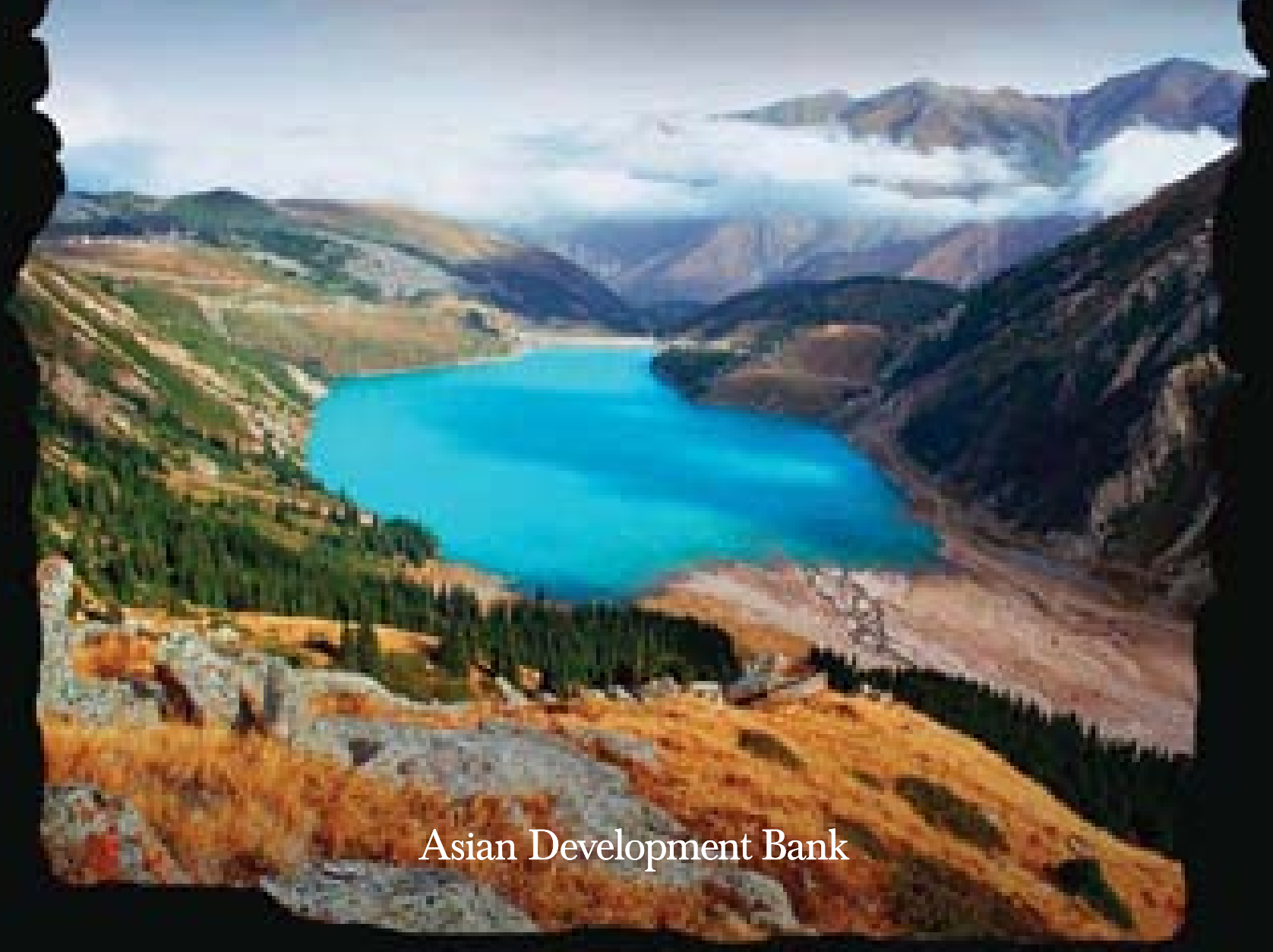
ADB

CENTRAL ASIA ATLAS OF NATURAL RESOURCES



Asian Development Bank

CENTRAL ASIA

ATLAS

OF NATURAL RESOURCES

ADB

CENTRAL ASIA ATLAS OF NATURAL RESOURCES

Central Asian Countries Initiative for Land Management
Asian Development Bank
Manila, Philippines

2010

Printed in Hong Kong, China.

The spelling of place names in this atlas generally follows Asian Development Bank (ADB) usage in those maps approved by the ADB country program specialist concerned and the editing group in the Office of the Secretary. ADB base maps were used for the regional and country profiles and thematic maps. Additional names and features on thematic maps were added by the cartographers, GIS Cartography, Bishkek, Kyrgyz Republic. These names were reviewed by the respective countries and amended based on reviewers' comments.

Remote-sensing images are Landsat Enhanced Thematic Mapper Plus (ETM+) images; Moderate Resolution Imaging Spectroradiometer (MODIS) images; Global Inventory Modeling and Mapping Studies (GIMMS), Land Cover Facility images; and Shuttle Radar Topography Mission (SRTM) images. Data on protected areas were from the World Database on Protected Areas; and on waterlogging from Raisa Taryannikova, head of the national secretariat of the Central Asian Countries Initiative for Sustainable Land Management. Details are provided in the References section of the atlas.

The major sources of social, economic, and natural resource statistics throughout the atlas were ADB *Key Indicators 2007*, World Bank *World Development Indicators 2009*, United Nations *Human Development Report 20007/2008*, and United Nations *Millennium Development Goals Indicators* (website). Statistics on agriculture, fisheries, and forestry are based on data reported by the countries to the Food and Agriculture Organization (FAO) of the United Nations.

The spelling of geographic features, animals, and plants follows generally accepted scientific usage. However, effort has been made to reflect common usage in the countries of the region.

Tabulated data are for years up to and including 2007. Unless stated otherwise, weights in tons are metric tons throughout, and maps showing the Aral Sea are based on different years, depending on the source. A separate map of the Aral Sea showing its decrease in size from pre-1960s to 2009 is provided.

The views expressed in this atlas are those of the contributors and do not necessarily reflect the views and policies of ADB or its Board of Governors or the governments they represent.

ADB does not guarantee the accuracy of data included in this atlas and accepts no responsibility for any consequences of their use.

By making any designation of or reference to a particular territory or geographical area, or by using the term "country" in this document, ADB does not intend to make any judgments as to the legal or other status of any territory or area.

ISBN: 978-971-561-886-1
Publication Stock No. BBK101663

Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 632 4444
Fax +63 2 636 2444
www.adb.org/projects/CACILM

Contents

The rising sun in the Zailiiski Alatau mountains in Kazakhstan.

Foreword

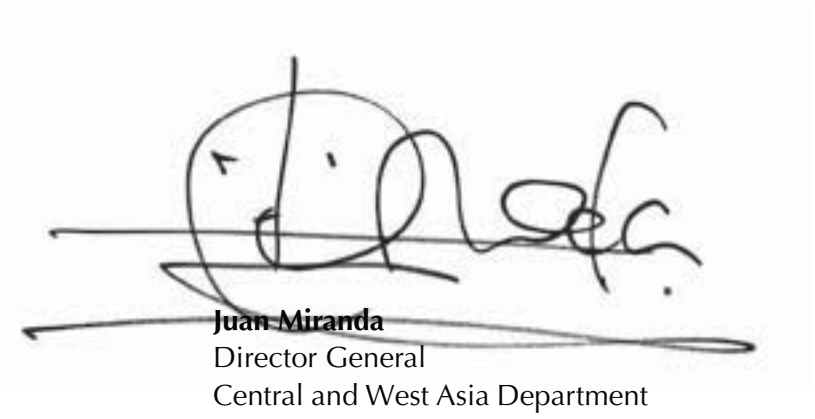
Central Asia, made up of Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan, is a vast land mass separating the countries of Eastern Europe and the Caucasus from East and South Asia. It is a region rich in natural resources, including oil and gas, and has a surprising variety of animals and plants. And it is a region long shrouded in mystery, known by most for its role in ancient trans-Asian commerce via the Silk Road.

This Atlas brings to readers a sense of the beauty and wealth of Central Asia's natural resources, some issues its peoples face in using and conserving them, and the progress being made toward sustainable development.

The Atlas is an output of the Central Asian Countries Initiative for Land Management (CACILM) Program, a 10-year partnership between the Central Asian countries and the international donor community that began in 2006. Its aim is to restore, maintain, and improve the productive functions of land in Central Asia, leading to better economic and social well-being, while preserving the ecological functions of the land. The initiative has set in motion an integrated approach to sustainable land management that will have local, national, and global benefits.

I would like to express sincere thanks to the many colleagues in the Asian Development Bank and those working on CACILM, and in institutions in the countries of Central Asia for their help in bringing this Atlas to life.

I hope that the Atlas fulfills its dual purpose of setting out the diversity and importance of the region's natural resources and the need to maintain them while offering a fascinating glimpse into this very special part of our world.



Juan Miranda
Director General
Central and West Asia Department

Amid Deserts, Steppes, and Mountains

The glacial landscapes of the Tien Shan mountains in eastern Kyrgyz Republic near its borders with the People's Republic of China and Kazakhstan.

Land Features of Central Asia

1:10000000

200 100 0 200

Kilometers

RUSSIAN FEDERATION

KAZAKHSTAN

ASTANA

Lake Zaisan

Lake Balkhash

PEOPLE'S REPUBLIC OF CHINA

Aral Sea

Caspian Sea

AZERBAIJAN

UZBEKISTAN

TURKMENISTAN

ASHGABAT

IRAN

AFGHANISTAN

BISHKEK

Lake Issyk-Kul

KYRGYZ REPUBLIC

TASHKENT

DUSHANBE

TAJIKISTAN

- Capital city
- International boundary

Major land types

- Riparian zone
- Desert
- Steppe
- Piedmont
- Mountain

Boundaries are not necessarily authoritative.

Data sources:
Geographical Atlas, Russia, 1982

Projection: Lambert Conformal Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatullin, GIS-Service Ltd.
Kyrgyz Republic, 2009

A Bowl of Sand in a Rocky Cradle

A glance at a map of Central Asia—Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan—reveals a vast bowl of mainly sandy deserts, broadly capped in the north by green plains of the Central Asian steppe and cradled in the south and east by soaring mountain ranges that form Central Asia's borders with Iran, Afghanistan, and the People's Republic of China. Despite having two inland seas, one the biggest in the world, it is mainly an arid and uncompromising region stretching some 4,000 kilometers from east to west, with an area the size of Europe. And come winter, much of the region, deserts and all, is covered in a white blanket.

Deserts occupy much of Kazakhstan and almost all of Uzbekis tan and Turkmenistan. The two major deserts, the Northern and Southern, are marked by temperature extremes, seasonal drought, snowy winters, and winds that move dunes, erode agricultural land, and stir up blinding dust storms.

Framing the deserts to the north is a broad transition zone, the Kazakh semidesert area, a mixture of grassy plains and desert shrubland stretching across central Kazakhstan. Capping the semidesert is a vast green belt of steppes, grassy plains with few or no trees. Most of the belt is the Kazakh steppe, a seemingly endless sea of rolling, open, and windy plains.

Thus, the great majority of the region is fairly flat and low, even below sea level near the Caspian Sea. Only in the southeast do elevations rise much above 1,000 meters and where they do, it is spectacular.

View across the desert from one of the hillside Ayaz Qala fortresses in Karakalpakstan, Uzbekistan.

Relief Map of Central Asia

1:10 000 000

200 100 0 200

Kilometers

N

55°0'E

75°0'E

50°0'N

40°0'N

RUSSIAN FEDERATION

KAZAKHSTAN

ASTANA

UZBEKISTAN

TURKMENISTAN

TAJIKISTAN

KYRGYZ REPUBLIC

PEOPLE'S REPUBLIC OF CHINA

AZERBAIJAN

IRAN

AFGHANISTAN

Caspian Sea

Aral Sea

Lake Zaisan

Lake Balkhash

TASHKENT

BISHKEK

ASHGABAT

DUSHANBE

National capital

International boundary

Elevation (m)

4,000
3,500
2,500
1,500
1,000
500
250
0

Boundaries are not necessarily authoritative.

Data source:
Shuttle Radar Topography Mission (SRTM90), 1999

Projection: Lambert Conformal Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd.
Kyrgyz Republic, 2009

Red poppy flowers and green rolling hillsides of southern Tajikistan.

Tall mountain ranges form the southern edge of Turkmenistan, nearly all of the Kyrgyz Republic and Tajikistan, and parts of eastern Kazakhstan. The Pamir range in Tajikistan reaches about 7,500 meters in height while the Tien Shan mountains, which lie partly in the Kyrgyz Republic, have dozens of peaks above 6,000 meters high.

Between the extremes of the central deserts and the mountains in the southeast are mild fertile valleys and foothills and lush plains alongside rivers and lakes, where agriculture thrives and forests of wild fruits and nuts abound.

Water, the keystone of life, is abundant in some mountains and plateaus of Kazakhstan, the Kyrgyz Republic, and Tajikistan, but only the two major rivers of the region, the Amu Darya and Syr Darya, venture across the sprawling deserts of Turkmenistan and Uzbekistan. Both rivers end in the Aral Sea but diversion of water for agriculture has greatly lessened their flow, such that the Aral Sea has been shrinking continually since the 1960s.

In the west of the region is the Caspian Sea, largest inland water body in the world and shared with other nations that border its shores—Iran, Azerbaijan, and the Russian Federation. Moderately saline, it supports large fisheries and is home to the famous sturgeon fish.

Desert village with summer yurts and winter houses in Damla Oasis, Turkmenistan.

Extreme Environments

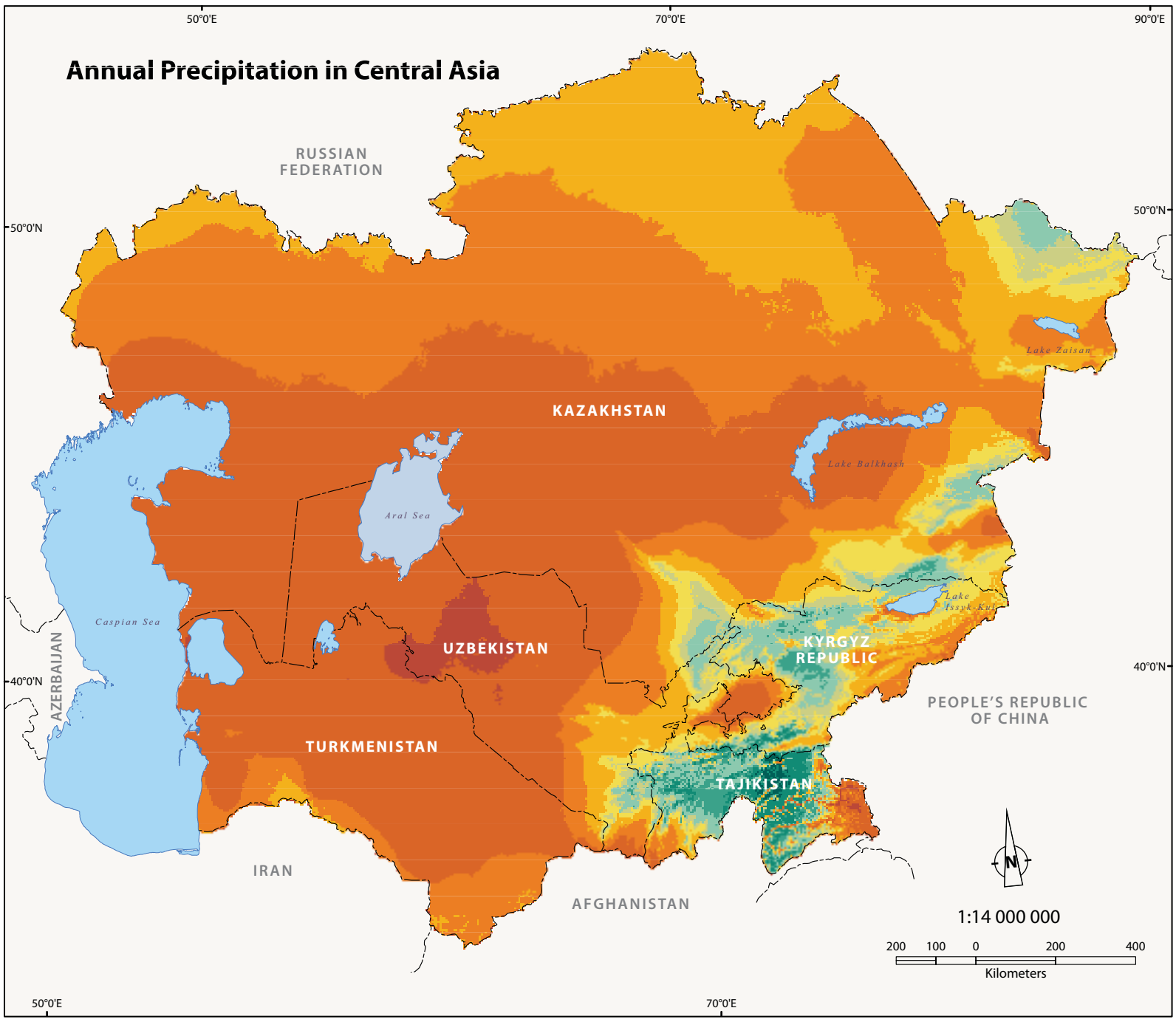
Temperatures across most of the region's steppes and deserts follow a gradient from north to south. Winters are severe in northern Kazakhstan, averaging as low as –20°C in January, blanketing crop and pasturelands in snow for much of the winter. Further south, conditions become milder, but average midwinter temperatures do not creep above zero except in southern Turkmenistan and Uzbekistan.

Summer brings above-zero temperatures throughout the steppes and deserts, with an average of up to 25°C in midsummer in northern Kazakhstan and above 30°C in southern Turkmenistan.

But in the mountains in the east and southeast, temperatures drop fast with altitude. Winters are bitter, averaging lower than –25°C in the highest plateaus, which remain snow-covered year round. Even the lower slopes of the mountainous areas average 10°C or less in midsummer.

Annual precipitation (rain, sleet, and snow) patterns explain the region's generally arid environments. There is a dearth of precipitation across the great deserts of Kazakhstan, Uzbekistan, and Turkmenistan, averaging less than 100 millimeters a year. Precipitation gradually increases around the deserts on the steppes and plateaus to the north, south, and east. The eastern and southeastern mountains receive the majority of precipitation, averaging 1,000 millimeters or more. From these mountains flow the mighty rivers that provide power to the Kyrgyz Republic and Tajikistan and irrigation to southern Kazakhstan, Turkmenistan, and Uzbekistan.

