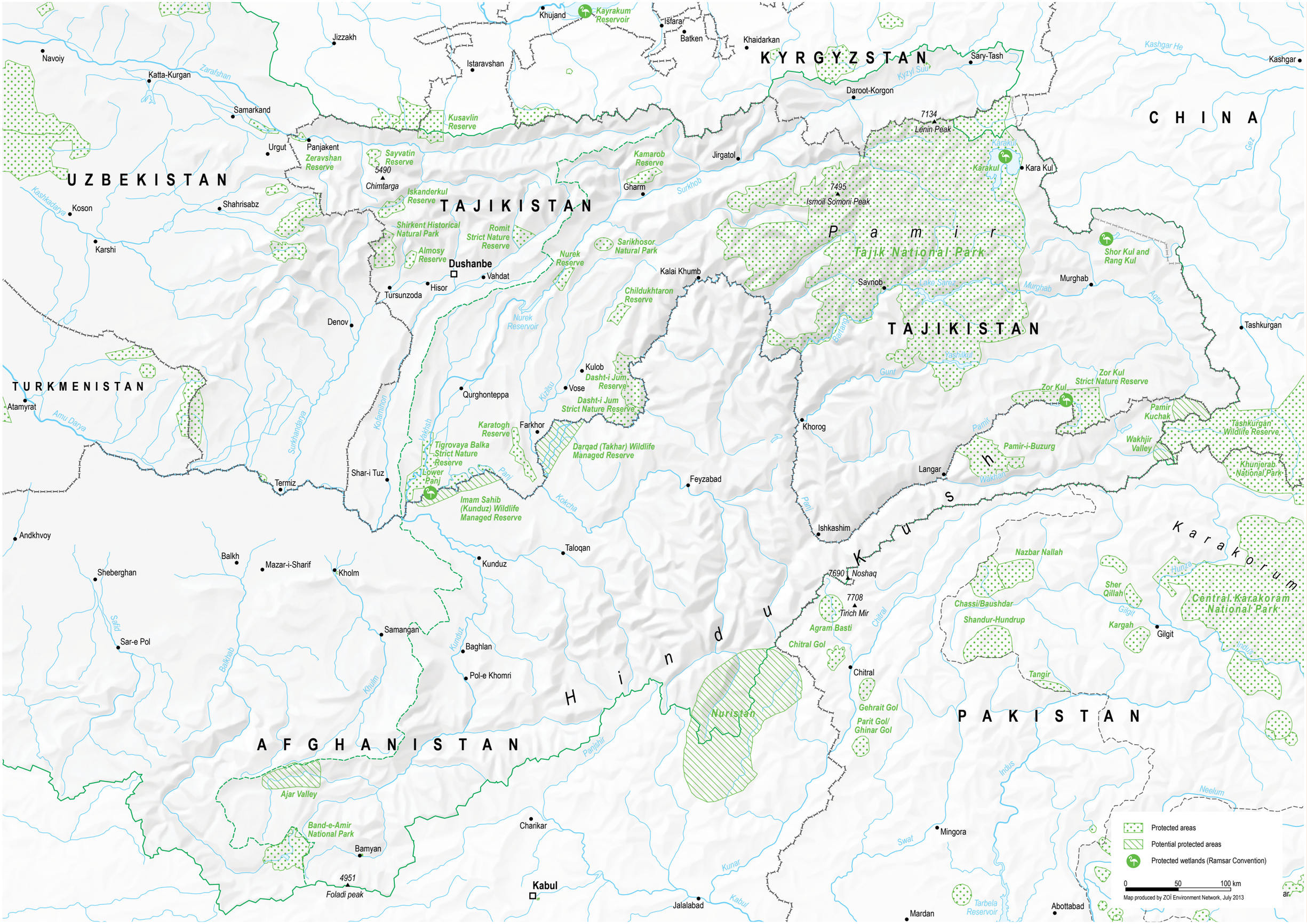
4 / *Previously hunted for its crocodile-like skin, the* **varan desert monitor** *is extremely well adapted to the lowland desert environment in the Amu Darya basin, and now faces the pressures of a changing habitat.*

5 / *Large for a* **leopard** *and very rare, the Central Asia leopard roamed Tajikistan until the 1950s–1960s. Now critically endangered, with only 500 remaining, these leopards are found mainly in Afghanistan and Turkmenistan.*

6 / *While not red-listed globally,* **the cobra** *is endangered in Central Asia. Among the most poisonous snakes in the region, the cobra lives in desert and low mountain habitat that is under increasing development pressures.*

7 / **The snow leopard** *thrives in the extreme high mountain environment. A nocturnal cat with a huge tail and excellent camouflage, the snow leopard is not aggressive, and unlike other large cats, will not attack humans.*

Dushanbe
Nurek Reservoir
Kulob
Qurghonteppa
Vose
Farkhor
Vakhsh
Kyzylsu
Panj
Kokcha
Feyzabad
Kalai Khumb
Gharm
Surkhob
Suu
Karakul
Kara Kul
Savnob
Lake Sarez
Murghab
Bartang
Yashilkul
Gunt
Khorog
Panj
Langar
Wakhan
Ishkashim
Taloqan
Kunduz
Bamyan
4951
Foladi peak
TAJIKISTAN
AFGHANISTAN


Khujand
Kayrakum Reservoir
Isfara
Batken
Khaidarkan
KYRGYZSTAN
Sary-Tash
Kashgar He
Kashgar
Jizzakh
Navoiy
Istaravshan
Zarafshan
Katta-Kurgan
Kyzyl Suu
Daroot-Korgon
Samarkand
Kusavlin Reserve
7134
Lenin Peak
CHINA
Urgut
Panjakent
Sayvatin Reserve
Zeravshan Reserve
Jirgatol
Karakul
Kara Kul
Gez
5490
Chimtarga
Kamarob Reserve
Gharm
Surkhob
7495
Ismoil Somoni Peak
UZBEKISTAN
Iskanderkul Reserve
TAJIKISTAN
Kashkadarya
Koson
Shahrisabz
Shirkent Historical Natural Park
Romit Strict Nature Reserve
Sarikhosor Natural Park
Pamir
Tajik National Park
Shor Kul and Rang Kul
Karshi
Almosy Reserve
Dushanbe
Nurek Reserve
Vahdat
Kalai Khumb
Savnob
Lake Sarez
Murghab
Hisor
Tursunzoda
Childukhtaron Reserve
Aqsu
Tashkurgan
Denov
Nurek Reservoir
Barrang
TAJIKISTAN
Yashilkul
Gunt
TURKMENISTAN
Kulob
Dasht-i Jum Reserve
Zor Kul Strict Nature Reserve
Vose
Qurghonteppa
Kyzylsu
Zor Kul
Atamyrat
Dasht-i Jum Strict Nature Reserve
Pamir Kuchak
Amu Darya
Kofarnihon
Yakhsh
Surkhandarya
Karatogh Reserve
Farkhor
Khorog
Tashkurgan Wildlife Reserve
Tigrovaya Balka Strict Nature Reserve
Darqad (Takhar) Wildlife Managed Reserve
Pamir
Pamir-i-Buzurg
Wakhjir Valley
Shar-i Tuz
Lower Panj
Langar
Wakhan
Termiz
Panj
Feyzabad
Khunjerab National Park
Imam Sahib (Kunduz) Wildlife Managed Reserve
Kokcha
Andkhvoy
Ishkashim
Hindu Kush
Karakorum
Taloqan
Nazbar Nallah
Balkh
Mazar-i-Sharif
Kunduz
Kholm
Sheberghan
7690
Noshaq
Hunza
Sher Qillah
7708
Tirich Mir
Chassi/Baushdar
Central Karakoram National Park
Safid
Shandur-Hundrup
Agram Basti
Chitral
Gilgit
Kargah
Gilgit
Samangan
Chitral Gol
Indus
Sar-e Pol
Baghlan
Kunduz
Balkhab
Tangir
Chitral
Pol-e Khomri
Khulm
Nuristan
Gehrait Gol
Parit Gol/ Ghinar Gol
PAKISTAN
AFGHANISTAN
Panjshir
Indus
Ajar Valley
Neelum
Charikar
Mingora
Band-e-Amir National Park
Swat
Bamyan
Kunar
4951
Foladi peak
Kabul
Jalalabad
Kabul
Tarbela Reservoir
Abottabad
Mardan
Protected areas
Potential protected areas
Protected wetlands (Ramsar Convention)
0
50
100 km
Map produced by ZOÏ Environment Network, July 2013

Dasht-i-Jum
– located in the middle of the Upper Amu Darya basin – has a mild subtropical climate. Home to red-listed mammals and pistachio forests, it has been a protected area since the 1980s.

Established in the late 1930s to protect tigers, **Beshai Palangon** *is the oldest protected area in Tajikistan. The tigers disappeared in Central Asia in the 1950s, but the area still hosts important ecosystems and provides habitat for many migratory birds.*

The landscape of the **Pamir and Wakhan corridor** *may seem lifeless, but as home to populations of snow leopards, argali and other rare animals and plants, it is a proposed peace park for Tajikistan, Afghanistan, China and Pakistan.*

The **Convention on Biological Diversity** aims to conserve biodiversity, to ensure that it is used sustainably and to see that the benefits derived from genetic resources are shared fairly. Parties to the convention number 193 countries: they include Afghanistan and Tajikistan and all neighbouring states. The convention covers ecosystems, species and genetic resources. Afghanistan is starting to develop policy and assessment documents on biodiversity, while Tajikistan is about to update its national red list and national biodiversity strategy and action plan in the light of lessons learned and of the Aichi Targets 2020.

The **Cartagena Protocol** on Biosafety is an international agreement intended to supplement the Convention on Biological Diversity. Tajikistan is among its 150 Parties. The protocol aims to ensure the safe handling, transport and use of living modified organisms that may have adverse effects on biodiversity, taking into account possible risks to human health. Parties are developing national biosafety frameworks and clearinghouse mechanisms for comprehensive legal and instrumental controls.

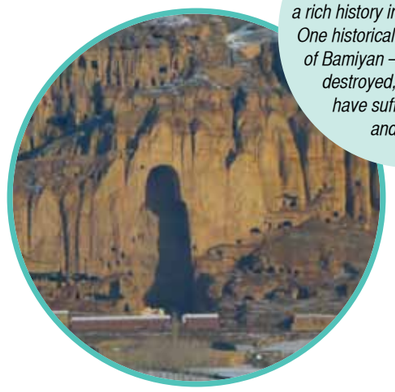
The **Nagoya Protocol** on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits arising from their Utilization is an international agreement that forms part of the Convention on Biological Diversity. It aims to share the benefits arising from the use of genetic resources in a fair and equitable way. Tajikistan has signed the protocol.

The **Convention on the Conservation of Migratory Species** of Wild Animals (the Bonn Convention or CMS) aims to conserve the world's migratory species on land, sea and in the air. Tajikistan is a Party. Parties try to provide strict protection of the species threatened with extinction by conserving or restoring habitats, reducing obstacles to migration and controlling other threats. The convention encourages states where these species live to conclude regional agreements.

The **Convention on International Trade in Endangered Species** of Wild Fauna and Flora (CITES) aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The convention protects about 5 000 animal and 28 000 plant species against overexploitation by international trade. Afghanistan is a Party.

The **Ramsar Convention** (the Convention on Wetlands of International Importance, especially as Waterfowl Habitat) aims at conserving wetlands and using them sustainably by slowing encroachment and promoting recognition of their ecological importance. The list of wetlands of international importance currently includes about 2 000 sites. Its broad definition of wetlands includes lakes and rivers, swamps and marshes, wet grasslands, oases, estuaries, deltas and tidal flats, mangroves and coral reefs, and human-made sites such as reservoirs and salt pans. Tajikistan is a Party. Afghanistan has not yet acceded to the Ramsar Convention but has compiled information on prospective sites.

The **World Heritage Convention** Concerning the Protection of the World Cultural and Natural Heritage was adopted by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Afghanistan and Tajikistan are among the UNESCO member states. Currently UNESCO maintains a list of 960 World Heritage Sites – forests, mountains, lakes, deserts, buildings and cities – identified as being of special cultural or natural significance. Afghanistan has two sites (both are listed as endangered) and Tajikistan has one. Several sites are listed as tentative pending endorsement.



In addition to the natural wonders of the region, the Amu Darya basin has a rich history in need of protection. One historical site – the Buddhas of Bamiyan – has already been destroyed, and other sites have suffered from war and neglect.

At a biodiversity conference in Japan in 2010, governments agreed to five strategic goals and 20 specific targets. Afghanistan and Tajikistan – like all Parties – are preparing national strategies to meet the Aichi targets. The suggested date for completion of the strategies is 2013–2014.

STRATEGIC GOAL A

Address the underlying causes of biodiversity loss by mainstreaming biodiversity across government and society

1. People are aware of the values of biodiversity and the steps they can take to conserve and use it sustainably.
2. Biodiversity values have been integrated into national and local development and poverty reduction strategies and planning processes and are being incorporated into national accounting, as appropriate, and reporting systems.
3. Incentives, including subsidies,harmful to biodiversity are eliminated, phased out or reformed in order to minimize or avoid negative impacts, and positive incentives for the conservation and sustainable use of biodiversity are developed and applied, consistent and in harmony with the Convention and other relevant international obligations, taking into account national socio-economic conditions.
4. Governments, business and stakeholders at all levels have taken steps to achieve or have implemented plans for sustainable production and consumption and have kept the impacts of use of natural resources well within safe ecological limits.