Annual Precipitation in Central Asia



Annual precipitation (millimeters)

0 100 200 300 400 500 600 800 1,000 1,500 2,000

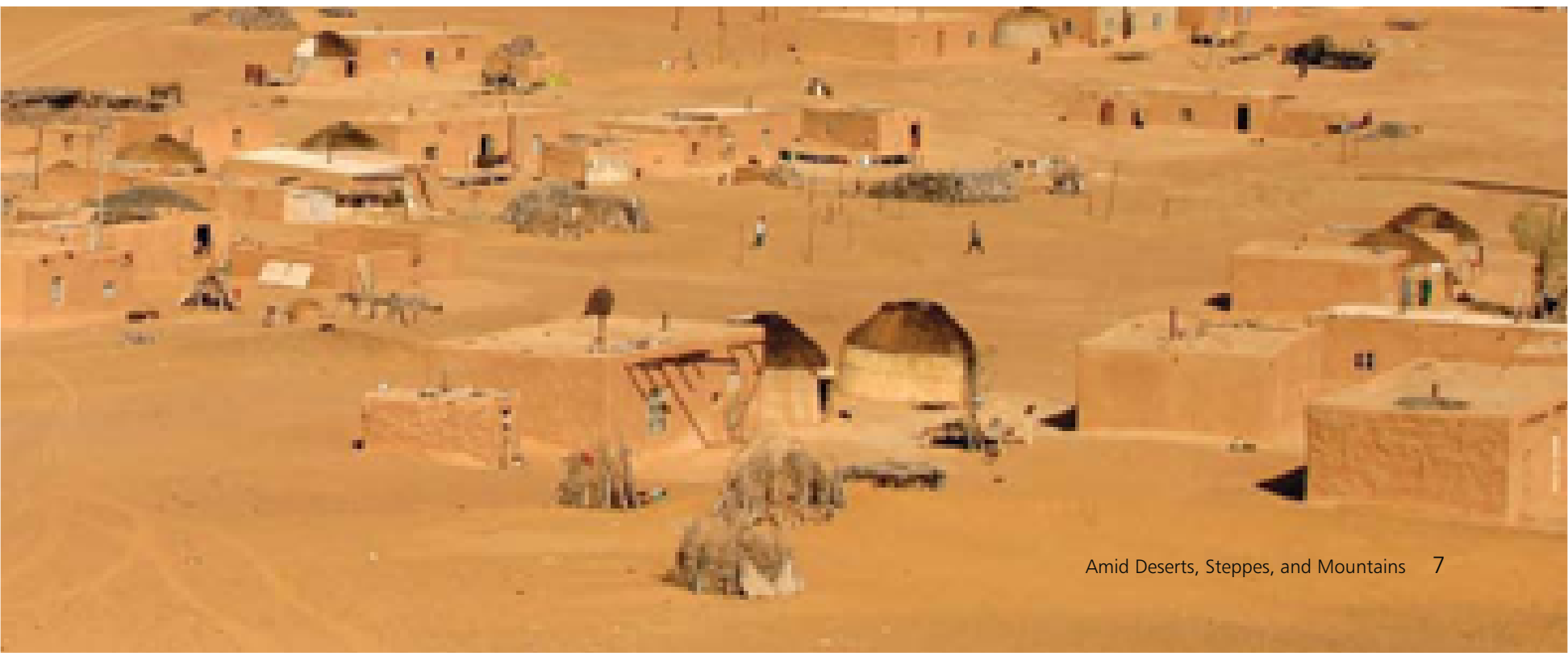
—-- International boundary

Boundaries are not necessarily authoritative.

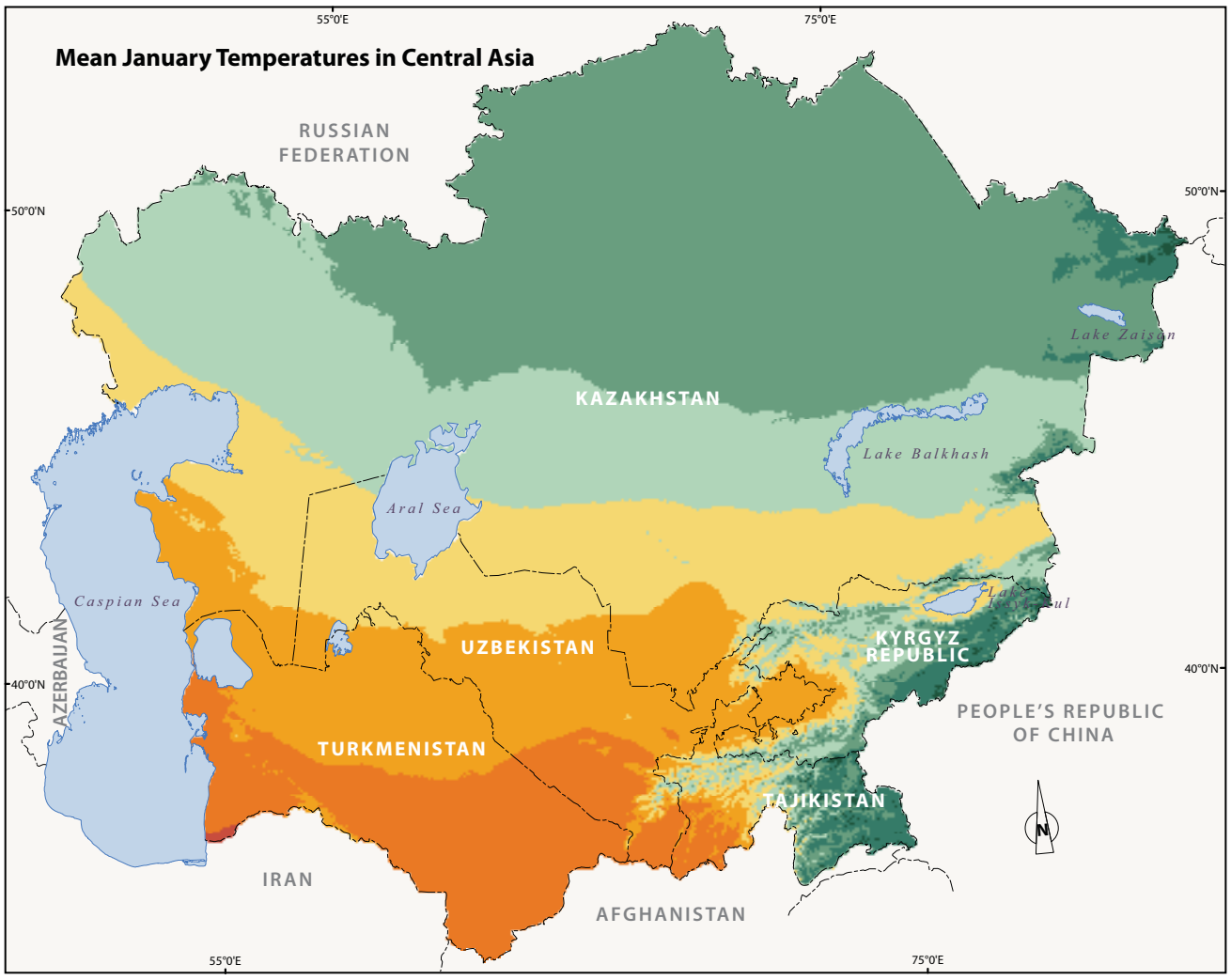
Data source:
De Pauw, E. 2008. ICARDA Regional GIS Datasets for Central Asia: Explanatory Notes. GIS Unit Technical Bulletin. International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria.

Projection: Equidistant Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd.
Kyrgyz Republic, 2009



Mean January Temperatures in Central Asia



Temperature, °C

below -25 -20 -15 -10 -5 0 +5 +10

—–– International boundary

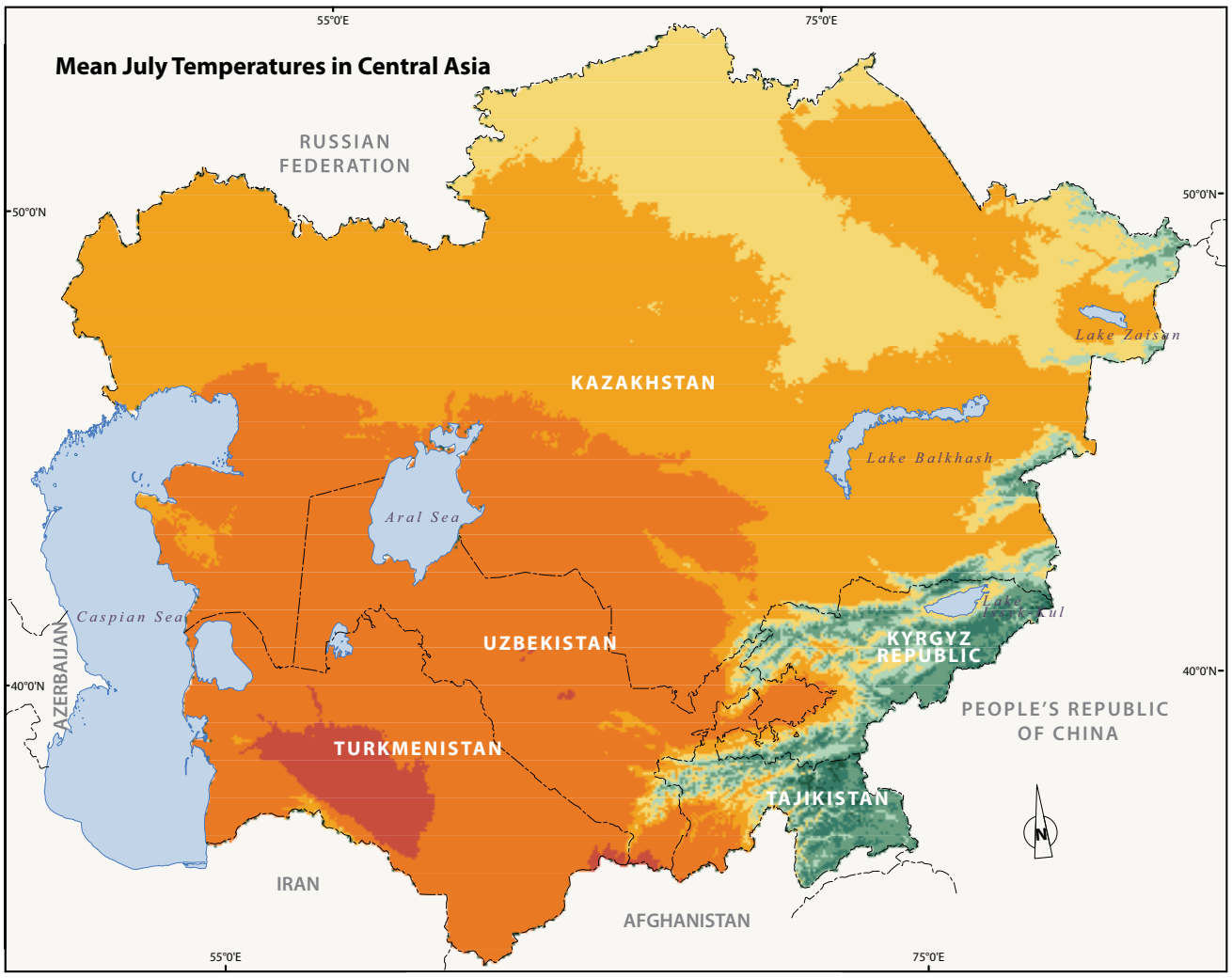
Boundaries are not necessarily authoritative.

Data source:
De Pauw, E. 2008. ICARDA Regional GIS Datasets for Central Asia: Explanatory Notes. GIS Unit Technical Bulletin. International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria.

Projection: Equidistant Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd.
Kyrgyz Republic, 2009

Mean July Temperatures in Central Asia



Temperature, °C

below 0 +5 +10 +15 +20 +25 +30 +35

—–– International boundary

Boundaries are not necessarily authoritative.

Data source:
De Pauw, E. 2008. ICARDA Regional GIS Datasets for Central Asia: Explanatory Notes. GIS Unit Technical Bulletin. International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria.

Projection: Equidistant Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd.
Kyrgyz Republic, 2009

■ Chimgan, a mountainous and resort area about 130 kilometers from Tashkent, Uzbekistan, whose peaks reach 3,300 meters

Woman making mud bricks, used for constructing winter houses in the desert.

Deserts: Land That Makes Demands

More than 40% of Central Asia is desert. These deserts are not simply large, empty expanses of sand. Although they exhibit extremes of temperature from day to night and from winter to summer and receive little rain—and what rain they receive evaporates quickly—they contain a world of uncommon biodiversity, where plants and animals have learned to make the most with less. In no other ecoregion is biological success as dependent on subtle changes as in the desert environment. Climate, water, and soil play equal roles in determining the composition and distribution of life. Plants and animals engage in a delicate balancing act, with survival dependent on ability to adapt to extreme conditions.

Of all the Eurasian deserts, those in Central Asia—particularly the sandy Northern Desert in central Kazakhstan and Southern Desert that embraces Turkmenistan, Uzbekistan, and southern Kazakhstan—support the greatest species diversity. Black saxaul and white saxaul are the most common tree shrub vegetation. The deserts are also home to small numbers of rare, endangered animals, such as Asian wild asses and Bactrian camels. The Southern Desert is described in detail as an ecoregion of unique diversity in the Living Resources chapter.

The desert climate is characterized by long, dry summers and high temperatures. In the Southern Desert, precipitation totals 70 millimeters or less each year and is seasonal, with more than half falling in spring, the remainder in late fall and winter. This creates two seasons: a mid-May through mid-October dry season, and a humid season the rest of the year. Winters are generally mild, with January temperatures between –1°C and +5°C and most plant growth stops for a short period only. Conditions are more severe in the equally large Northern Desert, where January temperatures are –10°C to –15°C and climb to 24°C–26°C in July. Precipitation (rain or snow) may fall any time of year, averaging up to 150 millimeters annually.

Deserts of Central Asia

1:10 000 000

200 100 0 200

Kilometers

RUSSIAN FEDERATION

KAZAKHSTAN

UZBEKISTAN

TURKMENISTAN

KYRGYZ REPUBLIC

TAJIKISTAN

PEOPLE'S REPUBLIC OF CHINA

AZERBAIJAN

IRAN

AFGHANISTAN

ASTANA

TASHKENT

BISHKEK

DUSHANBE

ASHGABAT

Caspian Sea

Aral Sea

Lake Balkhash

Lake Issyk-Kul

Lake Zaisan

55°0'E

75°0'E

50°0'N

40°0'N

Capital city

International boundary

Rivers and canals

Genetic types of deserts

- Clay-loess
- Crushed stone gypsum
- Sandy
- Sandy gravel
- Solonchak

Boundaries are not necessarily authoritative.

Deserts

1	Karakum lowlands	16	Muyunkum
2	Southeastern Karakum	17	Taukum
3	Sundukli	18	Sary -Ishikotrau
4	Soinagsak	19	Sarykum
5	Kyzylkum	20	Aryskum
6	Dardjakum	21	Greater Barsuki
7	Khanbagy	22	Lesser Barsuki
8	Sercheli	23	Near -Aral Karakum
9	Geirdjany	24	Akkum
10	Meshedkum	25	Karynzharyk
11	Oktumkum	26	Bostarkum
12	Chilmamedkum	27	Sam
13	Uchtagan	28	Motai
14	Zaunguzsky Karakum	29	Karakum
15	Kyzylkum	30	Ryekum

Data sources:
Babaev, A.G. 1999. Desert Problems and Desertification in Central Asia. Springer.

Projection: Lambert Conformal Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd.
Kyrgyz Republic, 2009

Area Covered with Deserts in Central Asia (square kilometers)

Country	Total area	Area Covered with Desert	
		All types	Sandy Desert
Uzbekistan	449,000	250,000	107,000
Turkmenistan	488,000	387,000	260,000
Tajikistan	143,000	25,000	5,000
Kyrgyz Republic	198,000	70,000	0
Kazakhstan	2,715,000	747,000	246,000
Total	**3,993,000**	**1,479,000**	**618,000**

Note: Areas are rounded numbers.
Source: Zakirov 1980 as cited by Babaev 1999.

Upper: The burning deserts of Altyn Emel National Park, Kazakhstan; **Lower:** Young boy at play in the sands of the Karakum Desert

Drought takes a toll in the deserts, reducing harvests on rainfed lands. Desert winds are another destructive element, causing sand erosion and moving dunes. Dust storms last on average for 20–40 days a year, blanketing fields in sand and dust, and lowering crop yields. Spring and autumn frosts retard growth on irrigated land and pasture alike, and shorten growing seasons. Desert mists, which appear 10–20 days a year, create dangers for transport. The thirst for water is ever increasing, with groundwater resources under increasing pressure. And the deserts are growing due to overgrazing and poor agricultural practices.

The Kyzlkum Desert, part of the Northern Desert, offers an insight into the diversity of landforms and wealth of resources of Central Asia's arid heart. Located southeast of the Aral Sea, between the Amu Darya and Syr Darya rivers, it covers some 300,000 square kilometers, and stretches across Kazakhstan, Uzbekistan, and Turkmenistan. The Kyzylkum includes areas of sandy, sandy-gravel, gravel desert, crushed stone gypsum, loess, and *takyr* soils. It consists of a massive plain with an altitude of up to 300 meters that slopes down toward the northwest, with a few small basins and mountains that rise to 900 meters. Crops are grown in oases and along rivers, while desert plants growing on the ridges serve primarily as pasture for camels, horses, and sheep.

The Kyzylkum is probably best known for its vast reserves of natural gas, and large deposits of aluminum, copper, gold, silver, and uranium. Measuring more than 300 meters deep and several kilometers across, the Muruntau gold mine in Uzbekistan is said to be one of the world's largest open pit mines.

A shepherd on horseback with his flock of sheep in the poppy fields of Kazakhstan

Steppes

TAMING A BOUNDLESS EXPANSE

The Central Asian steppe forms the middle section of an enormous chain of plains called the Eurasian Steppe that stretches from western Hungary to Mongolia. Long an area of fascination, it conjures up images of nomadic hordes—fearless mounted archers who thundered across the land to subdue the civilizations of the now People's Republic of China, South Asia, Europe, and the Middle East. To these conquerors, the steppe was a boundless sea that provided a thoroughfare for movement, enabling them to expand traditional homelands across continents in pursuit of empire.

Steppes are the product of continental climate characterized by low and unstable precipitation. The World Wildlife Fund (WWF) categorizes steppes by ecoregions, differentiating them by flora and fauna as well as such attributes as climate, elevation, and rainfall. The Central Asian steppe is made up of a variety of steppe types—low mountain desert steppe, mid-altitude mountain steppe, mountain xerophyte steppe, mountain grassland with shrub steppe, semidesert steppe, shrub and brushwood steppe, and forest steppe. The Alai-Western Tien Shan steppe of Kazakhstan, Tajikistan, and Uzbekistan, for instance, is a foothill and low-mountain region blanketed with forbs, tall grasses, and juniper and wild pistachio forests. It contains a wide variety of fauna, including mountain sheep and wild cats.

Another steppe type is the Tien Shan foothill arid steppe of Kazakhstan and the Kyrgyz Republic, which breaks westward from the Tien Shan mountains. Moist arctic air spilling in from western Siberia enables it to support meadows and spruce forests, plus a full range of mammals, including the rare ibex and snow leopard. The steppe in eastern Kazakhstan offers still another terrain, one that includes significant wetlands and forest vegetation, such as birch, birch-aspen, and pine.

Most impressive of all is the Kazakh steppe—the largest dry steppe region in the world. Before being targeted for massive cultivation in the 1950s, it consisted of a continuous belt stretching from the Altai foothills in the east to the Ural River in the west. The Kazakh steppe is a windy expanse that receives 250–300 millimeters of precipitation a year, and is known for hot and dry summers and cold winters with little snow accumulation. It is geologically diverse, with gentle hilly plains, plateaus, and flat low plains. Large rivers, including the Irtysh and Ural, cross the region, and it is dotted with numerous shallow lakes. The Kazakh steppe is noted for its grasslands, fescues, and wild oats.

THE STEPPES AND HUMAN INFLUENCE

Historically, Central Asia's steppe has been used by nomadic herders for grazing and growing fodder and small grain. It has also supported hunting and fishing. But though the steppe is still used as rangeland, much began to change in the 1950s when the former Soviet Union installed its Virgin Land Scheme to develop virgin and fallow land. The scheme introduced heavy cereal cultivation putting huge areas of steppe and forest-steppe to the plow for wheat production. Between 1950 and 1960, in Kazakhstan alone, the cultivated area increased from 7.8 million to 28.5 million hectares. Enormous steppe deterioration followed, so much so that millions of hectares of land plowed for wheat were eventually abandoned. Thanks, however, to heavy seeding with grasses and perennials, such as feather grass, wheat-grass, and wild rye, some of this land has been recovered. Still, research by the Kazakh Fodder and Pasture Institute suggests it could take 30 years for these abandoned steppe lands to fully recover.

Uzbekistan's Alai-Western Tien Shan steppe region, home to a significant percentage of the country's population, has been similarly altered. Plowing has occurred in virtually every area suitable for crops. Overgrazing has affected rangeland. Agriculture poses additional threats to steppe grassland and forests, especially fires caused by the burning of straw that could be better used as animal fodder. Once started, these fires are long-lasting and can spread quickly over large areas. Extractive industries have contaminated soil and water and destroyed vegetative cover. Some natural rehabilitation has taken place. However, primarily due to a recently declining economy, some farmers have abandoned their dry steppe fields, allowing the land to rest.

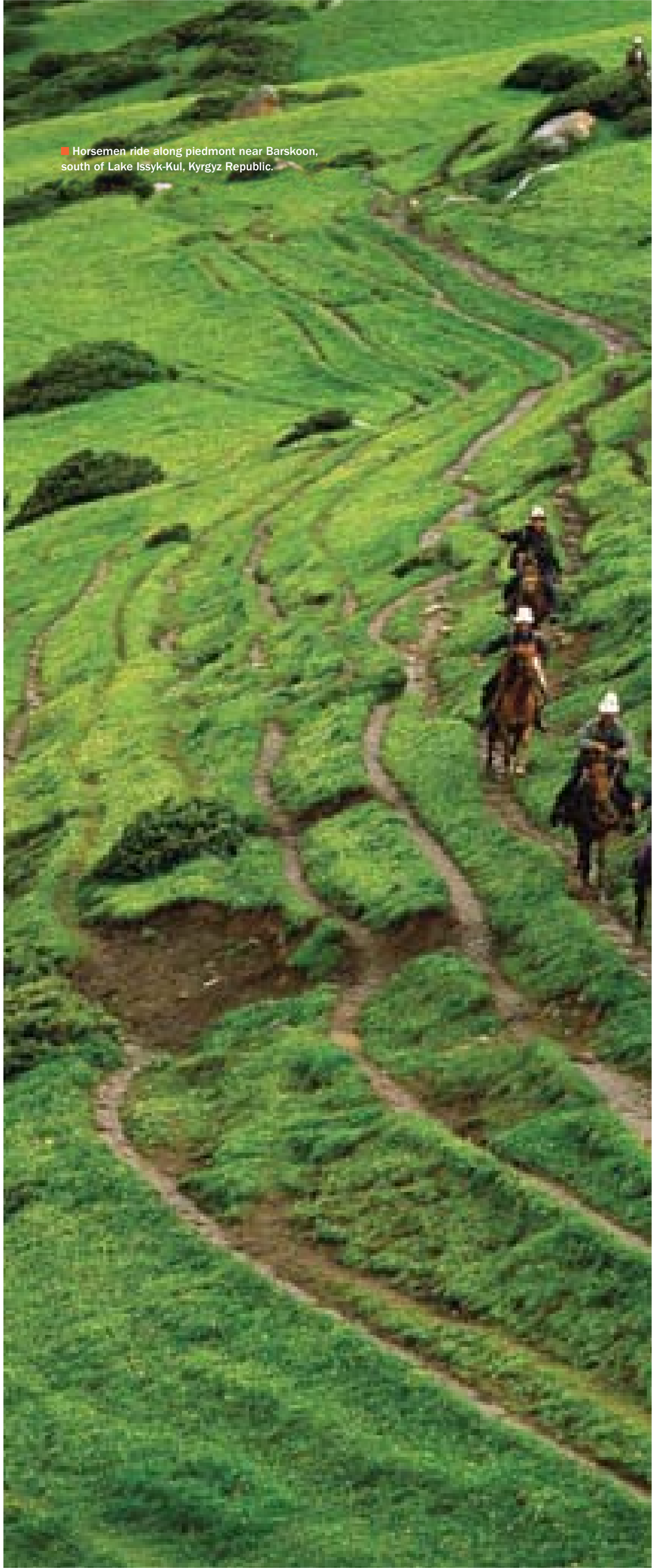
PROTECTING THE STEPPES

Protecting the steppes for future generations will take much work. Numerous efforts are now under way. Rehabilitation of the Golodnaya Steppe, or Hungry Steppe, in Uzbekistan using salt-tolerant plants for reclaiming abandoned saline soil has proven to be an effective means of bringing such soil back to production. Another approach is improving feed and livestock production technologies; promising technology includes crop rotation for production of fodder and silage. Better water management has also brought considerable benefit to the steppes. In the 1960s, a notable example was the integrated water resources management—combining the interests of all water users and water resources—of the canals of the Golodnaya Steppe and later the main canal systems of the Karshi Steppe and other irrigation zones.

Piedmont

Piedmont, or foothills, is the land found at the base of a mountain range. In Central Asia, it includes various ecosystems at elevations of 350–1,500 meters. Piedmont desert ecosystems of the Northern Tien Shan (400–800 meters) offer good spring and autumn–winter cattle pastures, and are densely populated. Piedmont short-grass, ephemeral semi-savanna ecosystems of the Western Tien Shan (350–700 meters) offer summer–winter pastures and are also densely populated. Similarly, piedmont and low mountain short-lived tall flowering plants, and tall grass ecosystems of the Western Tien Shan and Kopet-Dag (700–1,200 meters) offer highly productive winter–spring pastures and are densely occupied. Piedmont and low mountain xerophyte open woodland ecosystems of Western Tien Shan, Kopet-Dag, and Pamir Alay (1,000–1,500 meters) are known for their pistachio woodlands and high-value, wild, and cultured walnuts. In pre-agricultural days, these open and arid woodlands covered vast areas. Genetically valuable pistachio open woodlands occur at 700–800 meters altitude in the Western Tien Shan, southern Tajikistan, and Badhyz (Turkmenistan).

The region's famous fertile valleys are also piedmont areas. Among them in the Kyrgyz Republic are the Talas Valley, called the Land of Manas, after the Kyrgyz national hero; and the Chui Valley, site of the nation's capital Bishkek. The Fergana Valley, a breadbasket for the region, and heavily populated with settlements of three nations—the Kyrgyz Republic, Tajikistan, and Uzbekistan—is also a piedmont area.



■ Horsemen ride along piedmont near Barskoon, south of Lake Issyk-Kul, Kyrgyz Republic.

■ Pik Abi Ali ibn Sino (formerly Pik Lenina). At 7,134 meters, this is one of the highest peaks in the region and is located on the border of the Kyrgyz Republic and Tajikistan.

Mountains

TOWERS OF DIVERSITY

Though the Kyrgyz Republic and Tajikistan are almost completely mountainous, mountains cover little more than 10% of the total Central Asian land mass. Ranges include parts of the Kopet-Dag in Turkmenistan, Altai and Ural in Kazakhstan, and Talassikiy-Alatau in the Kyrgyz Republic. Most prominent are the Pamir Range in Tajikistan, and the Tien Shan in the Kyrgyz Republic and northern Tajikistan—two of the oldest and highest ranges in the world.

To ascend such mountains is to measure human strength and experience the arrival of many seasons in a day. Changing mountain elevations compress climate zones, making flora and fauna so diverse that mountains are home to almost half the world's species. In Central Asia, cascading elevations and an interior continental location provide conditions for great biodiversity. They also result in a mountain region that features such rich landscapes that alpine, nival, mountain forest, steppe, meadow-steppe, desert, and semidesert can all be found.

Mountain Ranges of Central Asia

Range	Location in Central Asia	Prominent Peak
Altai-Dzhungar Alatau, Tarbagatai, and Rudny Altai	Kazakhstan	Mt. Belukha (Gora Belukha): 4,506 meters
Tien Shan	Kazakhstan, Kyrgyz Republic, Tajikistan, Uzbekistan	Victory Peak (Pik Pobeda): 7,439 meters
Pamir Alay	Kyrgyz Republic, Tajikistan	Pik Ismoili Somoni: 7,495 meters
Gissar	Tajikistan, Uzbekistan	Peak of the 22nd Congress of the Communist Party (currently unnamed): 4,643 meters
Kopet-Dag	Turkmenistan	Highest peak in Turkmenistan: 2,940 meters
Alatau	Kyrgyz Republic	Peak Korona: 4,860 meters – highest peak in Ala-Archa National Park

■ Water, flowing west across the region from the mountains in the southeast, is its most precious resource.

A TROVE OF RESOURCES

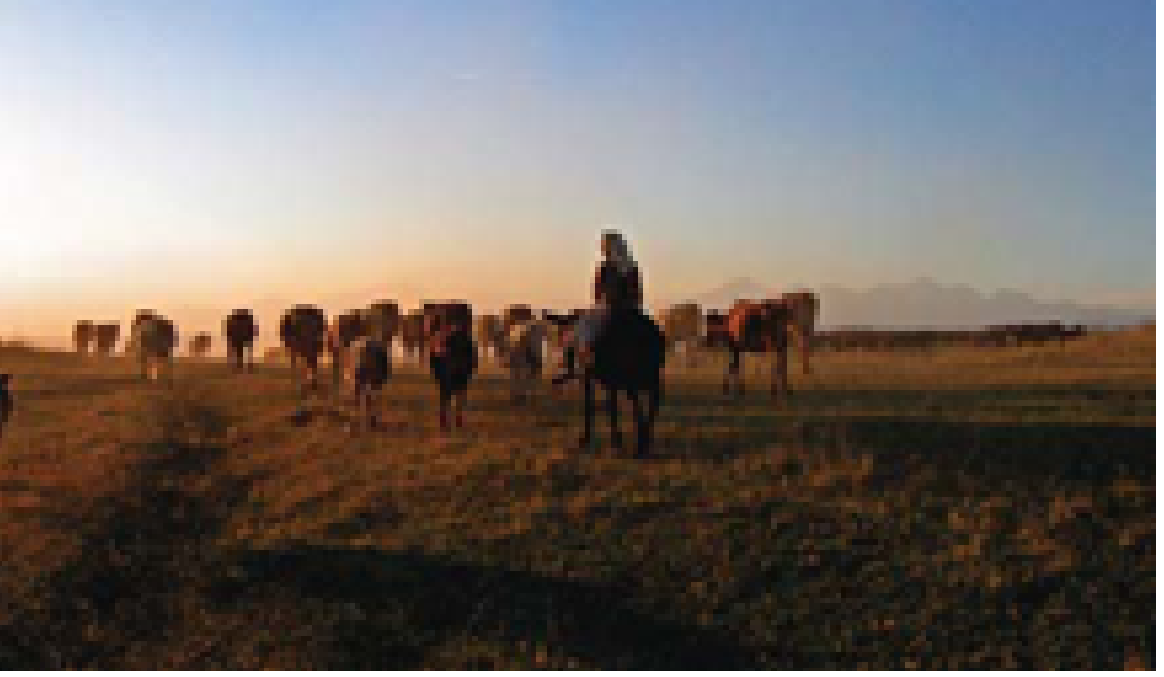
Half of all humans depend on mountain resources. The proportion is even higher in Central Asia, where people rely almost exclusively on mountain water to sate their arid landscape. Mountain areas receive the highest precipitation, 500 to more than 1,000 millimeters, of any land type in the region, plus they contain a glacial water storehouse. They provide most of the region's water for hydropower and agriculture, and the only renewable source of freshwater.

Large rivers, such as the Aksu, Atrek, Amu Darya, Ili, Karatal, Lepsa, Shu, Syr Darya, Talas, and Zarafshan, find their source in the mountains. They are served by a series of dams and reservoirs used for power generation and irrigation. Underground mountain water runoff also fuels numerous small rivers that begin in the foothills and help irrigate land in the valleys.

The mountains contain the region's primary forest resources. In addition to fuel wood and timber, forests supply fruit and medicinal plants, and are a habitat for wild animals. Originating in the mountain ecosystems are numerous cultivated plants and breeds of animals. These ecosystems serve as refuges for various plants and animal species, and provide a globally important gene pool for many species, including the walnut.

Arguably, the greatest mountain range in Central Asia is the Tien Shan, with more than 30 peaks that are 6,000 meters or higher. Aptly called the "Celestial Mountains," this vast range stretches almost 3,000 kilometers from the Kyrgyz Republic to the Mongolian frontier. Lines of mountains of the Tien Shan orient east–west in the form of parallel ranges around the catchment of the Naryn River, whose outflow reaches the Syr Darya, and numerous lakes, including Lake Issyk-Kul, purported to be the world's second-largest high-altitude lake. The highest Tien Shan peak within the region is Victory Peak (7,439 meters) in the Kyrgyz Republic.

Inhabitants of the Tien Shan are primarily Kazakh and Kyrgyz pastoralists whose animals include goats, horses, sheep, and yaks. The Tien Shan is an important source of oil, gas, and hydropower for the region, and has valuable reserves of antimony, copper, gold, lead, and tungsten.



Upper: Harvesters in cotton field.
Lower: Herding cows in Jalalabad, Kyrgyz Republic.

Agriculture to Uranium: Natural Resource Powerhouse

The Turks were mainly pastoralists, herding livestock. This was the main activity in most of Central Asia in past centuries and, indeed, it remains important today. Crop agriculture was confined to narrow bands around oases and along water courses with limited, though impressive, irrigation. The Soviets brought large-scale crop agriculture—cotton and wheat—to Central Asia. Vast tracts of marginal desert and steppe were plowed to make the area one of the world's leading cotton-producing centers and a breadbasket for the former Soviet Union's populations.

Cotton had its heyday in the Soviet period but production continues at a high level. Wheat production is increasing rapidly since independence of the region's countries, with the aim of food self sufficiency. Fisheries have declined dramatically since the 1980s, mainly due to the changes in river flows and pollution.

Large reservoirs were built during the Soviet period to regulate water flow for agriculture, hydropower, and storage; and more are being constructed or planned by the now-independent countries, especially on the two main rivers (Amu Darya and Syr Darya), resulting in conflict among user types and among the countries themselves. Finding a balance to suit all water users will be difficult but critical. Long-term water conservation measures are especially important because global climate

change is threatening the ecology of Central Asia; glaciers in the region are melting at an alarming rate. As they retreat, water supplies from them will gradually dwindle.

Signs of copious energy resources are clearly visible in the lowland parts of the region. Oil and gas pipelines crisscross the region, where once only camel caravans passed, especially in hydrocarbon-rich Kazakhstan, Turkmenistan, and Uzbekistan. Natural gas provides nearly all the energy needs of Turkmenistan and Uzbekistan, while Kazakhstan relies on coal power and is the biggest exporter of oil in the region. The mountainous countries, the Kyrgyz Republic and Tajikistan, derive nearly all their energy needs from water—hydropower.

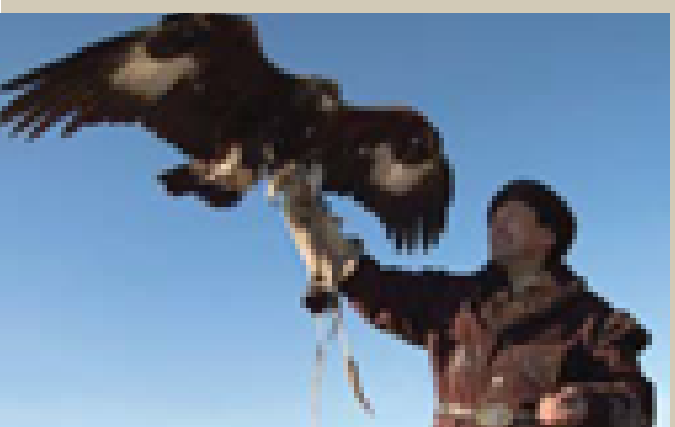
Apart from hydropower, the countries offer outstanding opportunities for other forms of alternative energy, particularly by harnessing wind and solar power. Biogas and biofuel production—energy from agriculture—is also being investigated.