STRATEGIC GOAL B

Reduce the direct pressures on biodiversity and promote sustainable use

5. The rate of loss of all natural habitats, including forests, is at least halved and where feasible brought close to zero, and degradation and fragmentation is significantly reduced.
6. All fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches, so that overfishing is avoided, recovery plans and measures are in place for all depleted species, fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems and the impacts of fisheries on stocks, species and ecosystems are within safe ecological limits.
7. Areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity.
8. Pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.
9. Invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.
10. By 2015, the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

STRATEGIC GOAL C

Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity

11. At least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.
12. The extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.
13. The genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

STRATEGIC GOAL D

Enhance the benefits to all from biodiversity and ecosystem services.

14. Ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable.
15. Ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification.
16. By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with national legislation.

STRATEGIC GOAL E

Enhance implementation through participatory planning, knowledge management and capacity-building

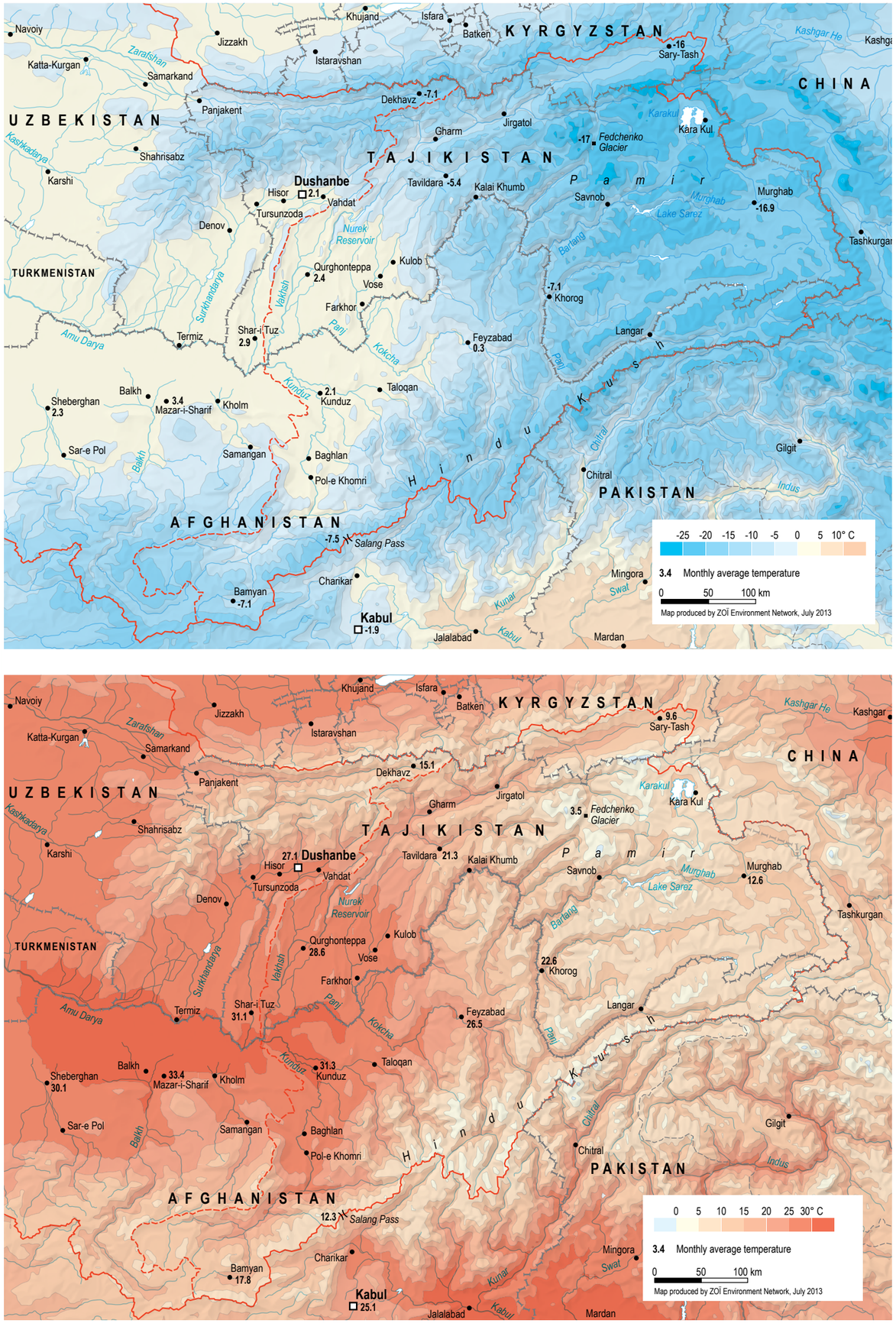
17. By 2015 each Party has developed, adopted as a policy instrument, and has commenced implementing an effective, participatory and updated national biodiversity strategy and action plan.
18. The traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention with the full and effective participation of indigenous and local communities, at all relevant levels.
19. Knowledge, the science base and technologies relating to biodiversity, its values, functioning, status and trends, and the consequences of its loss, are improved, widely shared and transferred, and applied.
20. The mobilization of financial resources for effectively implementing the Strategic Plan 2011–2020 from all sources and in accordance with the consolidated and agreed process in the Strategy for Resource Mobilization should increase substantially from the current levels.

Target 20 will be subject to changes contingent on resources needs assessments to be developed and reported by Parties.

Source of dust

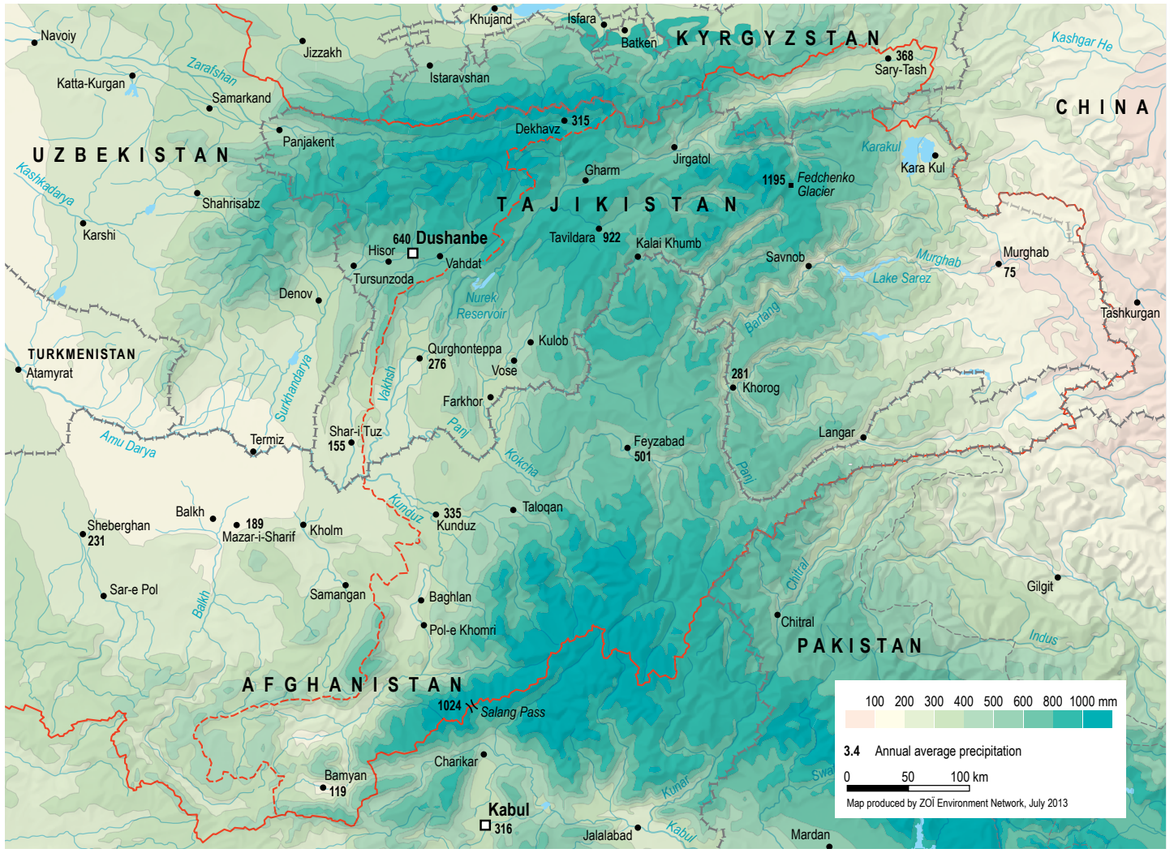
Where mountains meet deserts, the contrast can create microclimates, define ecosystems and determine where people live as well as what they do there. The deserts of the Lower Amu Darya often serve as sources of dust for the huge storms in the region. These dust storms normally happen in summer and autumn, and may travel 200–300 km from the source.

AVERAGE TEMPERATURE IN JANUARY



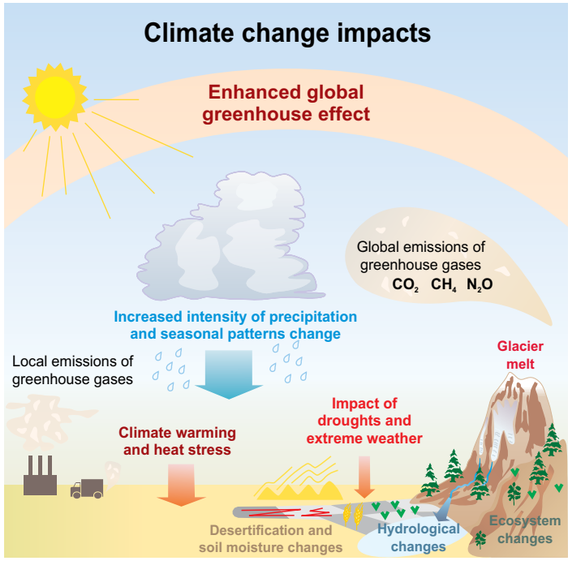
AVERAGE TEMPERATURE IN JULY

ANNUAL PRECIPITATION

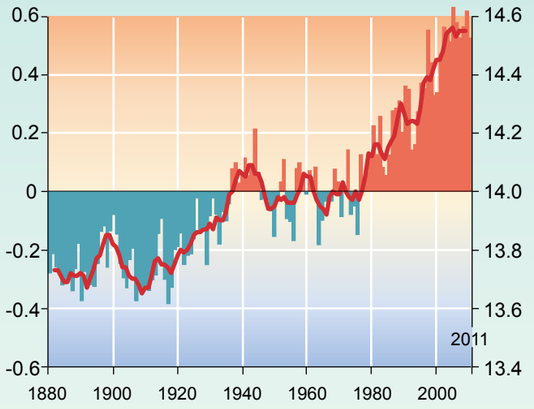


METEOROLOGICAL STATIONS

Climate change impacts

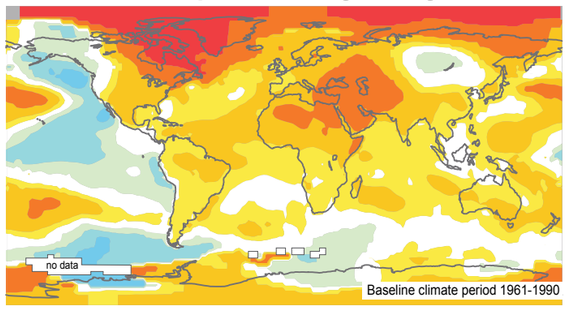


Trend in global average surface temperature

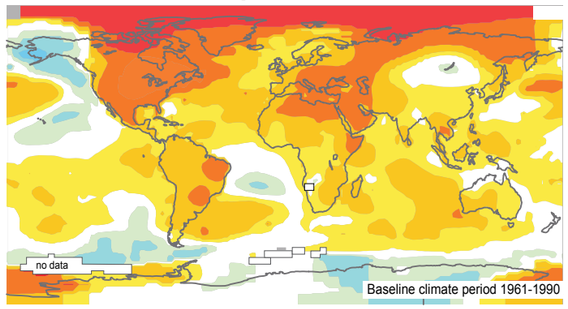


Source: NASA Visible Earth

Global annual temperature change during 1991–2012

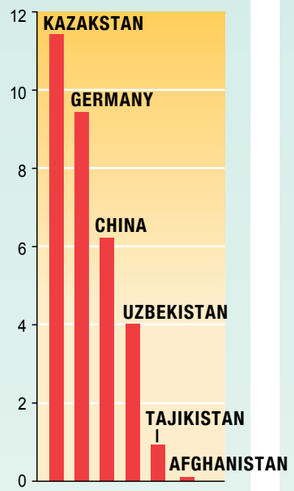


Global annual temperature anomalies in 2012



CO_2 emissions in 2010

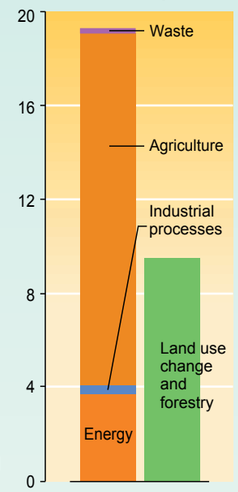
energy-related CO_2 emissions, tonnes per person



Source: U.S. Energy Information Administration http://www.eia.gov/

Greenhouse gas emissions in Afghanistan

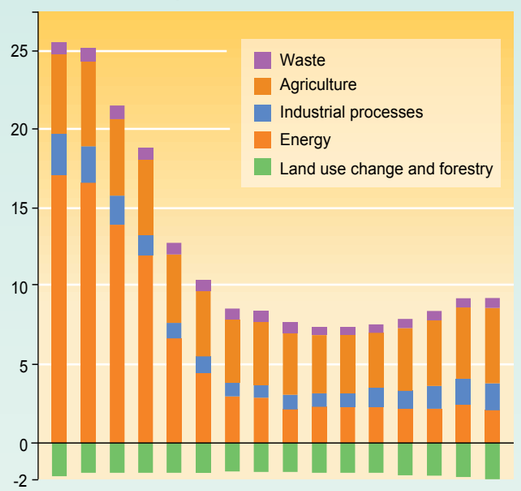
million tonnes of CO_2 equivalent



Source: Afghanistan's Initial National Communication to the UNFCCC, 2013

Greenhouse gas emissions by sector in Tajikistan

million tonnes of CO_2 equivalent



Source: Tajikistan's Second National Communication, 2008; preliminary data for 2004-2005

Climate change impacts, trends and responses

INDICATORS	Afghanistan	Tajikistan
Surface air temperature[1]	↑	↑
Rainfall and snow[1]	↑↓	↑↓
Melting ice[1]	↑	↑
Damage from extreme weather events[2]	↑	↑
Impact on food security and livelihoods[3]	↑	↑

INDICATORS	Afghanistan	Tajikistan
Policy instruments and actions on mitigation	●	●●
Policy instruments and actions on adaptation	●●	●●
National reporting to the UNFCCC	●	●●
Research and systematic observation[2]	●	●
Public awareness of climate change	●	●

↑ increase, intensification ↓ decrease ↑↓ mixed trends

[1] 1950-2010 [2] 2000-2010 [3] food crops, farmers, livestock, water availability

Sources: First and Second National Communications of Tajikistan to the UNFCC; National Action Plan of Tajikistan on climate change mitigation; Pilot Programme on Climate Resilience; UNEP 2009.