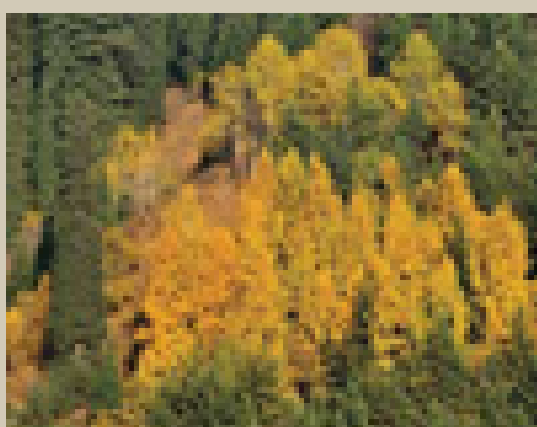
And all the countries have excess energy resources for export, even for nuclear energy: Kazakhstan and Uzbekistan have abundant uranium reserves.

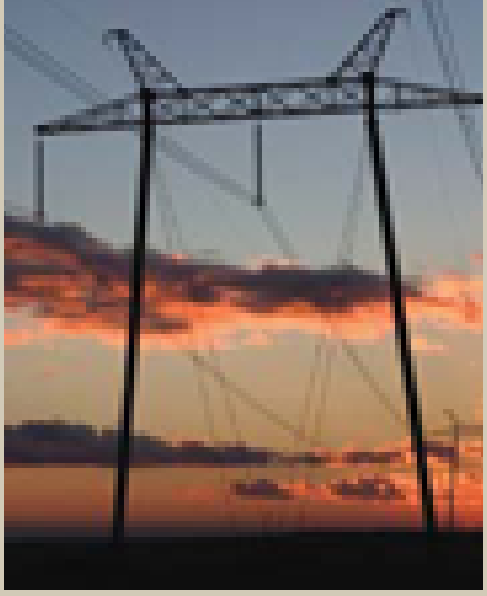
But uranium is a minor product—albeit with major environmental implications—in the region. Scattered across the deserts and mountains are huge reserves of other important minerals and ores. Mines produce scores of minerals from aluminum to zinc, and significantly contribute to the countries' gross domestic product.

Upper: Hydroelectric plant and Karakum reservoir in Tajikistan. **Lower:** Yellow cake at the North Karamurun PV-1 uranium mine in south Kazakhstan.

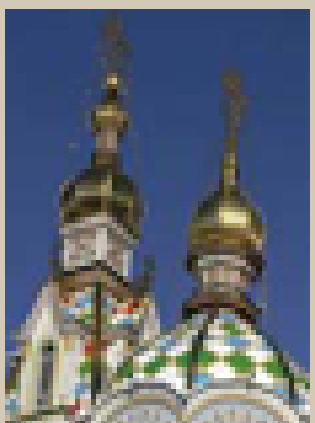
The Five Countries of Central Asia








75°0'E
50°0'N
40°0'N
Kostanai
Petropavlovsk
Kokshetau
Irtyshsk
Stepniak
Pavlodar
Makinsk
Aksu
Akkol
Ereimentau
Atbasar
Ekibastuz
ASTANA
Irtysh
Oskemen
Semey
Zyrianovsk
Nura
Temirtau
Karaghandy
Karkaralinsk
Lake Zaisan
Ayakoz
Sarysu
Karazhal
Balkhash
Ucharal
Lake Balkhash
Ushtobe
Tekeli
Taldykorgan
Zharkent
Ili
Chui
Kapchagay
Almaty
Talgar
Shu
Zhanatas
Kentau
Karatau
Turkestan
Taraz
BISHKEK
Tokmok
Balykchy
Karakol
Arys
Shymkent
Talas
Lake Issyk-Kul
Naryn
Lenger
KYRGYZ REPUBLIC
Tash-Kumyr
Naryn
TASHKENT
Jalal Abad
Namangan
Akhangaran
Andizhan
Osh
Gulistan
Khudzand
Kokand
Kyzyl-Kiya
Fergana
Isfara
Ura-Tyube
Ayni
Dzhirgital
Pendzhekent
Rogun
TAJIKISTAN
DUSHANBE
Denau
Kulyab
Murgab
Khorog
Kurgan-Tyube
Pyandzh
Ishkashim
Panj
Vakhsh
PEOPLE'S REPUBLIC OF CHINA
1:10 000 000
200 100 0 200
Kilometers
N
National capital
Provincial/oblast capital
City
Rivers and canals
Airport (international)
International boundaries
Boundaries are not necessarily authoritative.
Projection: Lambert Conformal Conic
Datum: WGS 1984
GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd.
Kyrgyz Republic, 2009



Facts and Figures About the Countries of Central Asia

	Kazakhstan	Kyrgyz Republic	Tajikistan	Turkmenistan	Uzbekistan
Local long form	Qazaqstan Respublikasy	Kyrgyz Respublikasy	Jumhurii Tojikiston	Turkmenistan	Ozbekiston Respublikasi
Geography					
Capital	Astana	Bishkek	Dushanbe	Ashgabat	Tashkent
Location	Located in the center of the continent of Asia, with a coastline only on the landlocked Caspian Sea. The Russian Federation forms its entire northern border.	Located along the eastern border of the Central Asian region, southeast of Kazakhstan, west of the People's Republic of China, east of Uzbekistan, and north of Tajikistan.	Located on the southern edge of Central Asia, bordering Afghanistan to the south, the People's Republic of China to the east, the Kyrgyz Republic to the north, and Uzbekistan to the west.	The farthest southwest country of Central Asia. Located on the eastern shore of the Caspian Sea. To the south is Iran, to the south and east is Afghanistan, and to the north are Kazakhstan and Uzbekistan.	Located east of the Caspian Sea, directly south of Kazakhstan, north of Turkmenistan, and on the western borders of Tajikistan and the Kyrgyz Republic.
Total area, thousand square kilometers	2,725	199.9	142.6	488.1	447.4
Climate	Continental climate. Rainfall varies from 100 to 200 millimeters/year; generally heaviest in the south and in the eastern mountains.	Continental climate	Continental climate, with drastic differences according to elevation; very dry in subtropical southwestern lowlands.	Mostly a subtropical desert climate that is severely continental.	Continental climate
Terrain	In the east and northeast, about 12% of territory occupied by parts of the Altay and Tien Shan mountain ranges. More than three-quarters of the country are desert or semi-desert. Along the Caspian Sea, elevations are below sea level.	Dominated by sharp mountain peaks and valleys, considerable areas are covered by glaciers. Relatively flat regions include Fergana Valley in the southwest, and the Chui and Talas valleys along the northern border.	Highly mountainous	Highly mountainous, dominated by the Alay Range in the north and the Pamir Mountains to the southeast. Lowest elevations are in the northwest, the southwest, and Fergana Valley.	Diverse: 80% is desert, dominated by Kyzylkum Desert in north–central part of the country and mountains in the far southeast and far northeast. In the northeast, Fergana Valley is surrounded by mountain ranges and intersected by the Syr Darya River. Far west is dominated by the Turan Lowland, the Amu Darya valley, and the southern half of the Aral Sea.
Lowest point	Vpadina Kaundy: 132 meters (m)	Kara Darya: 132 m	Syr Darya: 300 m	Vpadina Akchanaya: 81 m (Note: Sarygamysh Koli is a lake in northeastern Turkmenistan whose water levels fluctuate widely; at its shallowest, its level is –110 m; it is presently at –60 m, 20 m above Vpadina Akchanaya)	Sariqarnish Kuli: 12 m
Highest point	Khan Tangiri Shyngy (Pik Khan-Tengri): 7,010 m	Jengish Chokusu (Pik Pobedy): 7,439 m	Pik Imeni Ismail Samani: 7,495 m	Ayrybaba: 3,137 m	Adelunga Toghi: 4,301 m
Natural resources (nonliving)	Oil and natural gas, chromium, coal, copper, gold, lead, tungsten, and zinc	Gold, antimony and coal, mercury, tin, tungsten, and uranium oxide	Gold, silver, and antimony	Natural gas and oil, small amounts of salt and gypsum	Natural gas and oil; gold, copper, lead, silver, tungsten, uranium, and zinc
Natural hazards	Land degradation and desertification	Avalanches, floods, and landslides attributed to the melting of glaciers	Dust and sand from the deserts that cause air pollution	Sandstorms, droughts, and earthquakes	Severe earthquakes
People					
Population, total, million	15.48	5.23	6.74	4.96	26.87
Average annual population growth rate, %	1.14	0.82	1.50	1.30	1.43
Population density, persons/ square kilometer	6	27	48	11	63
Major ethnic groups	Kazakh (53%), Russian (30%), Others: Ukrainian, Uzbek, German, and Uyghur	Kyrgyz (65%), Uzbek (14%), Russian (12%), Others: Dungan (ethnic Chinese Muslim), Tartar, Uyghur, and Ukrainian (1999 Census)	Tajik (80%), Uzbek (15%), Russian (1%), Kyrgyz (1%). Others: German, Korean, Turk, and Ukrainian (2000 Census)	Turk (72%), Uzbek (9%), Russian (10%). Others: Tatar, Kazakh, Ukrainian, Azeri, and Armenian	Uzbek (76%), Russian (6%), Tajik (5%), Kazakh (4%), Tatar (2%), and Kyrgyz (1%) (1998 Census)
Religions	Muslim, primarily Sunni (47%), Russian Orthodox (44%), and Protestant (2%)	Muslim, primarily Sunni (80%), Christian, primarily Russian Orthodox (16%)	Sunni Muslim (85%), Shia Muslim (5%), Christian, mainly Russian Orthodox (3%) Others: other Christian denominations, and Jewish	Sunni Muslim (89%), Christian - Russian Orthodox (9%)	Muslim (88%), and Russian Orthodox (9%)
Languages	Kazakh, official "state" language (64%); Russian, official "language of interethnic communication" (95%)	Kyrgyz, official; Russian, second language and language of business	Tajik, official state language; Russian, widely used in government and business; and Uzbek (25%)	Turkmen, official state language (72%); Russian (12%), and Uzbek (9%)	Uzbek (74%), Russian (14%), and Tajik (4%)

* 2007 data are presented unless otherwise stated.

	Kazakhstan	Kyrgyz Republic	Tajikistan	Turkmenistan	Uzbekistan
Poverty					
Human Development Index/ Rank	0.807, 71st of 179 countries (2006)	0.694, 122nd of 179 countries (2006)	0.684, 124th of 179 countries (2006)	0.728, 108th of 179 countries (2006)	0.701, 119th of 179 countries (2006)
Population in poverty, below national poverty line, %	15.4 (2002)	43.1 (2005)	44.4 (2003)	58.0 (2000)	27.5 (2000)
Poverty head-count ratio at $1.25 a day (PPP), % of population	3.1 (2003)	21.81 (2004)	21.4 (2004)	4.6** (2003)	46.3 (2003)
Poverty head-count ratio at $2.00 a day (PPP), % of population	17.2 (2003)	51.90 (2004)	50.8 (2004)	28.9 (2003)	76.6 (2003)
Education					
Net enrollment ratio in primary education, %	99.0	93.5 (2006)	97.3 (2006)	—	78.2 (1991)
Pupils starting Grade 1 who reach last grade of primary, %	100.0 (2006)	98.6 (2005)	98.7 (2005)	—	98.6 (2005)
Literacy rate,15–24 years old, %	99.8	99.6	99.9	99.8	99.3 (2000)
Government expenditure for education, % of GDP	2.3 (2002–2005)	4.4 (2002–2005)	3.5 (2002–2005)	3.9 (1991)	9.4 (1991)
Gender equality and women empowerment					
Gender parity index in primary level enrolment	1.00	0.99 (2006)	0.95 (2006)	—	0.97
Gender parity index in secondary level enrollment	0.99	1.01 (2006)	0.83 (2006)	—	0.98
Gender parity index in tertiary level enrollment	1.44	1.27 (2006)	0.37 (2006)	—	0.71
Seats held by women in national parliament, %	15.90 (2008)	25.60 (2008)	17.50 (2008)	16.00 (2008)	17.50 (2008)
Share of women in wage employment in non-agriculture sector	49.40 (2004)	52.20 (2006)	46.40 (1996)	42.10 (2002)	43.50 (1995)
Health					
Life expectancy at birth, years	66.41	67.70	66.66	63.17	67.14
Mortality, children under 5, per 1,000 live births	29 (2006)	41 (2006)	68 (2006)	51 (2006)	43 (2006)
Mortality, maternal, per 100,000 live births	140 (2005)	150 (2005)	170 (2005)	130 (2005)	24 (2005)
Births attended by skilled health personnel, %	26 (2006)	36 (2006)	56 (2005)	45 (2006)	38 (2006)
Adolescent birth rate per 1,000 women 15–19 years old	28.6	25.8 (2005)	27.3 (2005)	19.0 (2001)	25.5 (2006)
Underweight children under 5 years of age, %	4.0 (2006)	3.4 (2006)	17.4 (2005)	11.0 (2005)	5.1 (2006)
Population below minimum level of dietary energy consumption, %	8 (2001–2003)	4 (2001–2003)	61 (2001–2003)	8 (2001–2003)	26 (2001–2003)
Population using an improved drinking water source, %	96 (2006)	89 (2006)	67 (2006)	72 (2004)	88 (2006)
Population using an improved sanitation facility, %	97 (2006)	93 (2006)	92 (2006)	62 (2004)	96 (2006)

* 2007 data are presented unless otherwise stated.

	Kazakhstan	Kyrgyz Republic	Tajikistan	Turkmenistan	Uzbekistan
People living with HIV/AIDS, 15–24 years old, %	—	0.1	0.3	—	0.1
Contraceptive use among currently married women 15–49 years old, any method, %	50.7 (2006)	48.7 (2006)	37.9 (2005)	37.9 (2000)	64.9 (2006)
Malaria incidence, notified cases per 100,000 population	—	9.34 (2003)	82.54 (2003)	0.12 (2003)	0.29 (2003)
Tuberculosis prevalence rate, per 100,000 population	142.1 (2006)	136.7 (2006)	297.7 (2006)	78.2 (2006)	144.6 (2006)
Government expenditure for health, % of GDP	2.3 (2004)	2.3 (2004)	1.0 (2004)	3.3 (2004)	2.4 (2004)
Economy					
GDP, current $ billion	104.85	3.74	3.71	12.93	22.31
GDP, annual growth rate, %	8.9	8.2	7.8	—	9.5
GNI, Atlas method (current $ billion)	78	3	3	2.91 (2000)	20
GNI per capita, Atlas method (current $)	5,020	610	460	650 (2000)	730
GNI, PPP (current international $) (billion)	149	10	12	21.04 (2005)	65
GNI per capita, PPP (current international $)	9,600	1,980	1,710	4,350 (2005)	2,430
Labor force, million	8.23	2.34	2.57	2.25	11.80
Unemployment rate, %	7.26	8.30 (2006)	2.20 (2006)	2.60 (2004)	0.22
GDP Composition by Sector					
Agriculture, value added, % of GDP	6	34	21	22.1 (2005)	23
Industry, value added, % of GDP	41	19	28	41.5 (2005)	31
Services, etc., value added, % of GDP	53	47	51	33.4 (2005)	46
Main exports	Oil, uranium, ferrous and nonferrous metals, machinery, chemicals, grain, wool, meat, and coal	Fruits, vegetables, gold, and tobacco	Aluminum, electricity, cotton, fruits, and textiles	Oil, gas, textiles, and raw cotton	Cotton, gold, natural gas, mineral fertilizers, ferrous metals, and textiles
Exports of goods and services (% of GDP)	49	45	21	63	40
Imports of goods and services (% of GDP)	43	90	66	48	30
Gross capital formation (% of GDP)	36	26	22	23 (2005)	19
Revenue, excluding grants (% of GDP)	15.9	21.0	13 (2004)	—	—
Cash surplus/deficit (% of GDP)	1.2	–1.5	– 0.8 (2000)	—	—
Environment					
Forest area, % of land area	1.22	4.37	2.88	8.46	7.44
Proportion of terrestrial and protected marine areas, %	2.8	3.1	13.7	2.5	1.9
Renewable internal freshwater resources, total, billion cubic meters	75.42	46.45	66.3	1.36	16.34
Renewable internal freshwater resources per capita, cubic meters	4,870.77	8,873.31	9,836.67	274.01	608.16

* 2007 data are presented unless otherwise stated.

	Kazakhstan	Kyrgyz Republic	Tajikistan	Turkmenistan	Uzbekistan
Annual freshwater withdrawals, total, billion cubic meters	35 (2000)	10.08 (2000)	11.96 (2000)	24.65 (2000)	58.34 (2000)
Annual freshwater withdrawals, agriculture, % of total freshwater withdrawal	82	94	92	98	93
Annual freshwater withdrawals, industry, % of total freshwater withdrawal	17	3	5	1	2
Annual freshwater withdrawals, domestic, % of total freshwater withdrawal	2	3	4	2	5
Rural Environment					
Rural population, % of total	42.34	63.88	73.56	51.82	63.22
Rural population density, persons per square kilometer of arable land	29.06 (2005)	257.18 (2005)	518.38 (2005)	110.74 (2005)	352.42 (2005)
Agricultural land, % of land area	77	56	33	69	63
Arable land, % of land area	8	7	5	4	10
Rangeland, % of land area	69	49	27	65	52
Urban Environment					
Urban population, % of total	57.7	36.1	26.4	48.2	36.8
Urban population growth rate, annual %	1.6	1.3	1.6	2.2	1.5
Population in largest city, % of urban population	13.6	43.3 (2006)	—	—	21.7
Proportion of population using an improved sanitation facility, % of urban population	97 (2006)	94 (2006)	95 (2006)	77 (2004)	97 (2006)
Energy Production and Use					
Electric power consumption, kilowatt-hours per capita	4,292.56 (2006)	2,015.37 (2006)	2,240.57 (2006)	2,123.30 (2006)	1,694.27 (2006)
Energy use (kilograms [kg] oil equivalent) per $1,000 GDP	398 (2005)	315 (2005)	357 (2005)	No data	895 (2005)
Energy use, kg of oil equivalent per capita	4,012.45 (2006)	541.98 (2006)	547.60 (2006)	3,524.47 (2006)	1,829.43 (2006)
Proportion of population using solid fuels (%)	5 (2003)	76 (2003)	75 (1999)	<5 (2003)	72 (2003)
Energy Efficiency of Emissions					
Carbon dioxide emissions, thousand metric tons	200,277.88 (2004)	5,726.73 (2004)	5,004.47 (2004)	41,725.93 (2004)	137,907.12 (2004)
Carbon dioxide emissions, metric tons per capita	13.3 (2004)	1.1 (2004)	0.8 (2004)	8.8 (2004)	5.3 (2004)
Ozone-depleting substances consumption, metric tons	79.9 (2006)	8.8 (2006)	3.6 (2006)	22.4 (2006)	3.5 (2005)

GDP = gross domestic product, GNI = gross national income, PPP = purchasing power parity.
* 2007 data are presented unless otherwise stated.
** at $1 per day
Sources:
ADB Key Indicators. https://sdbs.adb.org/sdbs/index.jsp
FAO FAOSTAT. http://faostat.fao.org
Library of Congress Country Studies. http://lcweb2.loc.gov/frd/cs/
United Nations Development Programme. 2007. *Human Development Report 2007/2008.* http://hdrstats.undp.org/
United Nations Millennium Development Goals Indicators. http://mdgs.un.org
World Development Indicators. http://publications.worldbank.org/WDI/

Kazakhstan

A Rich and Varied Landscape

Upper: Big Alma-Ata Lake, or Almaty Lake, in the Bolshaya Almatinka Gorge, attracts tourists with its fresh alpine air, ever-changing color of the lake's water, and splendid mountain vistas. **Lower:** Rural life in Kazakhstan is captured in this portrait of a Kazakh farmer's wife.

Every day, increasing numbers of people are turning their attention to Kazakhstan. Its enormous hydrocarbon and mineral resources and capacity for ever-increasing grain production are attracting business suitors from across the globe. And economic potential is only one of the things that make this vast country so notable. Measuring more than 2.7 million square kilometers, Kazakhstan is as large as Western Europe, more than twice the size of the other four nations of Central Asia combined, and the ninth largest country in the world. Moreover, its rich landscape embodies everything from rocky-snowcapped mountains to dense pine forests, seemingly endless steppe, and a giant inland sea.

At its furthest east-to-west extent, Kazakhstan is almost 3,000 kilometers wide; at its furthest north-to-south, 1,500 kilometers. The Tien Shan mountains flank the country's southern border with the People's Republic of China and the Kyrgyz Republic. Its eastern border with the People's Republic of China rides a series of mountain ranges, including the Altay, birthplace of the Turkic people. The vast Kyzlkum Desert straddles its southwestern border with Uzbekistan. To the north, Kazakhstan's flat and mostly treeless steppe meets the Western Siberian Plain of Russia. To the west is Kazakhstan's 1,894-kilometer Caspian Sea coastline.

More than 47,000 square kilometers of Kazakhstan's total area are occupied by water. The country boasts of seven rivers measuring over 1,000 kilometers in length. Primary among them are the Syr Darya, Central Asia's largest river, flowing north from Uzbekistan across Kazakhstan to the Aral Sea; and the Ural, flowing south from the Russian Federation to form Kazakhstan's giant Ural River Delta before emptying into the Caspian Sea. Other prominent rivers are the Chui, Emba, Illi, Irtysh, and Ishim. Largest bodies of water are the Aral Sea, and lakes Alakol, Balkhash, Tengiz, and Zaisan.

A Society Making Gains

Kazakhstan's population was about 15.5 million in 2007, and claims have been made that it is home to more than 100 different nationalities. Though this figure is unconfirmed, the population is relatively heterogeneous, with 53% Kazakh, 30% Russian, more than 11% Ukrainian,

Uzbek, German, Tatar, and Uygur; other groups, such as Azerbaijanis and Belarusians, are also present. People are mostly centered in the country's northeast and southeast, with Kazakhs predominantly concentrated in the south, and Russians in urban areas close to the Russian Federation in the north. Kazakhstan's population density of about six people per square kilometer is one of the lowest in the world. It is a bilingual country, with the Kazakh language recognized as the official state language, and Russian as the official language of interethnic communication.

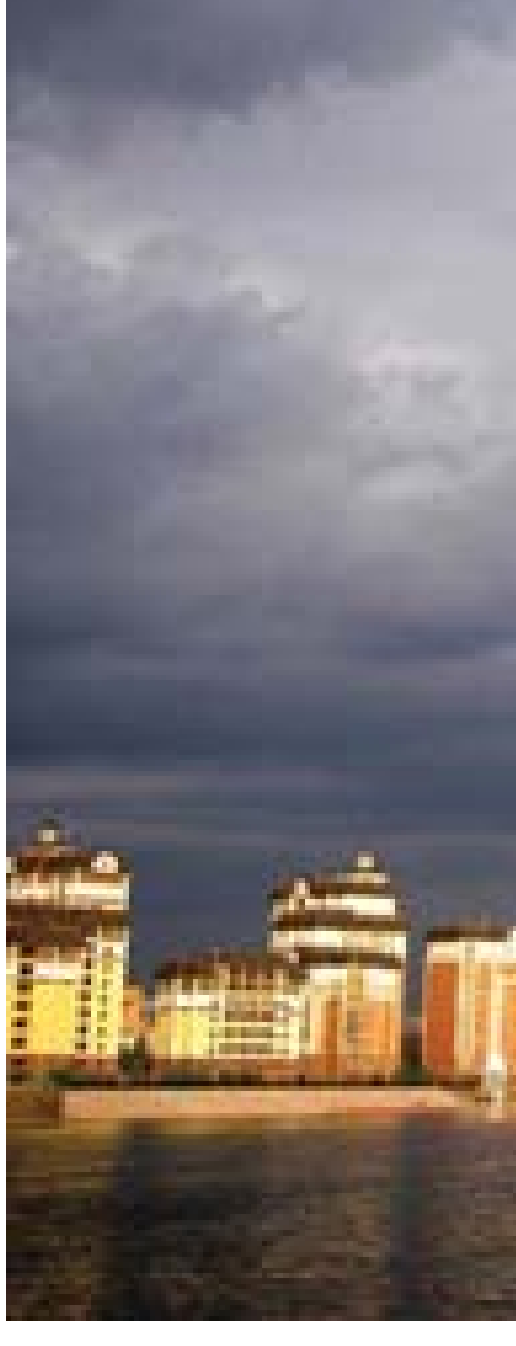
Kazakhstan's people have much to be proud of. The country has met several United Nations Millennium Development Goals and made excellent progress on others, including access to education and the promotion of women's rights. Kazakhstan's estimated gross national income per person of US$5,010 in 2007 is more than twice as much as any other country in the region. Of concern, however, is that a wealth gap between rural and urban populations exists. Work is also needed to improve health care, quality of education, and environmental sustainability.

Endowed With Natural Resources

Kazakhstan is resource rich, and thanks to its early and vigorous adoption of liberal market and trade reform, its oil, gas, and mineral sectors have been an investment magnet since shortly after independence. The country's enormous mineral deposits make it a world leader in reserves of coal, chromite, lead, and zinc, and its uranium deposits are estimated to be the second largest in the world. Natural gas reserves are substantial as well. Primarily located in the Caspian Sea region, they are found in associated oil and gas fields, such as the giant Karachaganak and Tengiz fields.

Petroleum, however, has gained the most attention. Since the early 2000s, more than half of the country's industrial output has consisted of oil, with a large number of other industries dependent on it. In 2008, Kazakhstan ranked among the world's top 20 oil producers. Most oil deposits are located in the Caspian Sea region, with the Kashagan field estimated to contain the

Apples are Almaty's namesake, derived from the Kazakh word for "apple."



Top left: Part of the vast wheat growing area in northern Kazakhstan. **Top right:** A view of Astana across the Ishim River. **Middle:** A hydraulic excavator scooping coal into the trains in one of the largest open pit mines of the world, operated by Bogatyr Access Komyr in Ekibastuz of Kazakhstan, ready for transporting them. **Bottom:** A variety of dried fruits and nuts at Almaty's Green Bazaar.

world's fifth largest oil reserves. Between 2000 and 2007, the country enjoyed healthy gross domestic product (GDP) growth of 8.5% or more. Not surprisingly, oil production and hydrocarbon investment drove Kazakhstan's rapid growth for years. Mining and quarrying, led by oil as well as coal and gas, continue to grow. Since 2005, however, the main growth engine has been the rapidly developing non-oil economy, particularly construction and services, which employs most people and accounts for more than half of GDP. This is good news because it suggests oil wealth has filtered through the economy. That 56% of the population live in urban areas, the highest percentage in the region, reflects Kazakhstan's increasing migration from farm regions to the cities by people in search of jobs in construction and services.

Dynamic Agriculture Sector

While accounting for only about a tenth of GDP, Kazakhstan's agriculture sector remains important, both economically and culturally, employing more than 30% of workers, and most rural poor. Over 75% of the country's land is agricultural: 22.3 million hectares of arable land and 185 million hectares of pasture—the fifth largest pastureland in the world. Like other countries in the region, Kazakhstan's agricultural roots are pastoral nomadic. Sheep breeding dominates; however, cattle, pigs, horses, and camels are abundant, resulting in a highly developed market in dairy, leather, meat, and wool products.

Kazakhstan's quality agricultural lands support a wide variety of crops. Wheat, two-thirds of which grows in Kazakhstan's rainfed north, is the number one crop. But though the soil is relatively rich, lack of water resources makes irrigated water from the Syr Darya essential for other crops. Major irrigated crops include cereals, fruits, fodder, potatoes, sugar beet, and especially wheat and rice. Cotton is grown along large stretches of the Syr Darya, but primarily near the Aral Sea; rice is grown mostly in the tail of the river in Kyzl Orda. Yields for each of these products could increase with improved water management. Better water management would also help arrest the environmental damage poor irrigation practices have caused.

The Need for Environmental Protection

Kazakhstan's major ecological systems include desert, forest, mountain steppe, and bodies of water. Its diverse altitudinal zones enable a great variety of flora and fauna to thrive. More than 6,000 species of plants have been counted. And the country has more than 170 species of mammals and 480 species of birds. Many plants and animals, however, are endangered due

to destruction of habitat. People's health and livelihoods have also been affected by a polluted environment. Much of Kazakhstan's water supply is polluted from industrial and agricultural runoff. Desertification has destroyed a significant area of agricultural land. Industrial centers are affected by air pollution. Expanding oil operations have severely polluted the Caspian Sea. Soviet-era weapons tests have left Semepalatinsk in the northeast contaminated by radiation. And water diversion for irrigation has dried out much of the Aral Sea.

While the challenges are many, the government has embarked on numerous projects to arrest the damage and protect the environment. To preserve biodiversity, the National Biodiversity Strategy and Action Plan calls for adding 13 new protected reserves by 2030 to double the area currently protected. The country has rehabilitated structures along the Syr Darya and constructed a dam across the Aral Sea. This has resulted in significantly increased water levels in the portion of the sea near Kazakhstan.

Other projects are also in the works. More is needed, however, if the country is to better address its problems of sanitation, air and water quality, irrigation practices, and land degradation. Kazakhstan has the basic resources required for great nationhood. Achieving it requires taking the path of sustainable development.

Astana

Rising bravely from the northern steppe, along the banks of the Ishim River, is Kazakhstan's new capital, Astana. The city was just a dream in the mid-1990s when Kazakhstan's President Nursultan Nazarbayev proposed moving the capital from the country's financial and cultural center, Almaty, to the "little known" town of Akmola. The intention was to anchor a new capital in the center of the vast nation, and it has paid off. Since its 1997 inauguration as capital, Astana (as Akmola was renamed) has been asserting itself as a modern, vibrant capital that is host to numerous foreign missions.

The city, whose population stood at roughly 600,000 in 2006, features architecture that combines modern design with oriental flavor. Symbol for the city is the Baiterek Tower, 105 meters tall. Its observation deck offers panoramic views of city and surroundings. Astana was awarded the United Nations Educational, Scientific and Cultural Organization (UNESCO) title of World City in 1999, and is site for international conferences and exhibitions. It is also home to ballet and drama theaters, traditional folk festivals, and museums. Still growing, many business buildings and entertainment areas are yet to be completed. The complex of government departments is situated in a new modern center by the Ishim River.

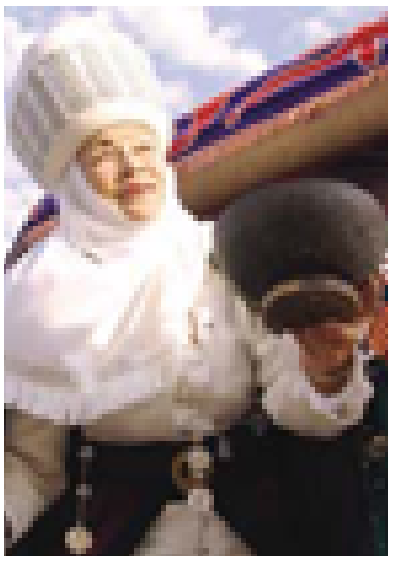
Almaty

Located in the country's southeast, Almaty is not only Kazakhstan's cultural, business, and financial center but also Central Asia's most cosmopolitan city. Resting in the foothills of the stunning Zailiysky Alatau mountain range, the city is a picturesque mix of rolling hills, verdant treelined streets, and architecturally bold buildings. Almaty is a city in ascent that holds allure for everyone—from international business people looking to take advantage of Kazakhstan's relatively open market economy, to tourists who wish to shop, ski on the Shimbulak's flank or skate on the high-altitude Medeo skating rink, or enjoy exotic nearby wilderness. For a busy city of more than a million, Almaty is remarkably clean. Its many museums, parks, sports stadiums, and cafes offer something for those who like the day; its restaurants, casinos, and nightclubs offer a vibrant nightlife as well.

Top: The "Baiterek" in Astana. There is a viewing area inside the ball, which gives panoramic vistas of the city. **Middle:** Buildings in Astana's "new city" located south of the Ishim River, south of the old city, built to hold government and embassy offices and their housing. **Bottom:** Hot air ballooning is popular on Independence Day in Almaty.

Kyrgyz Republic

The Spirit of Welcome



Upper: Mother with her child on a horse by their summer home, a yurt, in the alpine valley Tes Tur, a favored summer spot for many shepherds' families and their herds. **Lower:** Woman in traditional dress by the entrance of a yurt.

Welcome is a popular word in the cities, towns, and villages of the Kyrgyz Republic, for hospitality in this mountainous country is a human resource that is never in short supply. A welcome hand is extended to the Kyrgyz storytellers (*manaschi*) who visit house to house. And it greets the weary traveler arriving from abroad. It is a welcome that reflects the spirit of congeniality that is pervasive among Kyrgyz people.

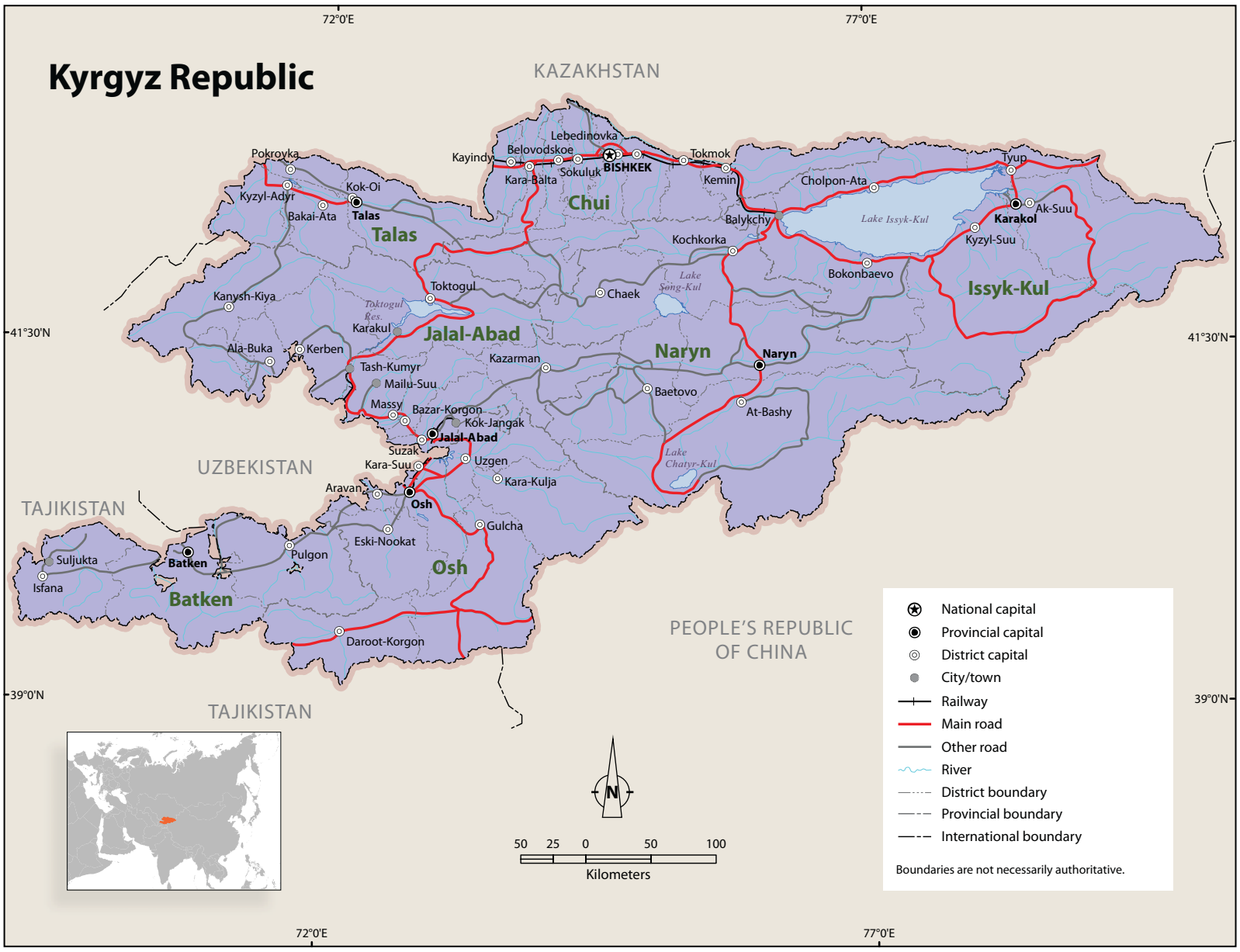
The Kyrgyz Republic is Central Asia's second smallest country, about 200,000 square kilometers in area. It is located in the southeast corner of the region, and is one of Central Asia's least geographically accessible countries. The Kyrgyz Republic shares borders with Kazakhstan to the north, the People's Republic of China to the west and south, Tajikistan to the south and east, and Uzbekistan to the west. It extends roughly 900 kilometers east to west and 400 kilometers north to south. Mountains cover 90% of the country, with more than half of this area rising higher than 2,500 meters above sea level.