● some progress
●● advanced progress

Climate change mitigation options

Energy	• Improved efficiency of coal-fired plants • Increased energy prices, reduction of subsidies • Development of hydro, solar and wind energy potential • Minimizing gas flaring in fossil energy production • Reduction of heat, electricity and natural gas losses in local and national energy networks
Transport	• Hybrid and more fuel-efficient vehicles • Development of railways • Shift from individual to public transport • Cycling and walking • Transport planning, improved quality of roads
Buildings	• More efficient appliances • Efficient lighting, use of daylight • Improved insulation • Passive and active solar design
Industry	• More efficient electrical equipment • Heat and power recovery • Material recycling and substitution • Control of non-CO_2 emissions
Agriculture	• Improved crop and pasture management to increase soil carbon storage • Restoration of degraded lands, sustainable farming • Improved rice-growing techniques and livestock and manure management to reduce methane emissions • More efficient application of nitrogen fertilizers
Forestry	• Afforestation and reforestation; agro-forestry • Reducing deforestation • Improved management of forest resources
Waste	• Recycling and minimizing waste • Composting organic waste • Waste incineration with energy recovery

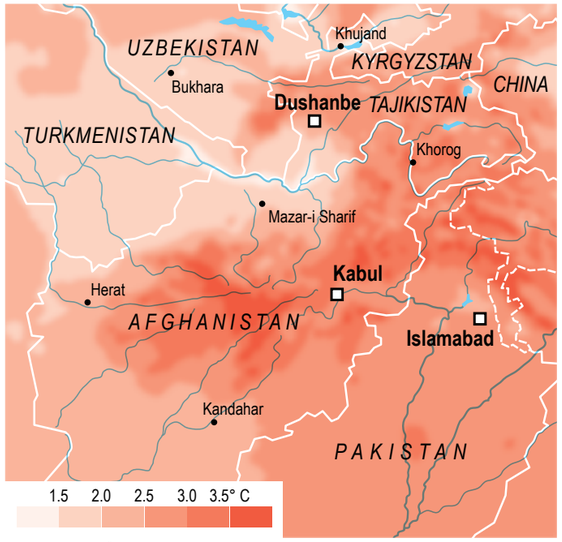
Based on compilation of information from the Second National Communications to UNFCCC, National Action Plans on Climate Change and IPCC 2007

Climate change adaptaion options

Water use	• Improved climate and water monitoring and forecasting • Integrated water resource management (IWRM) • Revision of water consumption limits and regulations • Broad introduction of efficient irrigation technologies • Water reuse and water conservation • Improved water quality and pollution prevention • Water saving incentives and training for farmers • Rehabilitation of water pipelines and canals
Agriculture	• Improved agrometeorological and veterinary services, training, scientific and technical support for farmers • Introduction of drought-resistant crops; pest control • Conservation of valuable agrobiodiversity • Water storage for reliable water supply in dry years • Crop rotation and shift towards more suitable areas • Rehabilitation of degraded pastures and croplands • Remote sensing and mapping of pasture conditions • Insurance, strategic food and forage reserves
Health	• Malaria prevention and control • Improved drinking water quality and sanitation facilities • New regulations for farmers working in the field in summer • Public awareness and early warning • New urban planning principles, better microclimate control
Transport and Energy	• Adjustment of hydropower plant operation according to stream flow change and projected climatic impacts • Improved security of energy supply and transfer networks • Revised road construction norms and traffic load • Protection of vulnerable transport infrastructure
Ecosystems	• Conservation of priority ecological areas and species • Monitoring and research
Disaster Risk Reduction	• Monitoring and forecasting of extreme weather events • Engineering measures and early warning systems • Insurance and risk management; public awareness

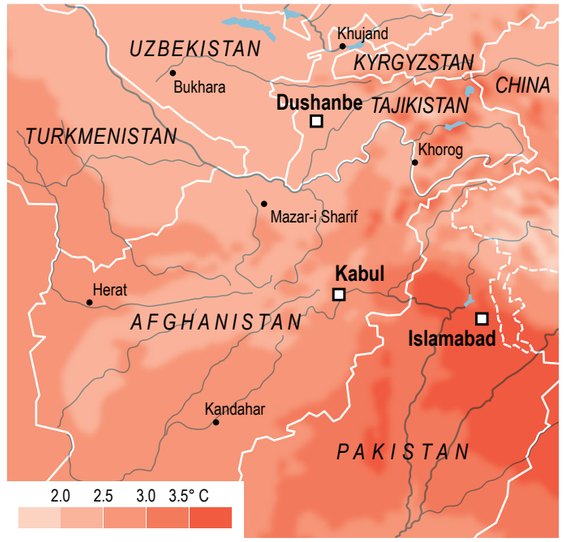
Based on compilation of information from the Second National Communications to UNFCCC, National Action Plans on Climate Change and IPCC 2007

Projected winter air temperature changes



Map produced by ZOÏ Environment Network, March 2013

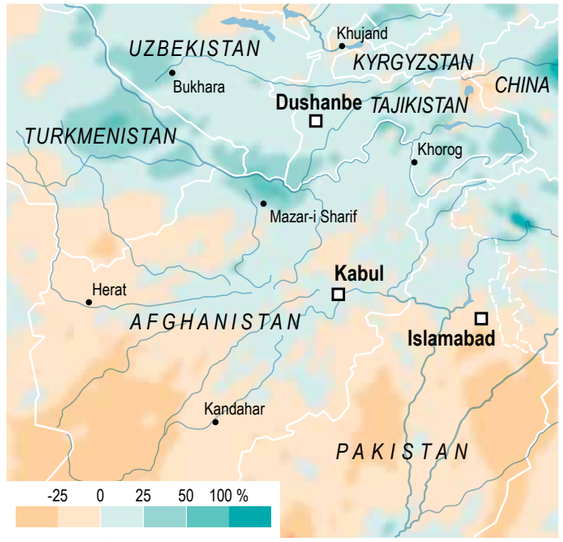
Projected summer air temperature changes



Map produced by ZOÏ Environment Network, March 2013

Source: regional climate model REMO

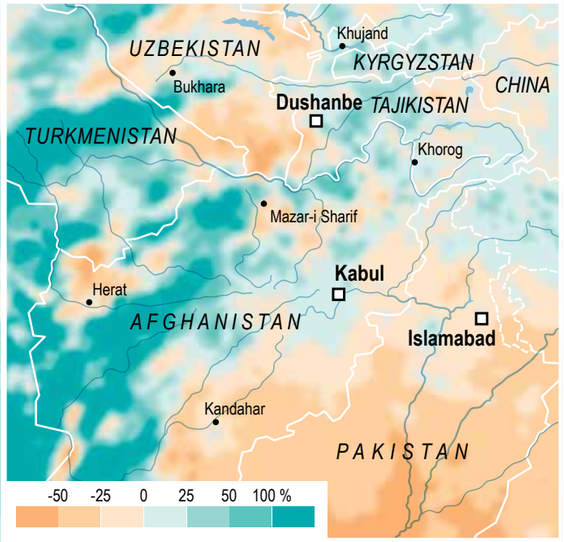
Projected winter precipitation changes



Map produced by ZOÏ Environment Network, March 2013

Source: regional climate model REMO

Projected summer precipitation changes



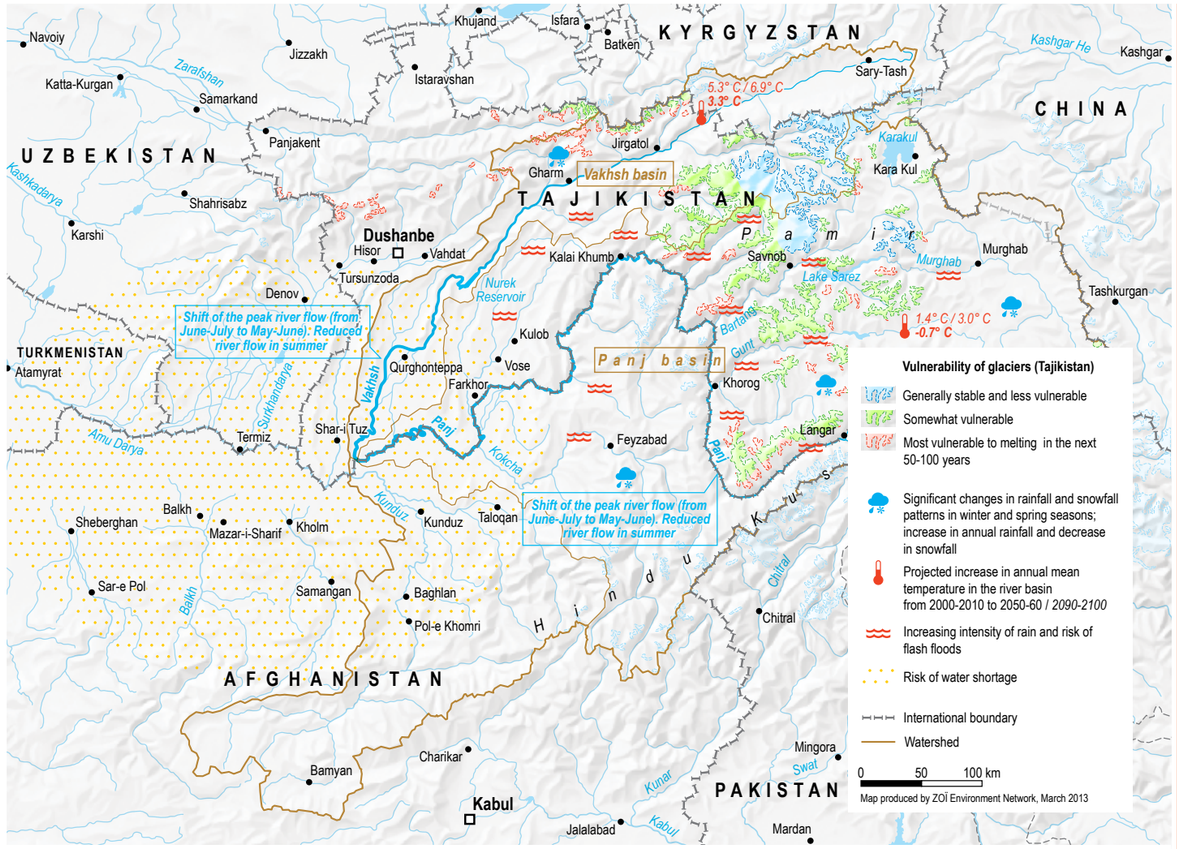
Map produced by ZOÏ Environment Network, March 2013

Source: regional climate model REMO

Data kindly provided by Central Asian Water research network (→ www.cawa-project.net) and University of Würzburg

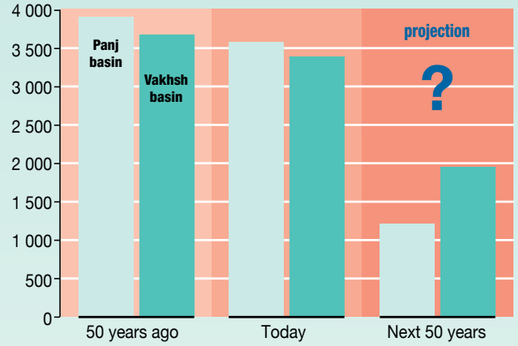
Note: Changes are based on differences between climate baseline simulation for 1991–2010 and climate projections generated by the REMO model (IPCC A1B scenario) for 2051–2070. Other scenarios and models may produce different results.

Because mountain ecosystems are particularly sensitive to environmental changes, climate observations at high elevations provide the first indications of global climate change. Local factors that influence precipitation, soil cover and moisture and evapotranspiration interact with snow cover, sun reflection and melting glaciers and permafrost in complex ways. For Central Asia, strong warming together with decreasing precipitation would be the worst-case climate change scenario.

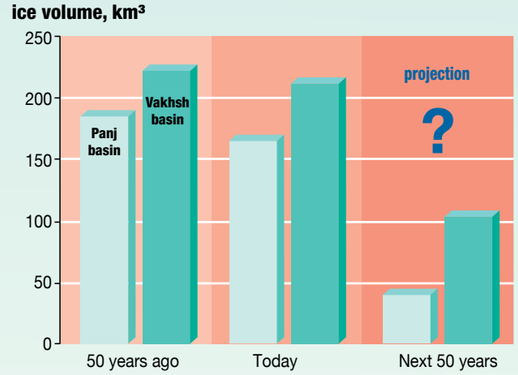


Glacier area and volume change in the Upper Amu Darya basin

glacier surface area, km²



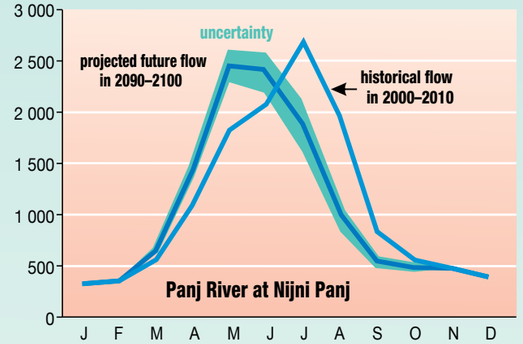
ice volume, km³



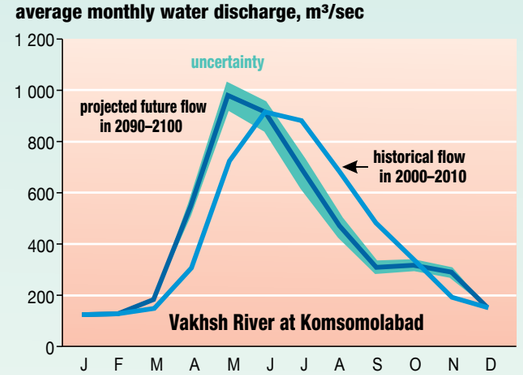
Source: Hoelzle et al. 2010

Projected hydrological changes in the Upper Amu Darya basin

average monthly water discharge, m³/sec



average monthly water discharge, m³/sec



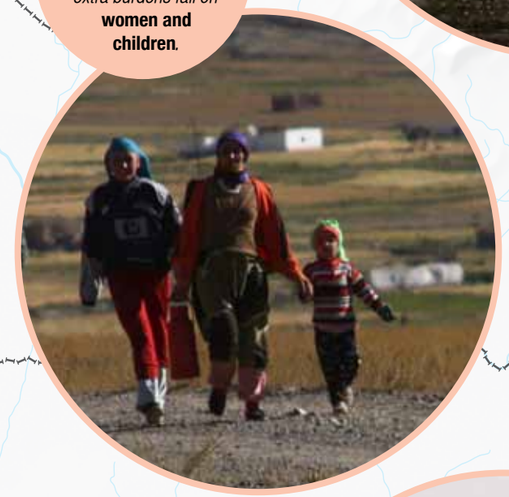
Source: Pilot Programme for Climate Resilience study in Tajikistan 2012

The applications of different scenarios and models often result in completely different projections of the effects of climate change in the mountains. This means that the way that climate change will affect the region is highly uncertain.

Tajikistan's potential for **hydropower** *production may decline or increase by 20 per cent relative to current levels, an uncertainty that policy makers and engineers should take into account. If precipitation becomes more intense, the build-up of sediments is likely to increase. Small dams have traditionally been used in Central Asia as a hedge against water deficits; now they are considered to be viable adaptation options in light of climate change disruptions to the hydrologic cycle.*

Global warming encourages the spread of malaria to higher elevations and other previously cooler places. The effectiveness of control measures of such **vector-borne diseases** *depends on a regional approach – another area for cooperation and coordination.*

When men migrate to find work in response to the effects of climate change, extra burdens fall on **women and children**.



The melting of glaciers *may change the local hydrological cycle and lead to the formation of new glacial lakes and to sudden floods.*

Climate models predict increased risk of droughts in the southern part of the Amu Darya basin, and more frequent infestations of locusts may be linked to climate change. The effect of drought on **rural workers** *is high stress related to the relentless sun.*

Because of the vertical contrast and high biodiversity in the mountains, changes in **mountain ecosystems** *are more visible. The range of habitats varies among species; some may benefit from climate change, while others may suffer.*

Infrastructure *is particularly vulnerable to climate change. Landslides resulting from heavy rains and changing environmental conditions in the mountains can lead to a variety of failures. And when the permafrost melts, so do the roads built there.*

Dushanbe
Gharm
Surkhob
Kyzyl Suu
CHINA
Kalai Khumb
Savnob
Lake Sarez
Murghab
Murghab
Nurek Reservoir
Barrang
Yashilkul
Gunt
Kulob
Qurghonteppa
Kizilsu
Vose
TAJIKISTAN
Farkhor
Vakhsh
Khorog
Panj
Feyzabad
Langar
Kokcha
Panj
Ishkashim
Taloqan
Kunduz
AFGHANISTAN
Kunduz
Baghlan
Pol-e Khomri
Bamyan
4951
Foladi peak
Kabul

1 / *The World Glacier Monitoring Service (WGMS) has collected data on the* **Abramov glacier** *– the only glacier's mass balance in the Amu Darya basin to be monitored – since 1969 (with an interruption between 1998 and 2012, since corrected).*

2 / Snow Covered Mountains
Most of the water that flows from the mountains comes from snow not from glaciers.

3 / Smaller glaciers
in the Hindu Kush and Pamir are melting fast, and some are disappearing. When precipitation levels are low, these glaciers provide water security, and their disappearance leaves communities without natural water storage in the mountains.

4 / Glaciers in the Upper Amu Darya basin
now cover almost 7 000 km^2, hold 400 km^3 of ice and define the iconic landscape: without the glaciers, the Pamirs are not the Pamirs.

5 / *In the Pamir Mountains, many* **rock glaciers** *– frozen rocks that hold ice just as permafrost does – provide additional melt in the summer.*

6 / The Alai glaciers and permafrost
are tourist destinations for alpinists. Easily accessible, these areas are visited by professional climbers, and are an important attraction for the region.

7 / *At 70 km long and 740 km² in area, the* **Fedchenko glacier** *is one of the largest glaciers in Eurasia and a key geographic landmark of the region. Because of its size, it melts slowly, but is nevertheless affected by global warming.*

Fedchenko glacier retreat
Central Pamir Mountains, Tajikistan

1928

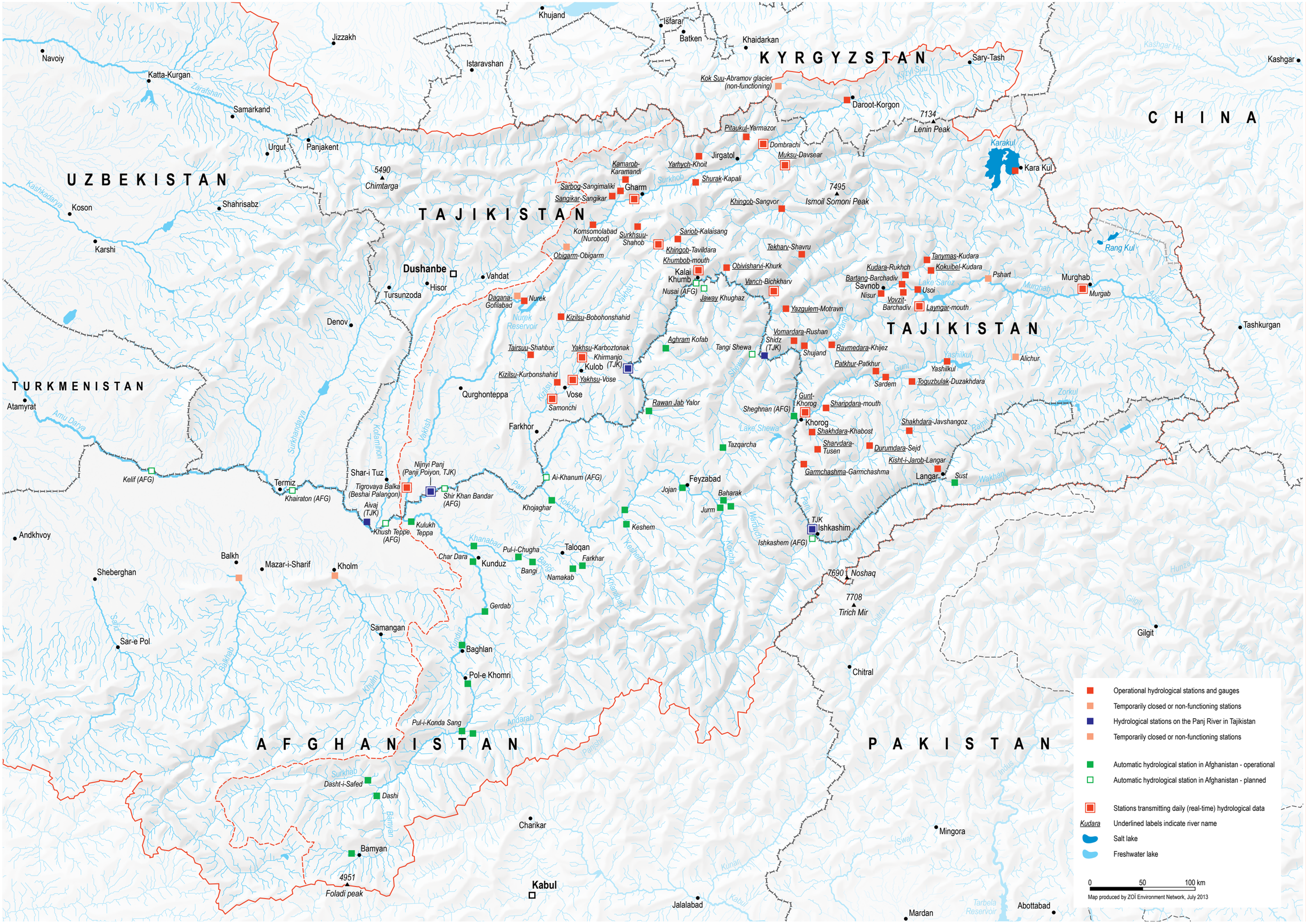
1958

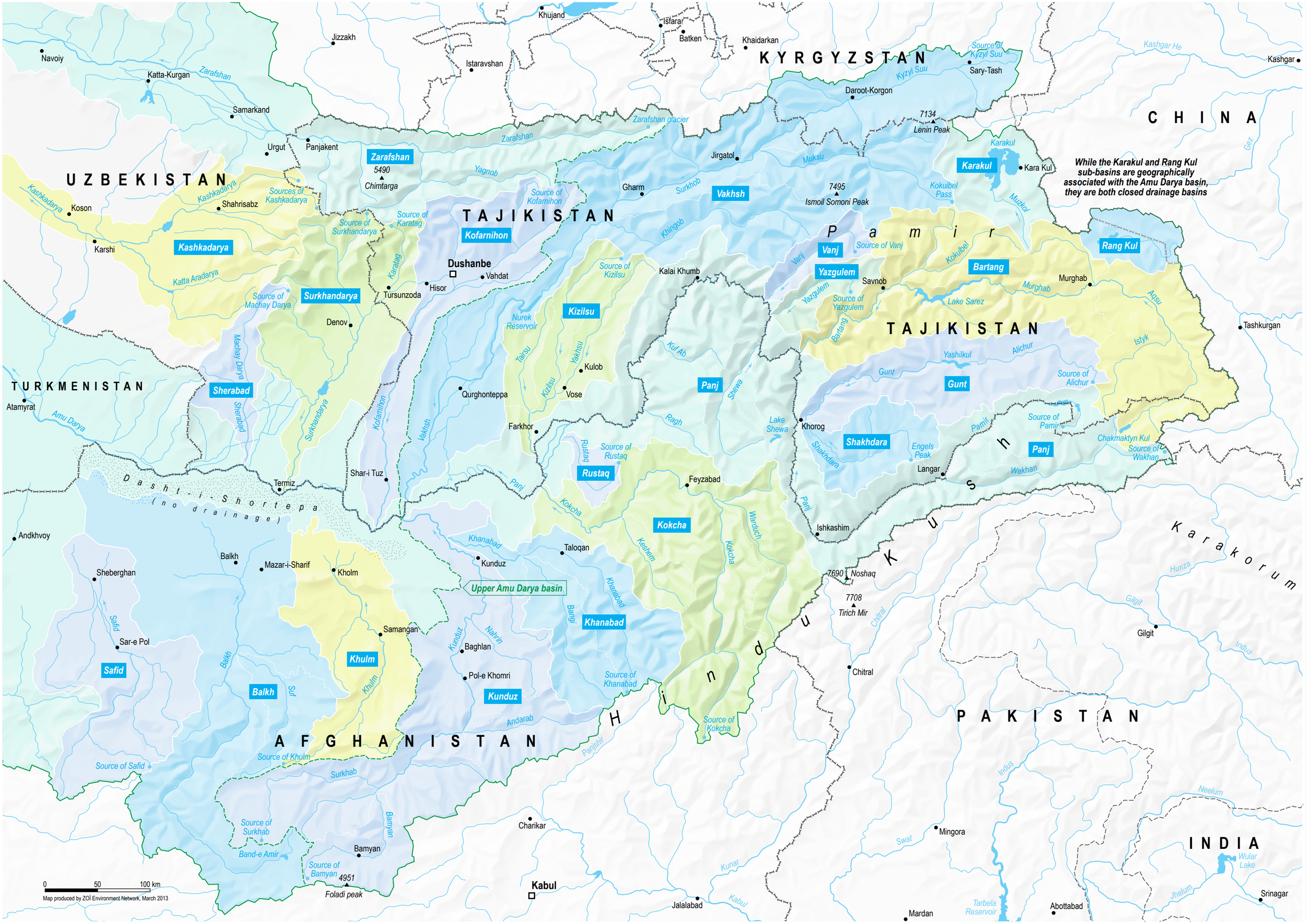
2006

Glacier terminus

Medveji glacier

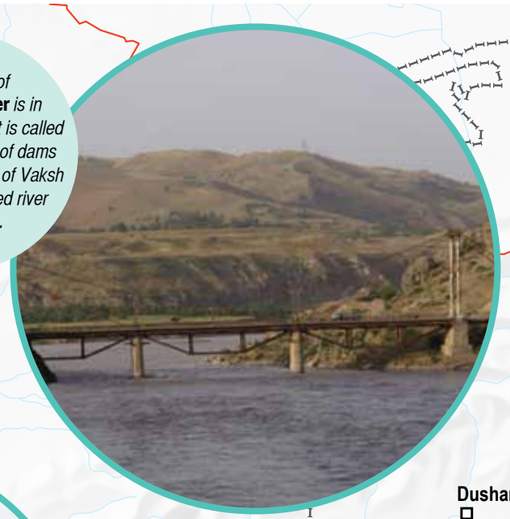
8 /
As a "surging" glacier, the **Medveji glacier** *advances and retreats periodically. In narrow valleys, such glaciers block rivers, form large lakes and cause flooding when glacial dam melts.*