Mountain ranges are heavily glaciated and include sections of the Pamir and Alatau, and a large portion of the Tien Shan, which dominates the country and divides it in two: a northern zone that includes the capital Bishkek and the Talas, Chui, and Issyk-Kul oblasts (provinces); and a southern zone comprising Jalal-Abad, Naryn, and Osh oblasts. Less than 10% of total land area is fit for crop agriculture and permanent settlement. This severely restricts land use and population distribution. In fact, most people are concentrated in the relatively flat Chui Valley along the Kazakhstan border in the north, and Fergana Valley in the south.

About two-thirds of the population are Kyrgyz, 14% Uzbek, 9% Russian, and about 1% each Dungan (ethnic Chinese Muslim), Ukrainian, and Uyghur, with a large array of smaller ethnic groups making up the remaining 6%. In spite of increased migration to the capital, Bishkek, about two-thirds of the people still live in rural areas. Kyrgyz is the country's official language; Russian is officially designated the second language and is the primary language of business and higher education.

Achieving Solid Goals

Since independence, the Kyrgyz Republic has undergone a difficult period of economic, social, and political transition. Reflecting this was the



2005 "Tulip Revolution," which ousted the country's long-time president, bringing a new one to power. Despite enduring political tension, the Kyrgyz Republic has been able to make progress, achieving macroeconomic stability. In the mid-1990s, to accelerate economic growth, the country began to pursue more liberal economic policies than its neighbors, liberalizing foreign trade and introducing broad systematic reforms to establish the platform for a market economy. This appears to have paid off because the country has enjoyed average yearly gross domestic product (GDP) growth of nearly 4.9% since 1996, capped by an impressive 8.2% GDP growth in 2007. Kyrgyz Republic's economic pillars are agriculture, hydropower, and mining. Agriculture accounts for roughly a third of GDP. Gold by itself accounted for 1.9% of GDP in 2003, most coming from the Kumtor mine—one of the world's largest gold mines. Things may be changing, however. Vibrant construction, services, and manufacturing sectors drove 2007 growth, suggesting greater diversification is taking place and a sign that the economy is maturing.

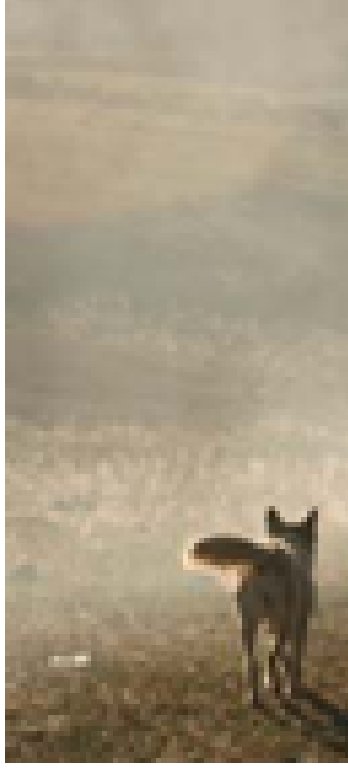
The country's record in achieving national Millennium Development Goals (MDGs), however, is somewhat mixed. Overall poverty has declined; however, regional disparities and inequality have increased. Complicating poverty reduction have been labor migration and a "brain drain." Improvements in education are also questionable, for while enrollment rates in secondary school approach 95%, enrollment in primary education has declined, and negative trends in literacy rates among 14- to 24-year olds have been observed.

Available analyses also indicate challenges to achieving MDG targets for gender equality, maternal health, and infectious diseases, such as HIV/AIDS and tuberculosis.

A Biodiversity Hot Spot

Located in the middle of the Central Asian biodiversity "hot spot," the Kyrgyz Republic has a multitude of endemic species representing Himalayan flora and fauna biotypes. It is home to 1% of world species, including 3% of world fauna; contains diverse gene pools; and has eight principal biogeographical regions and 22 identified ecosystems. The widest variety of ecosystems is in the mountains at altitudes of 2,000–3,000 meters, while a few are found in the Fergana Valley and southern Kazakhstan biogeographical region. Several ecosystems are vitally important because of their rarity, such as

Edelweiss *(Leontopodium alpinum)* flowers near Altyn Arashan, located in an alpine valley south of Karakol. The area is famous for its hot and cold springs.



Top left: Reservoir on the Naryn River. Top right: Shepherds are as much at home on horseback as on their own two feet. **Middle:** Transforming sheep wool into *shyrdak* or felt carpets is not only a tradition very much alive today but also an important source of additional family income. **Bottom:** In a classroom in Karakol.

fruit and nut forests, and pistachio and almond forests. Others, including mountain meadows, canyons, river valleys, and lowland steppes, are important for the county's general resource base.

But these rich biological resources are under threat. Misuse of land and water resources is at the heart of the problem. As a member of the former Soviet Union, the country specialized in agriculture and mineral production. Infrastructure for irrigation and mineral processing were built accordingly. The end of collectivized agriculture and decline of the mineral processing industry revealed to the new nation how much its predominantly rural population depends on resources in their more natural state.

For example, the agriculture sector is the country's largest employer, providing more than 50% of employment between 2000 and 2005, and involves most of the rural population, the segment comprising the majority of the country's poor. Farm productivity, however, is held back by the natural constraints of a rugged mountain country and agricultural practices that continue to degrade land. Waterlogging, salinization, and pollution from agricultural chemicals affect irrigated land. Soil erosion on sloping lands affects dryland agriculture. Overgrazing depletes land and causes erosion, while deforestation to create farmland and supply fuel has drastically reduced fir and juniper, and fruit and nut forests. Better management practices for irrigation, croplands, rangelands, and forests would result in significant economic benefits. To ensure its sustainable future, Kyrgyz Republic's biota needs protection.

To its credit, the country has had modest success in rehabilitating some irrigated areas damaged by salinity and waterlogging, and has expanded its area of national parks to protect biodiversity. Moreover, the Kyrgyz Republic encouraged the United Nations to declare 2002 the International Year of Mountains. At the associated Global Mountain Summit in Bishkek that same year, the Kyrgyz Republic presented a National Strategy and Action Plan for Sustainable Mountain Areas to serve as a country model for the region.

Tapping the Country's Water Potential

Although Kyrgyz Republic's mineral sector is an export leader, its immense water resources may hold the country's greatest revenue potential for the future. Abundant mountain precipitation combined with glacial and snow melt give rise to some 25,000 rivers and streams. There are about 70 major rivers, including the Chui and Talas, which flow northwest into Kazakhstan, and Naryn, which meets the Kara Darya to form the Syr Darya in Uzbekistan. The total length of all these rivers and streams is about 500,000 kilometers.

Hydroelectricity provides the Kyrgyz Republic with more than four-fifths of its electrical energy, yet current water withdrawals use but a small percentage of available water capacity. One facility that taps water resources is the Soviet-built Toktogul Reservoir, which regulates the Naryn River for irrigation and hydropower. In progress are two Kambarata hydropower stations on the Naryn and a series of stations on the Sary Djaz River; other stations are in the planning stage. And plans are also in the works to make hydropower a sustainable source of revenue by constructing electrical networks to export electricity beyond the region.

To use water resources properly, however, more integrated water management both within the country and across national borders is essential. This is because lacking hydrocarbon energy sources, the Kyrgyz Republic—like its water-rich neighbor Tajikistan—releases vast amounts of water in the winter to meet energy needs. These untimely releases cause floods, degrading downstream lands, and reduce water reserves essential for seasonal irrigation in Kazakhstan and Uzbekistan. Mutual action by all countries interested in using the region's waters is needed to adopt better water management and to create enforceable agreements that are respected by all.

■ **The alpine plateau, located at 3,016 meters above sea level, is a favored summer home for many shepherd families and their herd, where they live for half the year in traditional yurts.**

Making the Most of Its Resources

Natural resources will likely remain the primary source of livelihood for most Kyrgyz Republic's people for years to come. Preventing and mitigating environmental risks, therefore, will remain key. In promising sectors such as agro-processing, energy development, mining, and tourism, environmental safeguards and natural resources management should be strengthened. Improvements in managing state-owned land, including pastureland, as well as the majority of croplands transferred to private ownership in 1998, should also be made. Likewise, support for sustainable development for irrigation infrastructure must be maintained.

Regarding agricultural efficiency, reductions in the country's incidence of rural poverty in the early 2000s were largely attributable to improved agricultural performance and rising wages. This suggests that more efficient agricultural practices could result in substantial gains in productivity, lifting more rural poor out of poverty. Because it has fewer natural resources and a much smaller domestic market than its neighbors, the country will also need to maintain its attractive investment climate and place emphasis on developing more highly educated human resources.

Bishkek

Kyrgyz Republic's capital, Bishkek, is reputed to be the greenest city in Central Asia. And few could argue. Its numerous parks, wide boulevards, and grid-patterned streets feature countless trees that offer welcome shade on even the hottest summer day. The city is located in the central Chui Valley, in the foothills of the snowcapped Kyrgyz Alatau range, which picturesquely paint its southern skyline. Home to about 837,000 people, Bishkek is the country's largest city.

The site on which Bishkek now stands has history that traces back to the 6th century, when it was a caravan rest stop on the great Silk Road. In 1825, the Khan of Kokand built a fortress there, which was captured in 1862 by invading Russians. A small town named Pishpek (the Kazakh word for the pole used in the churn to make the traditional and medicinal drink of mare's milk called *kymys)* grew on the site. Under Soviet occupation, the town—renamed Frunze—grew to become the republic's most important city. When the Kyrgyz Republic declared its independence in 1991, the city was renamed Bishkek.

In many ways, Bishkek still retains its Russian feel, with Soviet-era buildings and gardens dominating newer architecture. As Bishkek modernizes, however, an exciting vitality is emerging. Foreign cars and minibuses crowd busy city streets. Restaurants, cafes, and shops have popped up everywhere. As Kyrgyz Republic's economic and cultural center, the city has much to offer. The State Museum of Applied Arts contains marvelous examples of Kyrgyz traditional handicrafts. Ala-Too Square in the city center is a gathering place for state events and celebrations. Supermarkets and open markets laden with fresh fruits and vegetables are popular. And busy Dordoy Bazaar, which stretches for more than a kilometer, is one of Central Asia's greatest marketplaces, serving as an entrepôt for local wares as well as for goods from the People's Republic of China, the Russian Federation, Thailand, Turkey, and many other Asian nations.

Tourism has also taken hold, with Bishkek becoming the jump-off point to nearby Lake Issyk-Kul, the world's highest and largest glacier lake. But perhaps most exciting of all is a revival in Kyrgyz culture, which has revitalized Bishkek's theaters, art museums, and even its streets with a spirit of national identity and pride.

■ **Views of Bishkek. The panorama is the Ala-Too Square, the main city square.**

Tajikistan

Proud Mountain Nation

Upper: Yaks grazing near the village of Tokhtamysh in the Aksu Valley in the Pamir mountains. **Lower:** A young boy riding his donkey carries firewood along the banks of the Vakhsh River in Sangtuda.

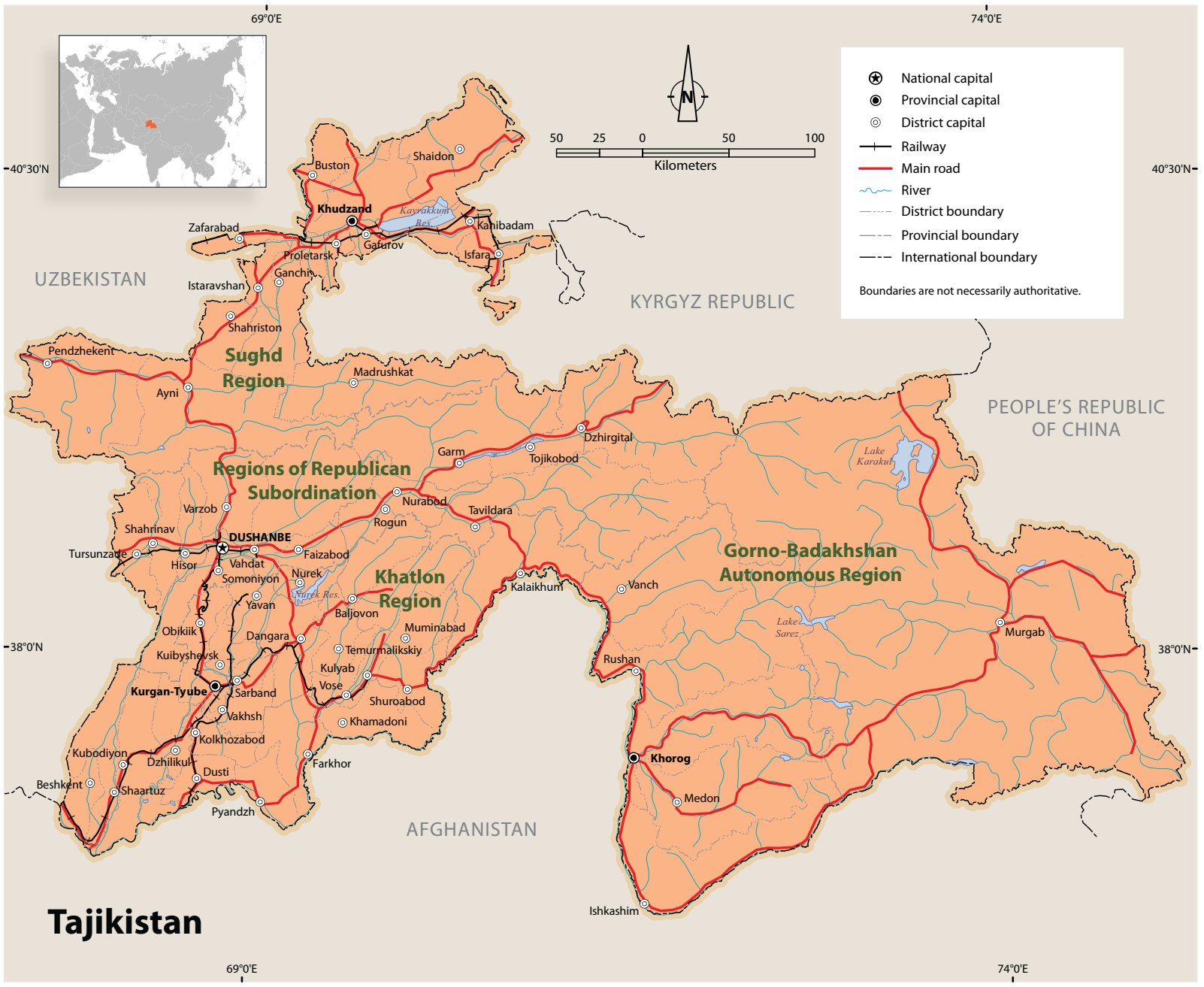
Scenically spectacular, culturally rich, and emergent from a difficult post-Soviet transformation are apt ways to describe Tajikistan. A ride along the Pamir Highway takes a visitor through high-altitude terrain as scenic as anywhere on the planet. The Persian-rooted Tajik language, distinct from the Turkik ones of the rest of the region, bespeaks the nation's cultural diversity. Independence, civil war, and consolidation mark the transformative steps Tajikistan has taken to evolve into a proud nation.

Tajikistan has an area of 142,557 square kilometers, and stretches roughly 700 kilometers east to west and 350 kilometers north to south. It is the region's smallest country, and shares borders with the Kyrgyz Republic to the north, Uzbekistan to the north and west, Afghanistan to the south, and the People's Republic of China to the east. Some 93% of land is mountainous, and approximately half lies 3,000 meters or more above sea level. Desert and semidesert zones are found in the south and southwest. To the southeast and east rise the Pamir Mountains, and to the north are the Alay and Kurama ranges. The vast mountains separate the country into various regions, and further separate these regions into a patchwork of valleys, often making communication difficult. Tajikistan is endowed with numerous rivers, principal among them being the Amu Darya, Syr Darya, Pianj, Vakhsh, and Kofarnihon.

Ethnically, the country's estimated 7 million people are 80% Tajik, 15% Uzbek, and 1% Russian and Kyrgyz each. Other nationalities include Germans, Koreans, Turkmen, and Ukrainians, as well as small Iranian ethnic groups. Though Tajik is the official state language, Russian is widely used in business and Uzbek is spoken by roughly 25% of the population. Nearly three-quarters of the population live in rural areas.

From Growing Pains to Growing Economy

While each of its regional neighbors experienced economic disruption in the period following the 1991 breakup of the former Soviet Union, only Tajikistan suffered the turmoil of civil war (1992–1997). During this painful period, tens of thousands were killed or displaced, the economy weakened, and wildlife and protected areas deteriorated. In 1997, a brokered peace marked a new chapter



Tajikistan

of stability. Reconstruction in the aftermath of the long civil conflict was slow. The country, however, has made substantial progress, with gross domestic product growth averaging roughly 8.6% over the last 5 years, incidence of poverty falling from 81.0% to 44.4% between 1999 and 2003, and people living with less than the revised standard of US$2.15 per day, declining from 81% to less than 60% between 1999 and 2007.

Although poverty has shown significant declines, and progress has also been made in education, Tajikistan remains the poorest nation in Central Asia and one of the poorest in the world. Moreover, its growing economy is undergoing accelerating inflation, led by increases in food and energy prices in recent years.

Economics and the Environment

Aluminum and cotton have long been the mainstays of the Tajik economy. But cotton is now losing its priority in the economy and its place is being taken by fruits and other horticultural products. The area planted to cotton is decreasing while that of orchards is increasing. Still, cotton contributes about 20% of exports, is farmed on 75% of irrigated land, supports 75% of farm households, and is the primary source of income for 75% of poor households. But as in other parts of the region, cotton has been planted extensively in semiarid tracts using irrigation networks that have not been well maintained, resulting in soil damage from salinity and chemical fertilizers and the spread of toxic elements to downstream fields, endangering populations. Since independence, Tajikistan has stopped using toxic chemicals in agriculture and greatly reduced the amounts of mineral fertilizers applied.

Tajikistan's aluminum industry, which provides almost 40% of exports, is a key performer but another cause of environmental concern. Aluminum is produced at the state-owned Tajik Aluminum smelter (TadAz) in Tursunzade. The smelter is the country's largest enterprise and among the world's largest smelters. However, it is extremely energy inefficient and, being of Soviet-era design, there are a number of legacies, which include contamination of the surrounding environment.

Young girls in colorful dresses for the national festival of Navrus, which takes place around the spring equinox (21 March) and is the biggest Central Asian holiday.

Top: Rolling hillsides of Sangtuda, southern Tajikistan. **Middle:** Fruits and vegetables, such as these onions, contribute to the economy's growth. **Bottom:** About a third of poor households in the country rely on cotton.