KYRGYZSTAN
UZBEKISTAN
TAJIKISTAN
TURKMENISTAN
AFGHANISTAN
PAKISTAN
CHINA
Khujand
Isfara
Batken
Khaidarkan
Jizzakh
Navoiy
Katta-Kurgan
Istaravshan
Samarkand
Sary-Tash
Kashgar
Kashgar He
Kyzyl Suu
Kok Suu-Abramov glacier (non-functioning)
Daroot-Korgon
7134
Lenin Peak
Pitaukul-Yarmazor
Dombrachi
Jirgatol
Muksu-Davsear
Karakul
Kara Kul
Urgut
Panjakent
5490
Chimtarga
Kamarob-Karamandi
Yarhych-Khoit
Surkhob
Shurak-Kapali
Sarbog-Sangimaliki
Gharm
Sangikar-Sangikar
7495
Ismoil Somoni Peak
Khingob-Sangvor
Kashkadarya
Koson
Shahrisabz
Karshi
Komsomolabad (Nurobod)
Surkhsuu-Shahob
Sariob-Kalaisang
Khingob-Tavildara
Obigarm-Obigarm
Khumbob-mouth
Tekharv-Shavru
Rang Kul
Dushanbe
Vahdat
Hisor
Tursunzoda
Kalai Khumb
Obivisharvi-Khurk
Vanch-Bichkharv
Nusai (AFG)
Jaway Khughaz
Kudara-Rukhch
Tanymas-Kudara
Kokuibel-Kudara
Bartang-Barchadiv
Savnob
Nisur
Usoi
Lake Sarez
Pshart
Murghab
Murgab
Vovzit-Barchadiv
Layngar-mouth
Yazgulem-Motravn
Dagana-Gofilabad
Nurek
Nurek Reservoir
Kizilsu-Bobohonshahid
Denov
Vomardara-Rushan
Shidz (TJK)
Ravmedara-Khijez
Shujand
Tangi Shewa
Agram Kofab
Tairsuu-Shahbur
Yakhsu-Karboztonak
Khirmanjo
Kulob (TJK)
Yakhsu-Vose
Kizilsu-Kurbonshahid
Vose
Samonchi
Qurghonteppa
Rawan Jab Yalor
Patkhur-Patkhur
Sardem
Yashilkul
Alichur
Toguzbulak-Duzakhdara
Tashkurgan
Gunt-Khorog
Sharipdara-mouth
Sheghnan (AFG)
Khorog
Shakhdara-Javshangoz
Shakhdara-Khabost
Lake Shewa
Tazqarcha
Sharvdara-Tusen
Durumdara-Sejd
Kisht-i-Jarob-Langar
Garmchashma-Garmchashma
Langar
Sust
Wakhan
Atamyrat
Amu Darya
Kelif (AFG)
Termiz
Khairaton (AFG)
Shar-i Tuz
Tigrovaya Balka (Beshai Palangon)
Nijnyi Panj (Panji Poiyon, TJK)
Shir Khan Bandar (AFG)
Aivaj (TJK)
Khush Teppe (AFG)
Kulukh Teppa
Ai-Khanum (AFG)
Khojaghar
Feyzabad
Jojan
Baharak
Jurm
Keshem
Ishkashim
TJK
Ishkashem (AFG)
Andkhvoy
Balkh
Mazar-i-Sharif
Kholm
Sheberghan
Sar-e Pol
Char Dara
Kunduz
Pul-i-Chugha
Taloqan
Farkhar
Namakab
Bangi
Khanabad
Gerdab
Samangan
Baghlan
Pol-e Khomri
Pul-i-Konda Sang
7690
Noshaq
7708
Tirich Mir
Gilgit
Chitral
Dasht-i-Safed
Dashi
Bamyan
4951
Foladi peak
Charikar
Kabul
Jalalabad
Mingora
Mardan
Abottabad
Tarbela Reservoir
Operational hydrological stations and gauges
Temporarily closed or non-functioning stations
Hydrological stations on the Panj River in Tajikistan
Temporarily closed or non-functioning stations
Automatic hydrological station in Afghanistan - operational
Automatic hydrological station in Afghanistan - planned
Stations transmitting daily (real-time) hydrological data
Kudara
Underlined labels indicate river name
Salt lake
Freshwater lake
0
50
100 km
Map produced by ZOÏ Environment Network, July 2013



While the Karakul and Rang Kul sub-basins are geographically associated with the Amu Darya basin, they are both closed drainage basins

1 / *The source of* **the Vakhsh River** *is in Kyrgyzstan, where it is called Kyzylsuu. A series of dams make the lower part of Vaksh the most developed river in the basin.*



2 / The Nurek reservoir *in central Tajikistan, built in the 1970s with a storage capacity of up to 10 km³, is the largest reservoir in the basin.*

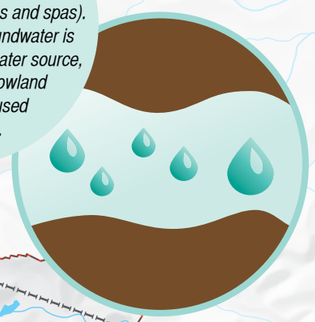
4 / *Red soils suspended in the turbid waters of the* **Kyzylsuu River** *in southern Tajikistan give the river its distinctive colour. When water levels are low, the Kyzylsuu looks peaceful, but heavy rains bring devastating floods.*

3 / **The Amu Darya river** *starts at the confluence of the Vakhsh, Panj, Kunduz Rivers.*

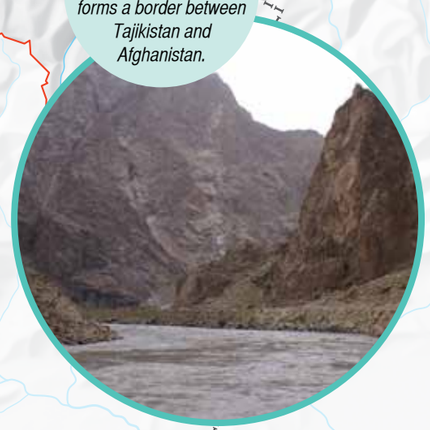
5 / The Kunduz and Kokcha rivers *in Afghanistan flow into the Amu Darya, and provide vital water for a large population.*

10 / *With a surface area of 380 km²,* **Karakul** *is the largest lake in the Amu Darya basin. At almost 4 000 m in elevation, Karakul fills the ancient crater created by a meteorite.*

Groundwater *in the mountains contains a wide range of minerals and is used for medical treatments (hot springs, cold springs and spas). In both countries, groundwater is an important drinking water source, and especially in lowland Afghanistan is used for irrigation.*



6 / **The Panj river** *flows mainly through narrow canyons, and forms a border between Tajikistan and Afghanistan.*

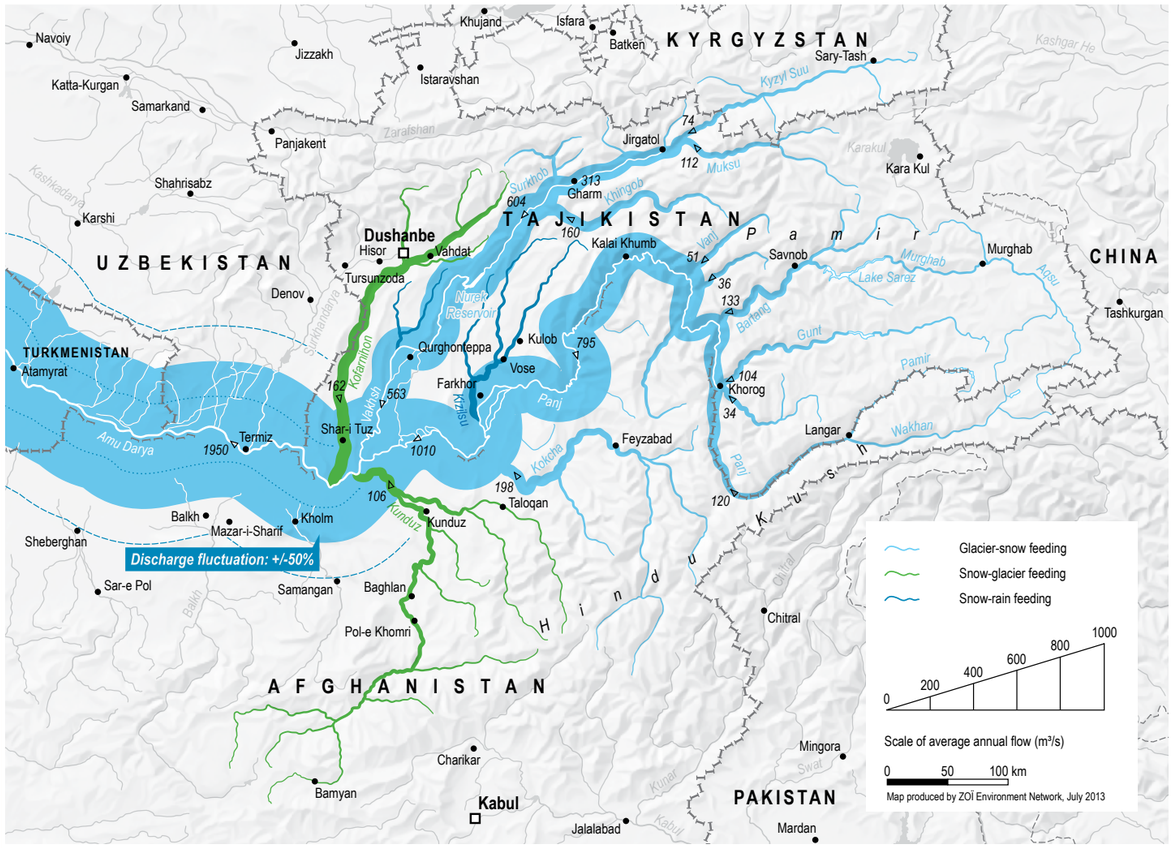


9 / Sarez lake *in Tajikistan formed in 1911 as result of a landslide. The height of the natural dam is more than 600 m, and the lake holds 17 km³ of water.*

7 / Shiva lake *in Afghanistan formed as result of an ancient landslide.*

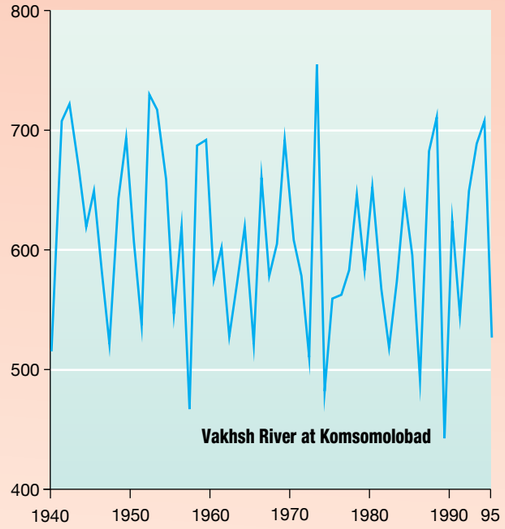
8 / *Another source of the Amu Darya,* **the Wakhan River** *flows through high mountain terrain in areas of low population.*

Dushanbe
Gharm
Surkhob
Kalai Khumb
Nurek Reservoir
Kulob
Vose
Qurghonteppa
Kizilsu
Farkhor
Panj
Kokcha
Feyzabad
Taloqan
Kunduz
Kunduz
Baghlan
Pol-e Khomri
Bamyan
4951
Foladi peak
Karakul
Kara Kul
Lake Sarez
Murghab
Murghab
Yashilkul
Gunt
Khorog
Panj
Langar
Wakhan
Panj
Ishkashim
TAJIKISTAN
AFGHANISTAN



River flow variability in the Vakhsh basin

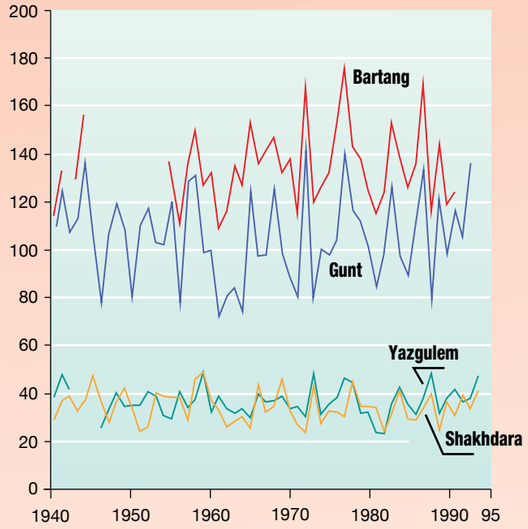
average annual water discharge, m³/sec



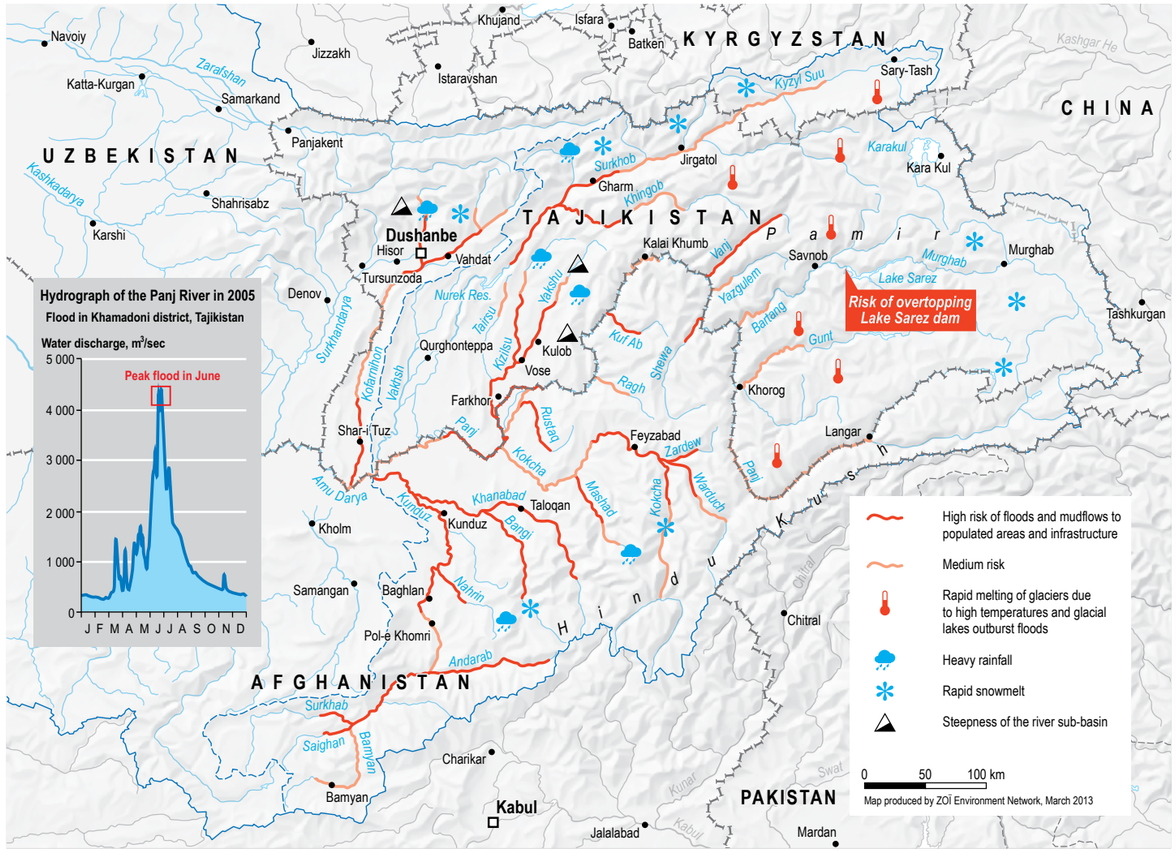
Source: Tajik Hydrometeorological Service

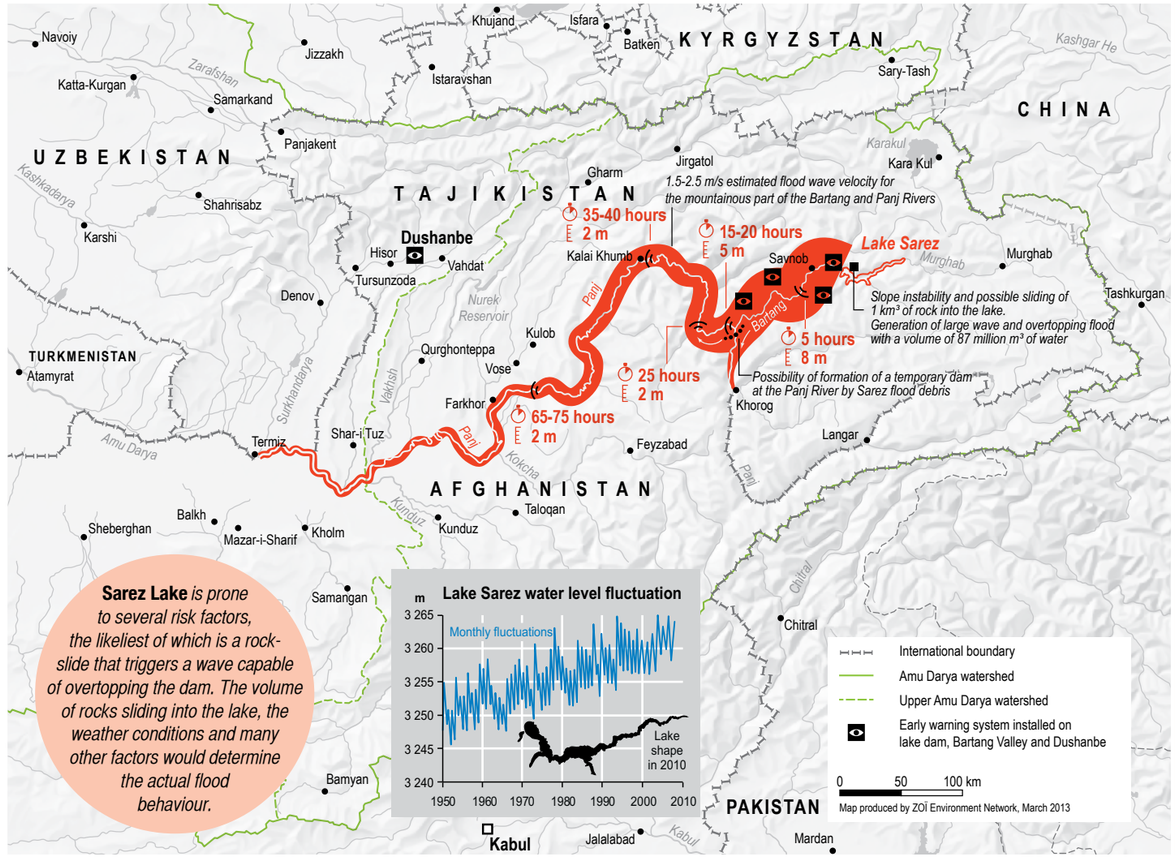
River flow variability in the Panj basin

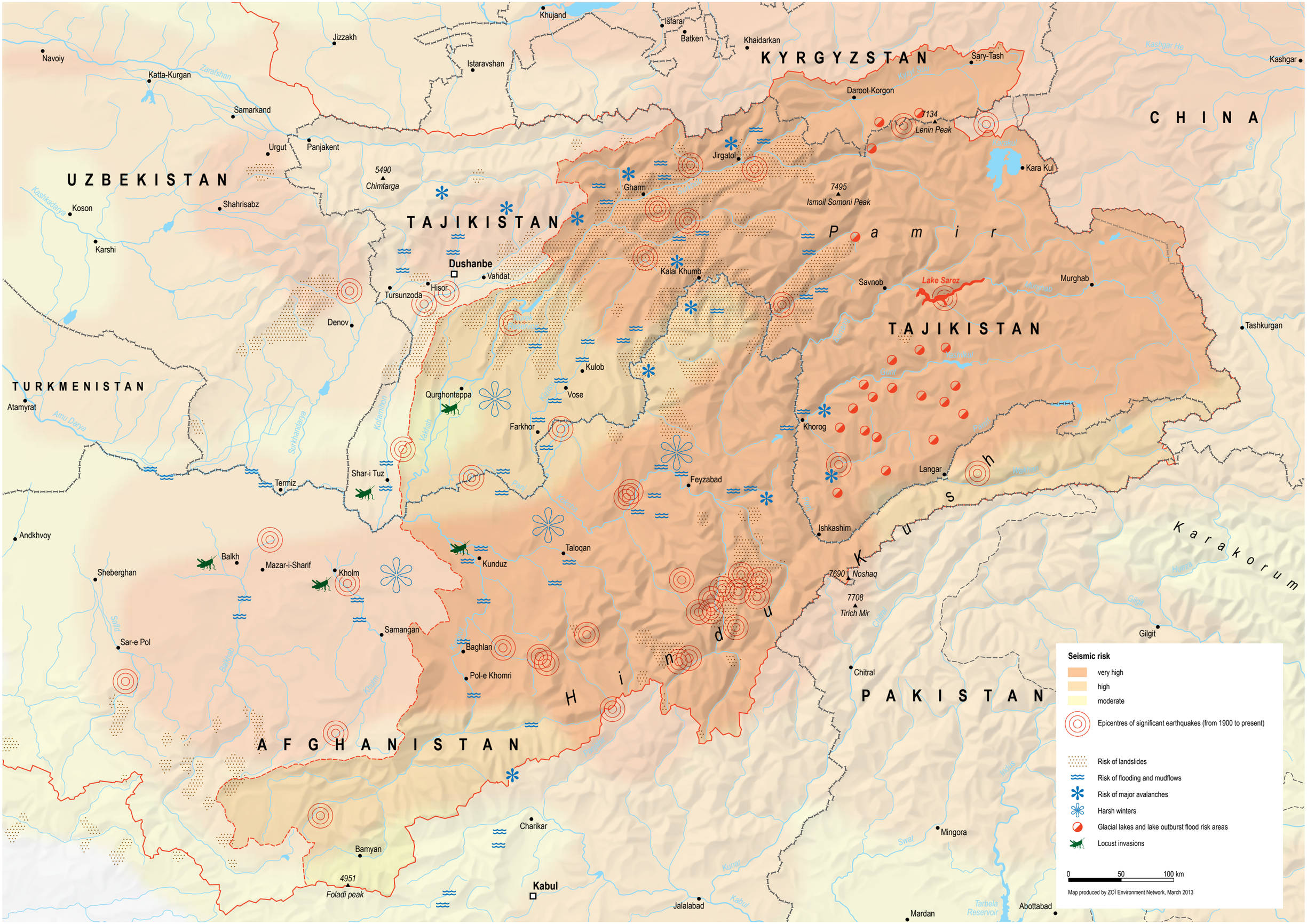
average annual water dischange, m³/sec



Source: Tajik Hydrometeorological Service



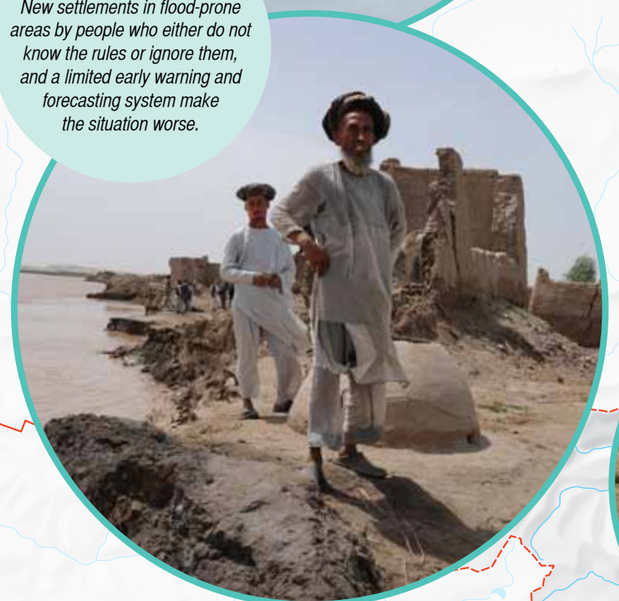



Khujand
Isfara
Batken
Khaidarkan
Jizzakh
Navoiy
Istaravshan
KYRGYZSTAN
Sary-Tash
Kashgar
Katta-Kurgan
Zarafshan
Daroot-Korgon
Kyrk Suu
Samarkand
7134
Lenin Peak
CHINA
Urgut
Panjakent
Jirgatol
Karakul
Kara Kul
Gez
5490
Chimtarga
UZBEKISTAN
Gharm
7495
Ismoil Somoni Peak
Kashkadarya
Koson
Shahrisabz
TAJIKISTAN
Pamir
Karshi
Dushanbe
Vahdat
Kalai Khumb
Savnob
Lake Sarez
Murghab
Hisor
Tursunzoda
Denov
TAJIKISTAN
Tashkurgan
Kulob
TURKMENISTAN
Qurghonteppa
Vose
Atamyrat
Amu Darya
Farkhor
Khorog
Surkhandarya
Kofarnihon
Vakhsh
Shar-i Tuz
Termiz
Feyzabad
Langar
Wakhan
Andkhvoy
Ishkashim
Taloqan
Balkh
Mazar-i-Sharif
Kunduz
Sheberghan
Kholm
7690
Noshaq
7708
Tirich Mir
Karakorum
Hunza
Gilgit
Samangan
Safed
Baghlan
Sar-e Pol
Pol-e Khomri
Chitral
PAKISTAN
AFGHANISTAN
Charikar
Mingora
Bamyan
4951
Foladi peak
Kabul
Jalalabad
Swat
Kunar
Kabul
Mardan
Tarbela Reservoir
Abottabad
Seismic risk
very high
high
moderate
Epicentres of significant earthquakes (from 1900 to present)
Risk of landslides
Risk of flooding and mudflows
Risk of major avalanches
Harsh winters
Glacial lakes and lake outburst flood risk areas
Locust invasions
0
50
100 km
Map produced by ZOÏ Environment Network, March 2013