On an environmentally bright note, the robust economic growth in 2007 was driven by rapid expansion outside the aluminum and cotton sectors. In fact, industry almost doubled its rate of growth in almost all subsectors but aluminum, with expansion in construction materials, food processing, and textiles leading the way. Non-cotton agriculture also expanded, driven by higher production of livestock, fruits, and vegetables, as did the service sector, thanks to expansion in construction, finance, and trade—evidence of increasing consumer spending and demand. This multisector expansion suggests solid movement toward a more diversified economy. Remittances from Tajik workers employed in the construction and oil sectors in Kazakhstan and the Russian Federation also played a part in boosting the Tajik economy and bringing in much-needed foreign exchange capital.

Immense Water Resources

Tajikistan is rich in mineral resources, including gold, silver, and uranium. As with the Kyrgyz Republic, however, water may be its greatest resource asset. The country's hydro capacity places it among the top 10 nations in the world for hydropower potential. Hydropower provides virtually all of the country's electricity needs, yet only a tiny percentage of estimated capacity is used. Projects under way to exploit this vast unused potential include the Rogun station on the Vakhsh and Dashtijum station on the Pianj; others are being considered. Plans are also being made to build networks for electricity export outside the region.

Like the Kyrgyz Republic, Tajikistan lacks alternative energy resources and so meets its energy demands through release of water in the winter, which affects downstream countries. Better intercountry water management and enforceable agreements are needed.

Rich Biota In Need of Protection

Tajikistan has diverse ecosystems and a wide array of flora and fauna. Plant species number in the thousands. They reflect altitude zonation, and range from arid to alpine, polar, and subtropical vegetation, with alpine meadows, and mountain and *tugai* forests comprising the most productive and diverse ecosystems. But these ecosystems are under threat. Unsustainable agricultural and industrial practices have resulted in land degradation, while natural disasters, such as earthquakes, droughts, and floods have, in some instances, combined to make things worse. Deforestation, land erosion, and salinization are common, and have degraded mountains, lowland plains, and valleys alike. Provision of safe drinking water in cities and towns has also become a major concern.

Reversing years of environmental abuse dating from the Soviet era will take time. And due to civil conflicts in the 1990s, Tajikistan had gotten off to a much slower start than its neighbors. There is hope, however. Regarding "water, the atmosphere, flora, fauna, and other natural resources," Article 13 of the Republic of Tajikistan Constitution has this to say: "the government guarantees their effective utilization in the interests of the people."

The Law on Nature Protection strengthens this mandate by establishing frameworks to prevent environmental degradation, and ensure environmental quality. With so many of Tajikistan's

people living in rural areas and depending on natural resources, protection of the environment is crucial. Recent economic expansion, reductions in poverty, and less reliance on cotton and aluminum are encouraging. Economic growth will continue, however, only if environmental laws are supported and enforced.

Left: The remote Pamir Highway, also known as the Rooftop of the World. **Right:** A top employer and a major player in Tajikistan's economy, the Tursunzade aluminum plant; however, its environmental effects raise concern.

Dushanbe

Some have called it Central Asia's most beautiful capital. A planned city, Dushanbe is known for its spacious treelined streets, pastel public buildings, and numerous squares and parks. Its mostly one-story buildings, kept this height as a precaution against earthquakes, create a pleasant and relaxing atmosphere. Add in its breathtaking mountain backdrop and it's easy to see why the city is so eye-catching. Nonetheless, Dushanbe is a city on the move, with the town center boasting a host of earthquake-resistant, new high-rise buildings, and a population that has grown to more than 650,000 people.

Covering roughly 124 square kilometers in Gissar Valley at the confluence of the Varzob and Kafernihon rivers in southwest Tajikistan, Dushanbe is a relatively young city. Built by the Soviets in the 1920s on the site of three former settlements, the largest of which was called Dushanbe for its Monday bazaar (Tajik dushanbe, meaning Monday), it became the capital of the Tajik autonomous oblast in 1925. Dushanbe received a major boost in the 1950s when Soviet big-state planning turned it into a cotton- and silk-producing center, and tens of thousands of people were relocated there.

Dushanbe became the capital of independent Tajikistan in 1991, and though it suffered during the Tajik civil war, at war's end the Tajik economy revived and the city experienced a renaissance. A beautification program began. Strong multi-story apartment and office buildings sprang up. New cafes, restaurants, hotels, and shopping centers as well as theaters and ethnic museums opened their doors. And Dushanbe transformed into a vibrant and growing cultural, commercial, and industrial center that is a leading source for cotton textiles, clothing, appliances, machinery, and foodstuffs, and a home to telecommunications and other service companies. A burgeoning ecotourism trade for visitors wanting to take in the surrounding natural beauty has also ignited.

But for Dushanbe to move forward, more needs to be done. One key to ensuring success is to provide greater access to regional markets. Several projects are under way to upgrade Tajikistan's road network. Of particular promise are plans for a tunnel through the Anzob and Shakhristan Pass that will connect the city with the country's northern region, and a highway linking Dushanbe with the People's Republic of China.

Top: Ayni Opera and Ballet Theater in Dushanbe. **Middle:** A holiday crowd by the statue of Lenin in Hissar, near Dushanbe, during the festival of Navruz. **Bottom:** A football game in front of the Medressa-i-Kuhna, a Muslim school that dates back to the 16th century, in Hissar.

Turkmenistan

Making the Most of Desert Resources

Upper: The Yangkala Canyon in northwestern Turkmenistan. **Lower:** The Mausoleum of Turkmenbashi in Ahal Province.

Turkmen hospitality is legendary, its roots in the distant past. Beyond the traditional *Khosh geldiniz* (welcome), a host's sacred duty has always been to be hospitable to guests, even if they are strangers. The hardship of life and travel in the desert that makes up most of the country is such that finding a friendly refuge could be a matter of life or death. Inhospitality to a traveler is virtually unthinkable.

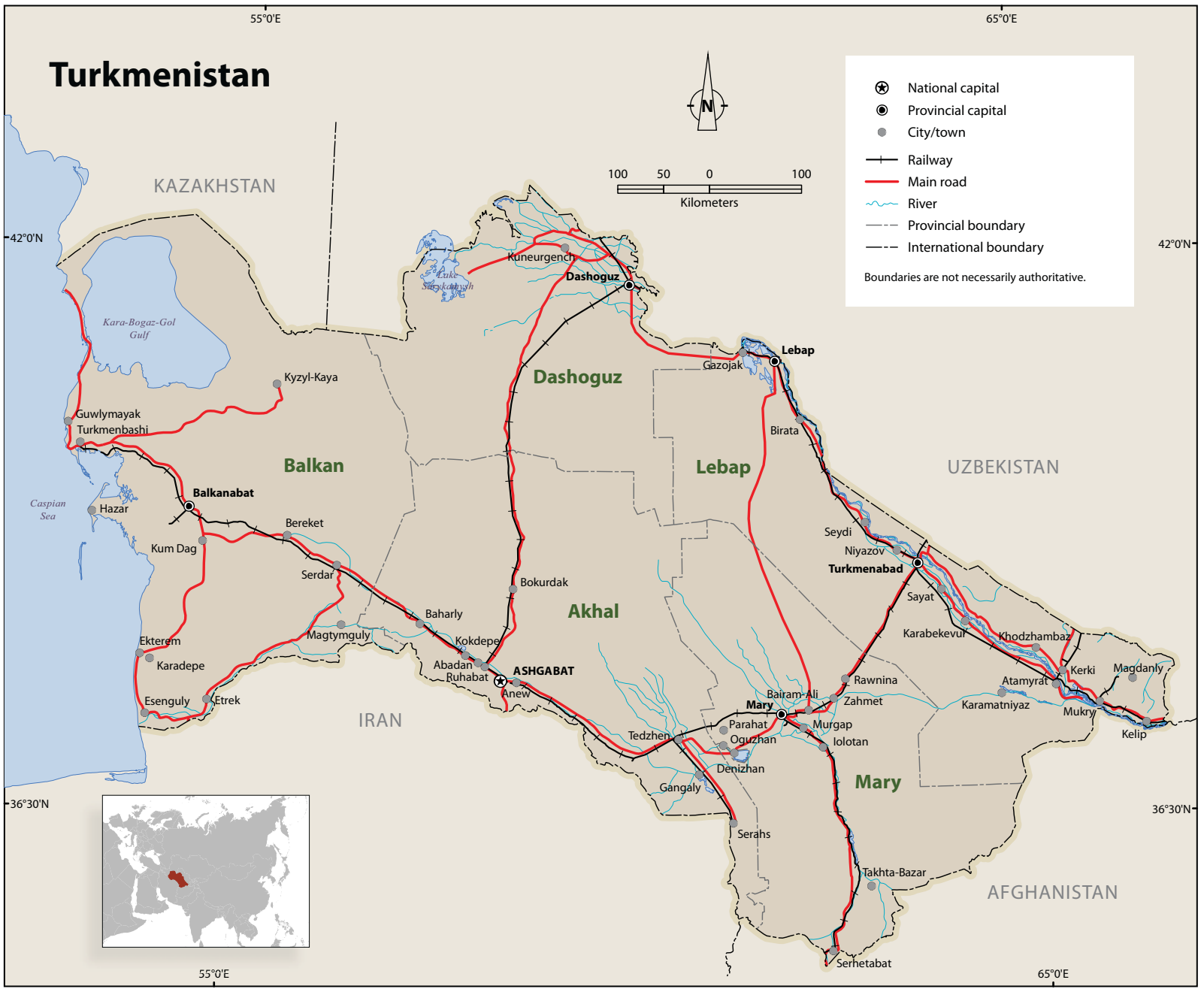
An Uncompromising Terrain

Turkmenistan, the second largest Central Asian country, covers 488,100 square kilometers, measuring about 1,100 kilometers from east to west and 650 kilometers from north to south, between the Caspian Sea in the west and the Amu Darya River in the east. It has borders with Kazakhstan to the north, Uzbekistan in the east, and Afghanistan and Iran to the south. The Caspian Sea forms the country's western border. The western edge of the Pamir–Alay Range juts into the eastern tip of the country and creates its highest point, Mount Ayrybaba, with an altitude of 3,137 meters.

There is little forested land. In fact, four-fifths of the country's surface is desert—most of it the Karakum (Garagum in Turkmen, the official language). And most of the remaining 20% of land is occupied by steep mountains. At the southwest edge of the Karakum, the Kopet-Dag Range rises up along Turkmenistan's southern border. This range forms part of the Trans-Eurasian seismic belt, which is unstable and has caused violent earthquakes in the country.

Turkmenistan's most important river is the Amu Darya, the longest river in Central Asia, which emanates from the Pamir mountains and flows northwesterly through Turkmenistan. Much of its water is diverted to the west for irrigation via the Karakum Canal. Other major rivers are the Tejen, the Murgab, and the Atrek.

Turkmen, who have lived in the area over millennia, are pastoral nomads, a way of life that continues to some extent today. Turkmen make up the majority (72%) of the total population of about 7 million. There are also many Russians (10% of the population), Uzbeks (9%), and Kazakhs (3%). Others include Armenians, Azerbaijanis, Tatars



(or Tartars), Persians, Lezghins, Uigurs, Beludzhi, and Kurds.

Specialized Wildlife

Most of Turkmenistan belongs to the Central Asian Southern Desert ecoregion, a rich area in terms of its highly specialized fauna—including many endemic mammals, reptiles, and insects—and flora, such as the black and white saxaul trees.

An important ecoregion in the south is the Kopet-Dag woodlands and forest steppe on the slopes of the Kopet-Dag range, which contains many endangered fauna, including leopard, wild sheep, bezoar bearded goat, hyena, Indian porcupine, and other rare species of mammals, birds, snakes, and lizards. According to the World Wildlife Fund, this area is the center of origin and genetic diversity for wild relatives of such cultivated plants as grapes, pomegranates, figs, almonds, walnuts, wheat, barley, and many others. However, these woodland habitats are being heavily logged and subject to overgrazing. They are under protection, but enforcement is inadequate.

Energy to Share

Turkmenistan's most abundant natural resources are hydrocarbons. Reserves of gas, estimated in 2008 at 9 trillion cubic meters, are the fifth largest in the world. Reserves of oil are estimated at 500 million barrels. Turkmenistan is a major exporter of natural gas, oil, and electricity, mostly to the Russian Federation and Ukraine.

Electricity exports are generated from natural gas. The country's excess capacity led to a modernization program for power generation and distribution systems that began in the early 2000s, with assistance from Iran, Turkey, and the United States. By 2011, generating efficiency should have improved by 40%.

The International Monetary Fund estimates that real gross domestic product, led by the gas and oil industries, is growing at 7.5% per year. Other contributors to this growth are large-scale state investments in oil refineries, textiles, food processing, transport, and construction projects.

Students attending a workshop in their school in Ashgabat.

Top left: Children and adults displaying Turkmenistan traditional costumes during a parade. **Middle left:** Turkmen girls in traditional costumes. **Bottom left:** A colorful display of melons and gourds in Ashgabat. **Right:** Some of Turkmenistan's famous "red" carpets.

Other than oil and gas, the main minerals mined commercially are bentonite (a clay used in oil and gas drilling mud and a variety of other industries), salt, and gypsum.

Dry Lands, Thirsty Crops

Nearly 70% of the land, albeit mostly desert, can be used for pasture for the nation's 14 million livestock, mainly sheep and goats. Only about 4% of the land is arable but agriculture accounts for 11% of gross domestic product and employs half the population. Most of the arable land, about 17,500 square kilometers, is irrigated. The main crop since the Soviet period has been cotton for export but harvests have been poor in recent years and exports have fallen by half. Wheat is becoming ever more important to make the country self-sufficient in its staple food. Production has almost tripled since independence. The state controls cotton and wheat production, but private farmers now grow most of Turkmenistan's fruits and vegetables, primarily tomatoes, watermelons, grapes, and onions.

Irrigation accounts for almost all (97%) of the country's water use. The 1,400-kilometer Karakum irrigation canal, one of the longest such canals in the world, takes water from the Amu Darya River in the east, and brings it to thirsty lands in the southwest of the country, turning desert into arable land, including the areas around the capital, Ashgabat. A new dam, the Dostluk, near the border with Iran was built in 2005 and has improved the water supply; another is planned

on the Atrek River. According to the National Environment Action Plan, the huge losses of water from irrigation infrastructure at present are greater than the planned supply of additional water from the new dams. If the losses are not stopped, the result will be a fundamental barrier to attaining the country's stated economic plans to 2020.

A major issue in the agriculture sector is land degradation, mainly because of irrigation problems—secondary salinization, water logging, and erosion of agricultural land—while pastureland around settlements is also degraded from overgrazing around settlements.

Turkmenistan's entire 1,768-kilometer western border faces the Caspian Sea. Yet, the only fishery of any significance is that for the small Black Sea sprat, and that has declined from a recorded catch of around 60,000 tons annually before independence to 15,000 tons in 2006. Turkmenistan launched a Caspian ecological program in 1998 for sustainable management of Caspian Sea living resources and many projects have since been launched toward addressing local and transboundary environmental issues in the Caspian basin.

Environmental conservation measures have been among the priority objectives of the government from the first days of independence. Turkmenistan has also ratified a number of United Nations environmental conventions and programs, and established a state commission to monitor the country's progress in fulfilling these international commitments.

Ashgabat

Ashgabat, the capital city, began as a fortress in the 19th century. The Trans-Caspian Railway reached it in 1885 and the town began to grow. The location, in an oasis in a scenic valley, was convenient and the area has the highest rainfall in the country, 30 centimeters, but there was a price: Ashgabat lies in the foothills of the unstable Kopet-Dag Range. In 1948, the city was completely destroyed by a severe earthquake that killed 110,000 people. Thus, Ashgabat today is a new city, with little of its past to display. Modern white marble buildings are graced by treelined avenues and fountains.

Upper: The 75-meter high Arch of Neutrality is topped by a statue of the late president Niyazov that revolves to always face the sun. Lower: Dusk view of the city of Ashgabat.

Landmarks include the Ashgabat National Museum of History, containing glimpses of the country's past in its archeological displays, and a unique carpet museum full of the best examples of the art since the 17th century, plus the largest carpet in the world, measuring some 400 square meters.

The highest point in the city is the Arch of Neutrality, built in 1998. Some other landmarks are the Presidential Palace, the building of Medzhlis, Academy of Sciences, Academic Drama Theatre, Bairam-Khan monument, Lenin Square, Mekan Palace, Conservatory, and Ertogrulgaz Mosque.

The main attraction for tourists to Ashgabat, however, is not the landmarks but the Tolkuchka market on the edge of the city, said to be the largest open bazaar in the world. Traditional carpets are a must, but everything from amulets to camels is on sale.

A new tourism activity is spending a night in a yurt, the felt-covered circular portable home of the nomadic pastoralists. Visitors can watch carpet making, drink fermented camel's milk *(chal)*, and even take a ride on an Akhal Teke horse, one of Turkmenistan's national symbols.

Uzbekistan

Crossroads of Central Asia

Upper: The hilltop fortress of Ayaz-Qala in Karakalpakstan, built in the 6th and 7th centuries. **Lower:** A dome of Ulughbek Medressa, in the Registan, the center of Samarkand. It was completed in 1420 and once housed 100 students. It is now a museum and tourist attraction.

It could easily be said that all roads in Central Asia lead to Uzbekistan. In walking the streets of its capital city Tashkent, one is as likely to encounter Uzbeks as one is to see Russians, Kazakhs, Koreans, Kyrgyz, or Tatars. The most historically rich country in the region, Uzbekistan's ancient villages and marvelous architecture take visitors back in time to the glory days of the Silk Road, when legendary cities, such as Bukhara, Khiva, and Samarkand, were prime stops for princes and merchants alike. Uzbekistan can truly be called the heart of Central Asia.

Stretching more than 1,400 kilometers west to east, and 900 kilometers north to south, Uzbekistan is the third largest country in the region, with an area of 447,000 square kilometers. It is Central Asia's only country that shares boundaries with each other nation in the region, bordering Kazakhstan to the north, the Kyrgyz Republic to the east, Tajikistan to the southeast, Turkmenistan to the southwest, and Afghanistan to the south. The country is approximately 80% flat desert or semidesert, with the vast Kyzlkum Desert filling its northern lowlands. To the southeast are the foothills of the Tien Shan, which rise steadily to heights reaching 4,500 meters above sea level. The elevated Fergana Valley, containing Uzbekistan's most fertile land, lies in the northeast.