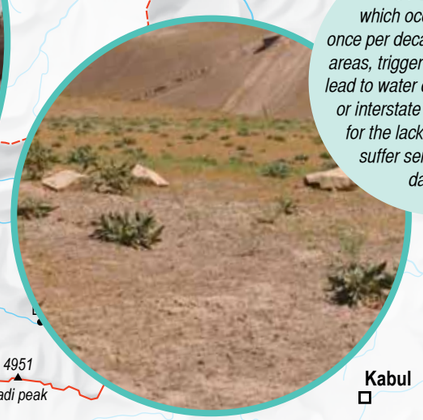
1 / Snow avalanches *occur in many parts of the Amu Darya basin, and present real hazards for roads and other infrastructure in some areas. In severe winters avalanches can cause many casualties.*

7 / Earthquakes *associated with intense geologic movements may not occur very often, but they can cause significant damage when they do occur.*

2 / Flash floods *cause serious damage. New settlements in flood-prone areas by people who either do not know the rules or ignore them, and a limited early warning and forecasting system make the situation worse.*

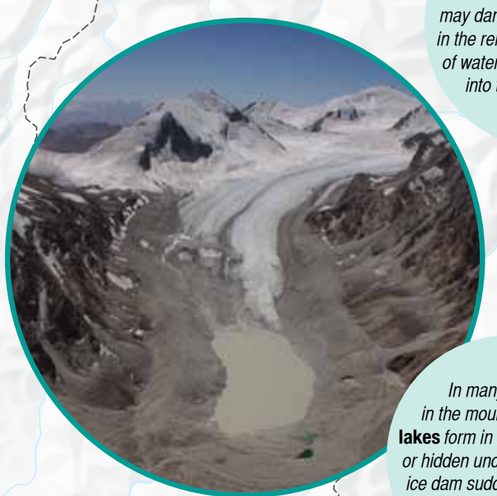


3 / Droughts, *which occur on average once per decade and affect large areas, trigger migration and may lead to water disputes at the local or interstate level. Unprepared for the lack of water, people suffer serious economic damages.*



4 / *A glacier avalanche occurs when an unstable surging glacier such as* **Didal**, *at the top of a mountain collapses and goes downhill, destroying everything in its path. Such events are rare, but cause considerable local damage.*

6 / Sarez lake *is located in a seismically active area, and an earthquake may damage the dam resulting in the release of a large amount of water. A huge rock collapse into the lake may cause a tsunami.*



5 / *In many locations in the mountains,* **glacial lakes** *form in front of, on top of, or hidden under glaciers. If the ice dam suddenly breaks, the outburst flood can cause significant damage.*

Dushanbe
Kulob
Qurghonteppa
Vose
Farkhor
Kalai Khumb
Gharm
Jirgatol
7134
Lenin Peak
Kyzyl Suu
Karakul
Kara Kul
7495
Ismoil Somoni Peak
Surkhob
Savnob
Lake Sarez
Murghab
Nurek Reservoir
Vakhsh
Kirtisu
Panj
Kokcha
Bartang
Yashilkul
Gunt
Khorog
Panj
Langar
Wakhan
Feyzabad
Ishkashim
Taloqan
Kunduz
Kunduz
Baghlan
Pol-e Khomri
4951
Foladi peak
Kabul
TAJIKISTAN
AFGHANISTAN
1
2
3
4
5
6
7

Tajikistan has more legacy **hazardous waste** *than Afghanistan, where military waste is a serious local issue that has not been addressed.*

Municipal waste *management systems are non-existent in Afghanistan, and underdeveloped in Tajikistan. While progress is limited, the problem is not yet great, but will increase as urban populations grow.*

The melting of glaciers *due to the accumulated effects of climate change adds to other environmental concerns.*

In the harsh desert environment, both wild and domestic animals browse **the Murgab Teresken bush**. *With no other energy source, the population uses teresken as fuel. Under these pressures, the slow-growing teresken may be eradicated.*

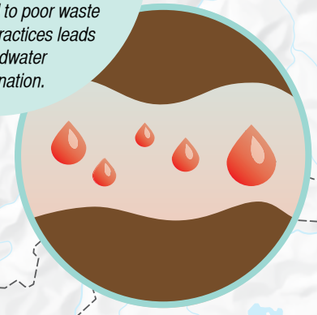
Improper irrigation *practices in Tajikistan have eroded large areas and built up salts in the soil. Central Asia farmers can learn from the example of Afghanistan.*

Local pollution *hotspots require action by citizens and authorities in both countries.*

Deforestation, overgrazing and soil compaction *in mountain areas have caused significant damage in Afghanistan. Similar damage is on the rise in Tajikistan.*

Both Afghanistan and Tajikistan have suffered through wars that resulted in environmental degradation. Because of the lack of attention to the environment, the impacts still echo across the countries.

Groundwater *in the region is under growing stress. In Afghanistan the pumping of groundwater for irrigation, the demands of a growing population and the lack of sanitary controls all affect groundwater availability and quality, while in Tajikistan pollution related to poor waste management practices leads to groundwater contamination.*



The illegal hunting *or collecting animals and plants is difficult to control in remote mountain conditions. Because the poachers and collectors cross borders, a common approach is necessary.*

Dushanbe
Gharm
Kalai Khumb
Savnob
Murghab
Lake Sarez
Kyzyl Suu
7134
Lenin Peak
Surkhob
Nurek Reservoir
Bartang
Pshilkul
Gunt
Kulob
Qurghonteppa
Vose
Kizilsu
Farkhor
Khorog
Pamir
Langar
Wakhan
Feyzabad
Kokcha
Panj
Ishkashim
Taloqan
Kunduz
Baghlan
Pol-e Khomri
Kabul
4951
Foladi peak

TAJIKISTAN

AFGHANISTAN

The countries have recently advanced their relations on environmental matters, and have signed useful **agreements on cooperation**. *Now that the paperwork is done, they are ready to move on to more practical measures.*

In the Soviet era, glaciers were well researched, but after independence monitoring was neglected. Now **monitoring** *– both manual and automatic – is being restored, an important development because glaciers determine water conditions in the basin.*

In spite of sharing their rivers, Afghanistan and Tajikistan have had only **limited exchanges of forecasting and hydrological information**, *a situation that has put constraints on both countries, but the growing cooperation is helping to improve information exchange.*

Experience exchange and mutual training *are key steps in advancing to the next stage of cooperation. The development of more operational and technical cooperation should be encouraged.*

The planting of forests *was first practiced for village amenity values, and now includes the use of wood for construction and fuel. Experience exchange may improve these centuries-old reforestation techniques.*

KYRGYZSTAN
TAJIKISTAN
AFGHANISTAN
Dushanbe
Kabul
Jirgatol
Gharm
Surkhob
Kalai Khumb
Savnob
Lake Sarez
Murghab
Murghab
Bartang
Yashilkul
Gunt
Nurek Reservoir
Kulob
Qurghonteppa
Vose
Kizilsu
Vakhsh
Farkhor
Panj
Kokcha
Feyzabad
Khorog
Panj
Ishkashim
Taloqan
Kunduz
Kunduz
Baghlan
Pol-e Khomri

PRIORITY AREAS FOR COOPERATION

Both Afghanistan and Tajikistan recognize the historical gaps in the hydrological monitoring that is crucial to the development of hydropower and agriculture and to interstate water relations. Both are taking steps to rectify the situation, but improving the monitoring on the Amu Darya is not a simple matter of installing equipment. The countries need to agree on a range of issues from methodology, measurements and data exchange to the placement of monitoring stations and the provision of security for the monitors.

Climate change, the protection of biodiversity and the preparation for natural disasters add more challenges. The geographic complexities of the region combined with the inherent uncertainties associated with global warming mean that the countries need to agree on a strategy for employing climate models. Climate scientists use many different models in making their projections because a wide range of model results leads to better forecasts, and the Afghan-Tajik cooperation may want to follow that example. The conflict-free management of water and food security is inextricably linked to land use, soil conservation and drought mitigation. Better knowledge and exchange of good practices on land and water resource management at the local and basin levels, the use of appropriate soil and water conservation technologies and agrometeorological advice may help improve the environmental security of the region. On biodiversity protection, the countries can take practical steps to adopt common standards, principles and monitoring to develop the most efficient interventions – reforestation in one location or the reintroduction of animal species in another, for example. Natural disasters do not respect borders and can originate far from where they strike. Mutual forecasting and early warning systems can prevent or limit damage, and common emergency procedures and the provision of aid can ameliorate the suffering.

Differences in institutional responsibilities between the countries create the potential for confusion and inefficiency. One ministry in one of the countries may have responsibilities that are spread among three ministries in the other country. Successful collaboration does not depend upon the countries having identical administrative schemes, but each needs to be aware of how the other operates.

As Tajikistan prepares to host an international conference in Dushanbe to mark the United Nations International Year of Water Cooperation, this atlas of cooperation confirms the value of transboundary efforts to manage and protect the vast resources of the Amu Darya basin.

A FRAMEWORK FOR COOPERATION: TECHNICAL TASK FORCE ON HYDROLOGY AND THE ENVIRONMENT

On 25 October 2010, the Islamic Republic of Afghanistan and the Republic of Tajikistan signed the agreement, "On cooperation in the field of development and management of water sources of the Panj/Amu Darya River basin". The countries subsequently established a Technical Task Force (TTF) on hydrology and the environment. Existing agreements, meeting decisions and the Terms of Reference guide the TTF, and in carrying out its activities related to hydrology, the TTF will consider the guidance and consultation of the World Meteorological Organization. The responsibilities of the TTF include conducting a comprehensive analysis of the basin, and coordinating the planning and implementation of hydrological and environmental monitoring, research, assessments and joint activities in the common interest of the states. The underlying goals of TTF activities are to strengthen cooperation and to promote coherent hydrological and environmental policies between the countries. International organizations with relevant mandates may provide scientific, technical and other support to the cooperation process, as necessary.

INITIAL COOPERATION ACTIVITIES FOR 2013–2014

General activities

Compile a list of each country's ongoing and planned projects and activities that have cross-border benefits or increase the scope for efficient collaboration on hydrological and environmental matters

Facilitate procedures for members and observers of the Task Force (border access, visas)

Hydrology activities

Compile fact sheets listing hydrological and data transfer equipment, locations and status of hydrological stations, and the needs and plans for modernization (focus on Panj River)

Establish points of contact, and draft procedures and agreements on the sharing and exchange of hydrological data – routine, historical and data for flood emergencies and forecasts

Facilitate installation of the new automated hydrological station on Sherhan-Bandar bridge, Panj River; pilot data exchange; catalyse support for the new hydrological station at Ayvaj, Amu Darya River

Establish snow cover monitoring, especially in the range of elevations of 2 000–4 500 m, using common approaches; collect and exchange data

Conduct joint glacier survey and assessment; collect and exchange data

Environment activities

Establish experience and data exchange on national communications and activities on climate change mitigation, adaptation and resilience

Establish experience and data exchange for agrometeorological services, and conduct joint work on early warning and mitigation of extreme climate-related events such as locust infestations, droughts and floods

Conduct joint work on conservation and monitoring of globally significant biodiversity in near-border protected areas, wetlands, migratory species habitats and ecological corridors

Map genetic resources and important ecosystem services in the Upper Amu Darya basin

Facilitate afforestation and reforestation programmes and sustainable land management, including documentation of good practices and their replication

Conduct joint survey and assessment of environmental quality and the state of the environment in the Panj/Amu Darya basin, and elaborate common environmental indicators and priorities

Provide capacity-building and training on environmental reporting and shared environment information systems in the Amu Darya basin countries and provinces

Work jointly on raising awareness of environmental challenges, success stories and good practices in the Upper Amu Darya basin; conduct training for young professions and students

Participate in international and regional environmental processes and relevant conventions

REFERENCES

Specific references and notes:

p. 13 two graphs at the right bottom:

AMU DARYA HYDROGRAPH 1950–2010

Data analysis: SIC ICWC (→ www.cawater-info.net). Data source: National hydrometeorological services of Tajikistan, Turkmenistan and Uzbekistan

p. 14 map at the bottom:

REGIONAL LAND AND WATER ISSUES

Sources: ENVSEC Amu Darya 2011; FAO LADA Land Degradation Assessment (→ www.fao.org/nr/land/degradation/en/); Central Asian Countries Initiative for Land Management; Environment and Security Initiative regional consultations in Ashgabat (Sep 2007) and Kabul (Nov 2007) and regional field missions (May 2008); National State of the Environment reports. Data analysis on drainage water use and discharge: SIC ICWC (→ www.cawater-info.net)

p. 15, two maps on the top:

CHANGE IN TEMPERATURE 1951–2001 AND CHANGE IN PRECIPITATION 1951–2001

Sources: U.K. Climate Research Unit (data synthesis → www.climatewizard.org) and compilation of information from the First and Second National Communications to the UNFCCC

p. 15, map at the bottom:

REGIONAL CLIMATE CHANGE AND NATURAL DISASTER IMPACTS

Sources: First and Second National Communications to the UNFCCC; ENVSEC, 2011; UNEP, 2009; Zoi, 2009

p. 16, two graphs at the bottom:

AMU DARYA FRESHWATER WITHDRAWALS PER COUNTRY AND WATER INPUTS TO AMU DARYA

Data analysis: SIC ICWC (→ www.cawater-info.net). Data source: National hydrometeorological services of Tajikistan, Turkmenistan and Uzbekistan. Additional source: Diagnostic report on water resources in Central Asia SIC ICWC 2002

p. 17, map on the top:

POPULATION

Sources: LandScan Global Population Database 2007, Oak Ridge, TN, Oak Ridge National Laboratory (→ www.ornl.gov/sci/landscan); World Gazetteer 2012 (→ www.world-gazetteer.com); Afghan Energy Information Centre (→ www.afghaneic.org)

p. 17, map at the bottom:

INFRASTRUCTURE

Sources: Central Asia Sustainable Mountain Development Report, 2012; Wikipedia, Rail transport in Afghanistan (→ en.wikipedia.org/wiki/Rail_transport_in_Afghanistan); CASA-1000 Project (→ casa-1000.org); Electric power sector of Tajikistan, Barki Tojik, 2011; Afghan Energy Information Centre (→ afghaneic.org); Russian Atlas of the Energy Resources in the 21st Century

p. 36–37:

LANDSAT IMAGE

Landsat 7, 1997–2003 (→ http://landsat.gsfc.nasa.gov)

p. 40–41, map:

LAND COVER

Sources: Global Land Cover 2000 database, European Commission, Joint Research Centre, 2003 (→ bioval.jrc.ec.europa.eu/products/glc2000/glc2000.php); GlobCover 2009, European Space Agency (→ ionia1.esrin.esa.int); Global Land Cover Characterization (→ edc2.usgs.gov/glcc/glcc.php); Tajikistan's State of the Environment Report 2002 (→ enrin.grida.no/htmls/tadjik/soe2001/eng/); Land use map produced by Central Asian Countries Initiative for Land Management, 2010; Afghanistan land cover map produced by OCHA and AIMS (→ afg.humanitarianresponse.info/mapcentre); Hindu Kush / Himalaya land cover mapping (→ http://www.glcn.org/databases/hima_landcover_en.jsp)

p. 42, map at the top:

MAIN ECOSYSTEMS

Source: World Wildlife Fund's Terrestrial Eco-regions of the World (→ worldwildlife.org/publications/terrestrial-ecoregions-of-the-world)

p. 42, maps in the middle:

VAVILOV'S CENTRES OF ORIGIN AND GLOBAL BIODIVERSITY HOTSPOTS

Sources: National Geographic; Global biodiversity hotspots: (→ www.biodiversityhotspots.org/xp/hotspots/resources/Pages/maps.aspx)

p. 43, map on the top:

HIGH THREATS TO HUMAN WATER SECURITY

Source: Rivers in Crisis database (→ riverthreat.net/nature.html). Scientific background: Global threats to human water security and river biodiversity. C. Vorosmarty, P. McIntyre, M. Gessner, D. Dudgeon, A. Prusevich, P. Green, S. Glidden, S. Bunn, C.A. Sullivan, C. Reidy Liermann and P. Davies, Nature 467, 555–561 (30 September 2010)

p. 44–45, map:

FLAGSHIP AND MIGRATORY SPECIES

Sources: National biodiversity strategies; National red lists; Wikipedia

p. 44–45, map:

PROTECTED AREAS

Sources: World Database on Protected Areas (→ protectedplanet.net); BirdLife International (→ www.birdlife.org); The Ramsar Convention on Wetlands (→ www.ramsar.org)

p. 52–53, satellite image:

DUST STORM IN AFGHANISTAN, JUNE 2008

Source: NASA Earth Observatory (→ earthobservatory.nasa.gov/NaturalHazards/view.php?id=20079); NASA image created by Jesse Allen, using data provided courtesy of the MODIS Rapid Response team

p. 54, map on the top:

TEMPERATURE IN JANUARY

Sources: WorldClim (→ www.worldclim.org); national climate data

p. 54, map at the bottom:

TEMPERATURE IN JULY

Sources: WorldClim (→ www.worldclim.org); national climate data

p. 55, map on the top:

ANNUAL PRECIPITATION

Sources: WorldClim (→ www.worldclim.org); national climate data

p. 55, map at the bottom:

METEOROLOGICAL STATIONS

Sources: Tajik hydrometeorological service; Watershed Atlas of Afghanistan, 2004

p. 56, two maps in the middle:

GLOBAL ANNUAL TEMPERATURE CHANGE IN 1991–2012 AND GLOBAL ANNUAL TEMPERATURE ANOMALIES IN 2012

Source: NASA Goddard Institute for Space Studies (→ data.giss.nasa.gov)

p. 58, four maps:

FUTURE REGIONAL CLIMATE PROJECTIONS

Sources: REMO model results generated by the University of Wuerzburg in the framework of the CAWa project funded by the German Federal Foreign Office as part of the "Berlin Process". B. Mannig, M. Müller, E. Starke, C. Merkenschlager, W. Mao, X. Zhi, R. Podzun, D. Jacob, and H. Paeth, 2013: Dynamical downscaling of climate change in Central Asia. Submitted to Global and Planetary Change

CAWa

p. 59, map on the top:

CLIMATE CHANGE IMPACTS ON GLACIERS AND RIVERS

Sources: Expert analysis of glacier vulnerability and changes by A. Yablokov, Tajik hydrometeorological service; Modelling of temperature and precipitation changes and hydrological responses: ADB, 2011: Climate Resiliency for Natural Resources Investments. Final Report

p. 60–61, map:

CLIMATE CHANGE CONCERNS AND VULNERABILITY

Sources: Second National Communication of Tajikistan to the UNFCCC; Government of the Republic of Tajikistan, 2003: National Action Plan for Climate Change Mitigation; UNEP, 2009; Tajikistan's Pilot Programme for Climate Resilience (PPCR), 2011: Improving the Climate Resilience of Tajikistan's Hydropower Sector. Final Report. R. Wilby, M. Friedhoff, R. Connell, B. Rabb, N. Minikulov, A. Homidov, M. Shodmanov and N. Leonidova, eds.

p. 63, graph:

ABRAMOV GLACIER MASS BALANCE 1969–2012

Source of instrumental records 1969–1998: Uzbek hydrometeorological service and SANIGMI. Data analysis by Martina Barandun, University of Fribourg. Data acquisition at Abramov Glacier is financed by the Swiss project CATCOS (→ www.meteoschweiz.admin.ch/web/en/meteoswiss/international_affairs/international_projects/CATCOS.html) Note: The values from 1994 to 2011 are based on model reconstruction and not on instrumental records. Contributors and collaborators: Matthias Huss, Martin Hoelzle, Nadine Salzmann, Erlan Azisov, Ryskul Usubaliev, Abror Gafurov, Aleksander Merkushkin.

p. 64, false-colour satellite image:

FEDCHENKO GLACIER IN TAJIKISTAN, OCTOBER 2011

Source: NASA Visible Earth (→ visibleearth.nasa.gov/view.php?id=78967). NASA image created by Jesse Allen and Robert Simmon, using Landsat data from the USGS Earth Explorer

p. 65, photo and graph on the bottom:

FEDCHENKO GLACIER RETREAT

Data: A. Lambrecht, Ch. Mayer, V. Aizen, D. Floricioiu, A. Surazakov, 2012: The Fedchenko glacier evolution in the Pamir during eight decades. (→ www.asiacryoweb.org/wiki/pub/Publications/PapersPrepared/Lambrecht_et_al_Fechenko_ice_thickness_submitted_2012.pdf); Iwata, Sh., 2010: Mapping Features of Fedchenko Glacier, the Pamirs, Central Asia from Space. Geographical Studies №84 (2009). Rikkyo University, Japan (→ www.ehs.unu.edu/palm/file/get/8432); Tajik hydrometeorological service. Note that glacier terminus retreat contours are generalized.

p. 66, satellite image:

MEDVEJI GLACIER IN TAJIKISTAN, JULY 2011

Source: NASA Visible Earth (→ visibleearth.nasa.gov/view.php?id=51498). NASA image created by Jesse Allen and Robert Simmon, using EO-1 ALI data provided courtesy of the NASA EO-1 team and USGS

p. 68–69, map:

RIVER DENSITY AND HYDROLOGICAL MONITORING NETWORK

Sources: Tajik hydrometeorological service; Watershed Atlas of Afghanistan, 2004; Ministry of energy and water of the Islamic Republic of Afghanistan

p. 70–71, map:

WATERSHEDS

Source: USGS HydroSHEDS (→ hydrosheds.cr.usgs.gov/)

p. 74, map:

ANNUAL RIVER FLOW

Sources: Tajik hydrometeorological service; Atlas of the Tajik SSR, 1968; Atlas of the Tajik SSR, 1986; USGS 2010.

p. 75, map on the top:

ENVIRONMENTAL FACTORS CONTROLLING FLOODS

Sources: Tajik hydrometeorological service; Tajik committee for emergency situations; Flood research conducted by MNV Consulting, R. Johnson in the framework of Tajikistan flood management project in 2001 (→ mnvconsulting.eu/2009/12/31/mnv-in-asia-environmental-factors-controlling-floods-in-tajikistan); Afghan disaster management authority; E. Hagen, NC3A, 2008: Afghanistan Flood Hazard Map v.2. 1:100 000; USAID iMMAP

p. 75, map at the bottom:

SAREZ LAKE FLOOD RISK SCENARIO

Principal source: USGS, 2006: Usoi Dam Wave Overtopping and Flood Routing in the Bartang and Panj Rivers, Tajikistan. J. Risley, J. Walder, and R. Denlinger, eds., USGS Water Resources Investigations Report 03-4004. Additional sources: Sarez disaster: geophysical forecast by L. Papyrin (→ sarez-lake.ru/monograph/); ISDR, 2007: Sarez Lake. The latest achievements and unsolved problems. Data on water level: Tajik hydrometeorological service

p. 76–77, map:

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Sources: Global Seismic Hazard Assessment Program (→ www.seismo.ethz.ch/static/GSHAP); National Geophysical Data Center/World Data Service's Significant Earthquake Database, Boulder, Colorado, U.S. (→ www.ngdc.noaa.gov/nndc/struts/form?t=101650&s=1&d=1); Global Risk Data Platform, UNEP/GRID-Geneva (→ preview.grid.unep.ch); Afghanistan natural hazards maps produced by OCHA (→ afg.humanitarianresponse.info/mapcentre)

p. 80–81, map:

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Ecological Footprint Network: http://www.footprintnetwork.org/en/index.php/GFN/page/footprint_for_nations/
Federal Institute of Hydrology. Global Runoff Data Centre: http://www.bafg.de/cln_031/nn_294112/GRDC/EN/02__Services/022__GIS_20Layers/gislayers__node.html?__nnn=true

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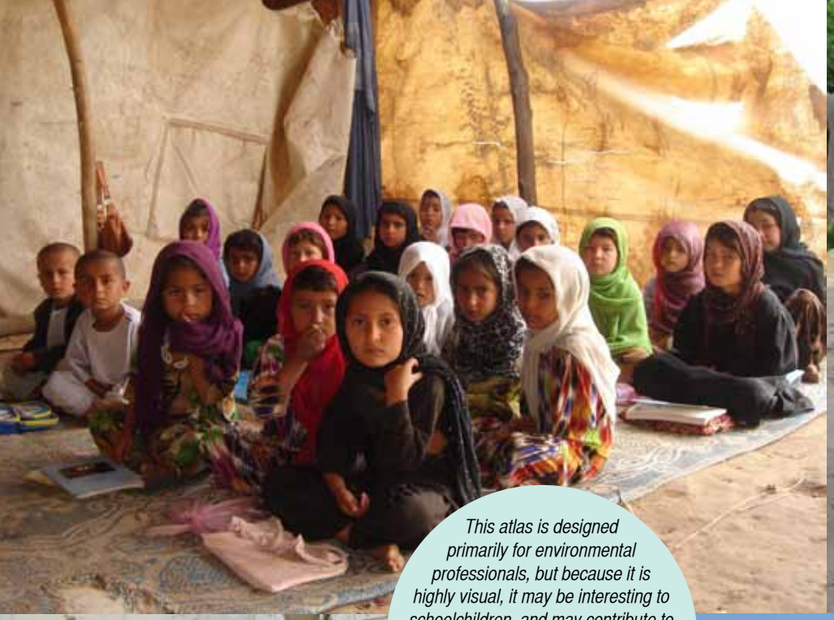

This atlas is designed primarily for environmental professionals, but because it is highly visual, it may be interesting to schoolchildren, and may contribute to their education and general awareness of the region. The children of the Amu Darya basin deserve a good future, and taking care of the environment is one way of taking care of the children.