With desert occupying so much land, and few lakes, water is scarce and unevenly distributed. Main sources of water are the Amu Darya, with headwaters in Tajikistan, and Syr Darya, which originates in the Kyrgyz Republic. Both are used extensively for irrigation, with some of their outflow diverted to artificial canals to expand the area of land in agricultural production. Irrigated agriculture along the valleys of these rivers has been practiced for millennia. Water diversion over the last half century, however, has meant the decline of what was once Uzbekistan's largest water body—the Aral Sea.

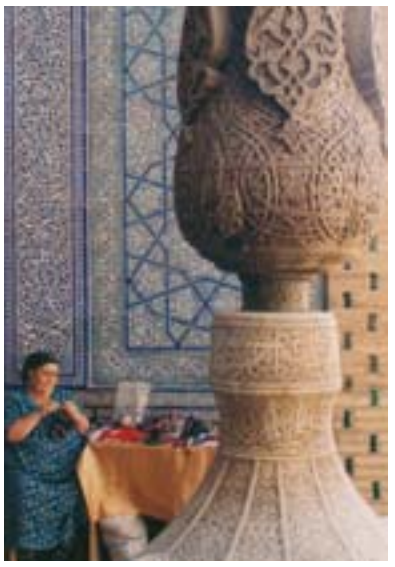
Uzbekistan's 27 million people make the country the most populated in the region. Ethnically, 76% of the population are Uzbek, 6% Russian, 5% Tajik, 4% Kazakh, 2% Tatar, and 1% Kyrgyz. Other groups include Armenians, Bashkirs, Karakalpaks, Koreans, Nogay, and Turkmen. Ethnic groups are spread across the Republic of Uzbekistan and Autonomous Republic of Karakalpakstan, in areas that accord with their traditions, livelihoods, and interests.

Growing and Diverse Economy

Uzbekistan's road to development after its independence in 1991 has been different from its neighbors. It has taken a more gradual approach to market reforms, relying on state-led development that has emphasized import-substitution industrialization. Results show significant increases in industrial value added. This approach has also helped make the economic and social transition to a new republic smoother than that experienced by other countries in the region, and has contributed to solid economic performance over the last few years. The country is now shifting to a market-based economy, with progress in reforms mixed.

In 2007, the economy grew by a healthy 9.5%. Industrial growth was anchored by increases in the production and export of automobiles, metals, and gas. Metals represent Uzbekistan's largest single export, and the country has made investments in their production in recent years. The country counts itself among world leaders in gold and uranium reserves, production, and export. The Almalyk complex, which produces copper, gold, lead, and zinc, and the Navoi complex, which produces gold and uranium, are two of the country's largest enterprises. Uzbekistan is also rich in natural gas. Unfortunately, reliance on Soviet-era pipeline infrastructure restricts most exports of natural gas to Central Asia and the Russian Federation. Once proper access rights are gained and new pipelines are built, Uzbekistan will be primed to become a significant gas exporter to more and more countries in Asia.

Nevertheless, agriculture has been and remains the keystone of the economy, accounting for roughly one-third of gross domestic product. During the Soviet era, Uzbekistan was transformed into a cotton center through the diversion of vast amounts of water that brought enormous tracts of land into cotton production. The country is a world leader in cotton and the product still dominates its agriculture sector. In a recent effort to increase grain self-sufficiency, however, cotton areas have decreased and more land is being sown to wheat. Areas producing fodder and rice have also been reduced while newer plantings include fruits, melons, potatoes, and vegetables. Karakul sheep are also raised, but reduced demand for the skins has created changes in meat production strategies.



Intricate stonework in the 19th century Tash Hauli Palace, Khiva.

Top left: The old city of Khiva, viewed from the Islom-Huja Minaret. **Top right:** Uzbek children waiting to perform a traditional dance. **Middle:** Uzbek spice seller in Bukhara market. **Bottom:** Traditional hat making from animal pelts is dependent on protection of wildlife.

Sustaining Citizen Well-Being

Uzbekistan maintained many Soviet-era social service protection for its citizens and refrained from a quick embrace of liberal economic reforms. This resulted in less economic shock for its people in the years following independence, and has helped Uzbekistan position itself for a high rate of Millennium Development Goals achievement.

The goal of universal access to education has been achieved, with literacy rates approaching 100%. Gender equality and female empowerment are moving in the right direction. This is evidenced by equal male and female attendance at the primary and secondary levels of education, increases in female students at the college graduate level, and introduction of affirmative action to encourage women to run in elections.

Protecting Environment and People

Uzbekistan's primary ecosystems include lowland deserts, piedmont semidesert and steppe, and riverine, wetland delta, and mountain systems. Each features its own distinct plant and animal life. The Kyzlkum Desert alone is home to more than 900 plant types, and 1,400 species and subspecies of animals. In all, more than 4,500 plant and 15,000 animal species are found in the country. Dozens of these species, however, are under threat, and hundreds of others are believed extinct.

As with other countries in the region, threats to the environment are many. The main causes are extensive agriculture development and use of harmful chemicals during the Soviet period, ineffective use of water resources and inadequate land-use practices, overgrazing, deforestation, pollution from hydrocarbon and mineral extraction, industrial waste, and climate change. The destruction of the Aral Sea is a prime example. Diversion of water inflow for irrigation and pollution from agrochemicals have not only dried up much of the Aral Sea but have also rendered most of it biologically dead.

Environmental damage is also hard on Uzbekistan's people, two-thirds of whom live in rural areas and so depend on the country's air, land, and water resources for their health and livelihood. For example, land degradation and salinization lead to reduction of cropland productivity and increase of abandoned land areas. People living near the Aral Sea and lowlands of the Amu Darya River basin experience health problems caused by river water contamination and windblown pollutants from the dry bed of the Aral Sea. Dangerous levels of industrial waste also affect the Samarkand and Tashkent regions.

The country is taking steps to address environmental issues. Since its independence, a number of environment protection programs and

Above left: Carpet salesmen in Bukhara. **Above right:** Cotton production goes into the making of some of Central Asia's most-renowned carpets.

strategies have been prepared, including the 1999 National Action Plan to Combat Desertification, National Biodiversity Strategy and Action Plan (1999), Concept and Strategy of Sustainable Development (2000), Agenda for XXI Century, Strategy of Welfare of the Uzbekistan Population for 2008–2010 (2007), and National Environmental Action Plan for 2008–2012 (2008).

Tashkent

With a population of more than 2 million, Uzbekistan's capital, Tashkent, is the largest city in Central Asia and one of the Asian continent's premier capitals. Located square in the middle of the Central Asian land mass, it has served as a major transport junction for 2 millennia. Known variously as Dzhadzh, Chachkent, Shashkent, and Binken, the name Tashkent ("Stone Village" in Uzbek) first appeared in the 11th century. The city functioned as a vital Silk Road link under the rules of the Arabs beginning in the 8th century, Ghenghis Khan in the 13th century, and Tamerlane in the 14th century. Named the cultural capital of the Islamic world in 2007 by the Islamic Educational, Scientific and Cultural Organization, the city is considered by many to be Central Asia's economic and cultural hub. The 2,200th anniversary of Tashkent was celebrated with much splendor and festivity on 1 September 2009.

Tashkent is situated in northeastern Uzbekistan in the Chirchiq River valley just west of the Chatkal Mountains. This is Uzbekistan's industrial heartland, where cotton is the chief crop and economic driver. Much of the city's economy revolves around manufacture of cotton textiles, and agricultural and textile machinery. It also manufactures automobiles, television sets, and tractors, and serves as Uzbekistan's military center. Tashkent is a major export center for products destined for Eastern Europe, serving as an entrepôt for everything from silk and cotton textiles to rice, coal, copper, oil, and sulfur. For travelers, it possesses the best international flight connections as well as connections for regional air and rail travel to any city in the region, plus boasts of Central Asia's only metro subway system.

But Tashkent is far more than just an economic center with rows of modern buildings. It has numerous research institutes and libraries, and more than a dozen colleges. The city features several stadiums and excellent museums, including the Museum of Cinematic Art, Museum of Decorative and Applied Arts, and the State Art Museum. It also contains numerous Uzbek and Russian theaters, such as the Navoi Theater of Opera and Ballet, located in the center of the city. The old section of the city, whose narrow, serpentine streets lead to a host of beautiful mosques and colorful bazaars, attracts tourists from around the world. What's more, thanks to its carefully laid-out parks, Tashkent is incredibly green.

Upper: Bird's-eye view of the city. **Lower:** Sympathetic architecture links the modern Hotel Chorsu and ancient Kikeldash Medressa near the main Chorsu Bazaar in Tashkent.

Energy Resources

Enormous Development Potential

Thanks to the immensity of its known energy reserves, potential for discovering more, and midpoint position between Europe and energy-hungry East Asia, Central Asia is on the threshold of exciting energy opportunities. Reserves of hydrocarbons, especially gas, are vast. Hydropower capacity and deposits of coal and uranium are additional sources. Excellent wind regimes make the region one of the world's best in wind power potential, while the abundant sunshine offers prospects for large-scale conventional and thermal solar power. Together, these resources could ensure self-sufficiency and help make the region an important market for trading, transport, and sales of energy far into the future.

Export potential is especially great close to home, where Asia's developing nations are experiencing the fastest industrial and energy growth rates in history. Kazakhstan, Turkmenistan, and Uzbekistan already export oil and natural gas via pipeline and as liquefied natural gas. The Kyrgyz Republic and Tajikistan hold significant hydropower resources that could be tapped to market electricity for Afghanistan, the People's Republic of China, Iran, Pakistan, and the Russian Federation. Kazakhstan is a world leader in coal production, and Kazakhstan and Uzbekistan are among the top 10 nations in known uranium reserves.

Each Central Asian country is actively developing its energy capacity and export capabilities. Energy security and expansion of energy resources are being pursued. Key to achieving these are investment in hydropower generating capacity, development of new oil and gas fields, rehabilitation of existing infrastructure, increases in petrochemical production, and regional cooperation. Plans are also being made to secure transport access for resources and expand pipeline networks and electricity grids to nations outside the region. Success in this process will be an important first step in reaching global markets, and attracting the kinds of foreign investment required to build the region's energy industry.

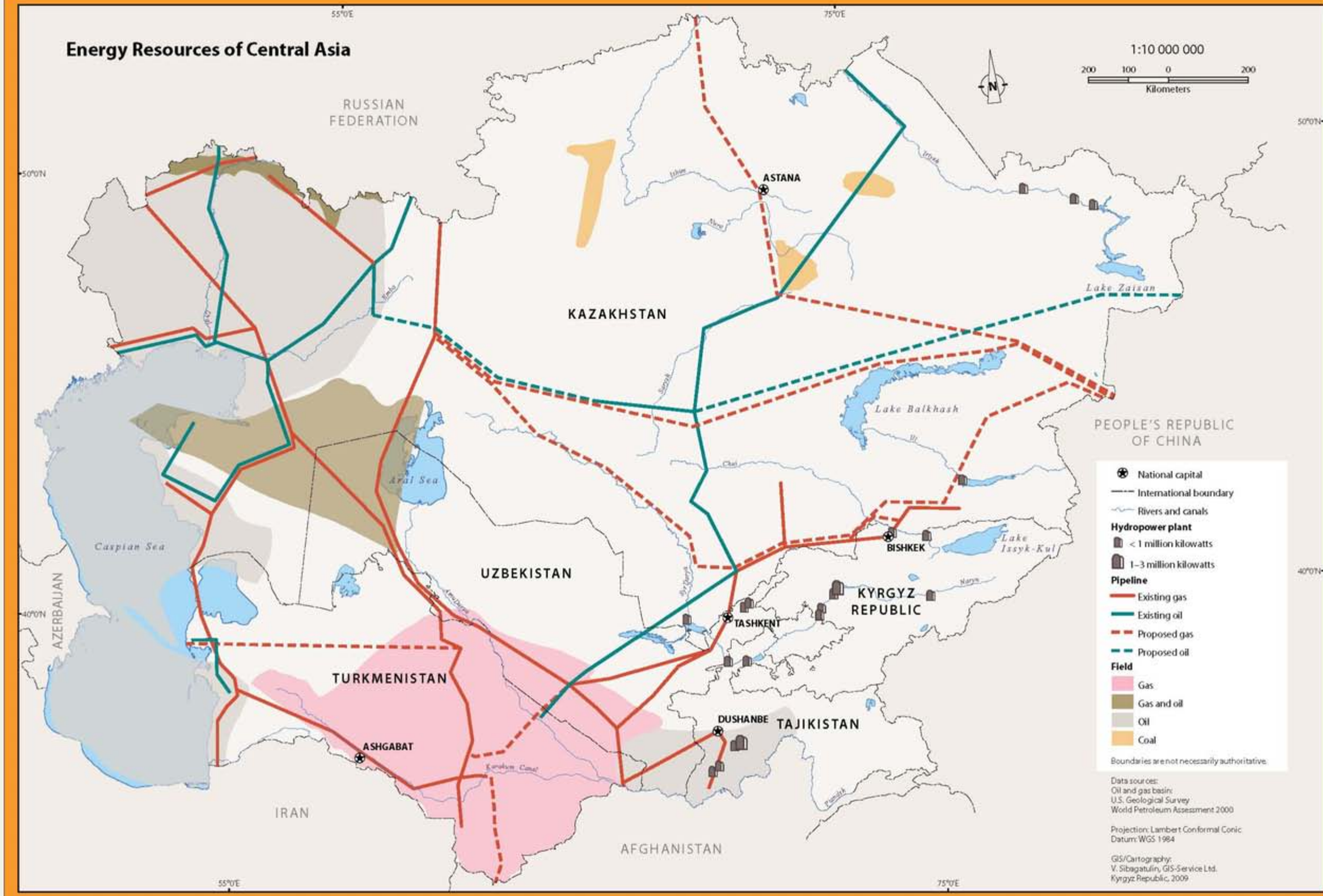
Energy Potential of Central Asian Countries

	Kazakhstan	Kyrgyz Republic	Tajikistan	Turkmenistan	Uzbekistan	Total	Share of Central Asia in World Reserves %
Oil,[a] billion barrels	30.000	0.040	0.012	0.600	0.594	31.246	2.37
Natural gas,[a] trillion cubic feet	100	—	—	100	65	265	4.28
Coal,[b] million short tons	34,502[d]	895[e]	—	—	3,307[f]	38,704	4.16
Uranium, thousand tons U	817	—	—	—	111	928	17.00
Hydropower[c], billion tons kilowatt-hours/ year	317	99	27	15	2	460	—

[a] Proved reserves; [b] World Energy Council definition of "Proved Recoverable Reserves": As per WEC definition are the tonnage within the Proved Amount in Place that can be recovered (extracted from the earth in raw form) under present and expected local economic conditions with existing available technology; [c] Economic hydropower potential; [d] 90% anthracite and bituminous, 10% lignite and subbituminous; [e] lignite and subbituminous; [f] 33% anthracite and bituminous, 67% lignite and subbituminous; — reserves missing or very insignificant
Sources: EIA, 2006 and 2008; WNO, 2008; and *EDB Industry Report* no.2.

One of the largest open-pit coal mines in the world, in Ekibastuz, Kazakhstan. **Inset:** Part of the 1,700 km pipeline project to export gas from Turkmenistan to energy-deficient South Asia through Afghanistan.

Energy Resources of Central Asia



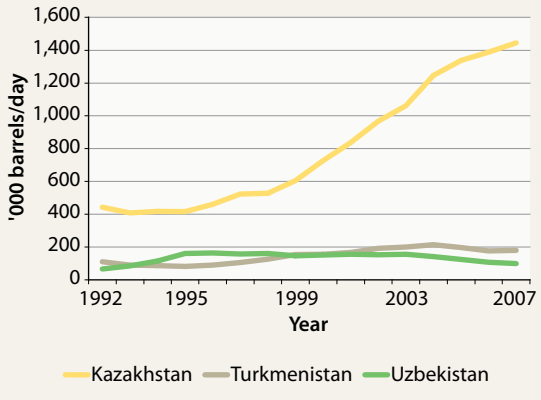
Petroleum – Fueling the Region's Growth

For more than a half century, one commodity has had the ability to transform developing economies like no other—oil. Kazakhstan is a prime example. Oil is Kazakhstan's fastest-growing industry sector. After years of foreign investment, the country boasts of an oil industry that has made it Central Asia's economic leader, with a gross domestic product greater than those of its four neighbors combined. Most encouraging is that the country's middle class is growing, suggesting that its hydrocarbon wealth is spreading widely. Kazakhstan's total oil production of roughly 1.4 million barrels per day ranked it among the top 20 oil producers in the world in 2007. And if its growth of more than 250% in crude petroleum production and 275% in exports between 1991 and 2007 is any indication, it could quickly move up in the rankings. In 2007, Kazakhstan exported about 80% of its oil production.

Kazakhstan has more than 100 oil-producing fields. Except for the Karachaganak field in the northwest, virtually all are within the Caspian Sea or just offshore. In recent years, Kazakhstan has had the Caspian region's greatest increases in oil production and has accounted for more than half of that region's total production. Caspian oil fields include Kashagan, the world's fifth largest in oil reserves, and Kurmangazy. In the low-lying wetlands along the Caspian's northeastern shores is the Tengiz field—the country's largest producer.

Turkmenistan and Uzbekistan have substantial oil industries as well, with each ranking within the top 50 oil producers in 2006. Although Turkmenistan was the only country in the region to show steady oil production increases after independence, its production began to decline after 2004. Still, the country is self-sufficient in oil, and exports as

Total Oil Production in Kazakhstan, Turkmenistan, and Uzbekistan; thousand barrels/day, 1992–2007



Note: Production of crude oil includes lease condensate, natural gas plant liquids, and other liquids, and refinery processing gain (loss).
Source: Based on EIA data US Government.
http://tonto.eia.doe.gov/country/index.cfm

Upper: Worker in the Kumkol oil fields in Kazakhstan. **Lower:** Oil is transported by pipeline and rail to the port of Aktau for export to neighboring countries.

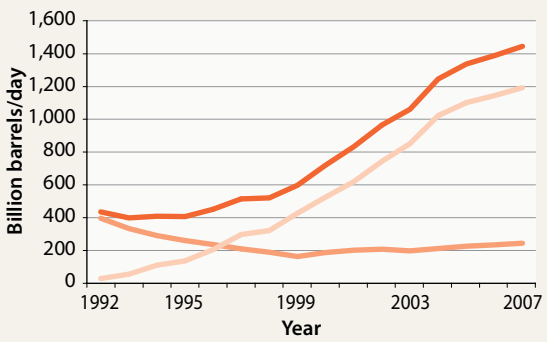
Oil exploitation in Tengiz, Kazakhstan. Workers inside a petroleum plant.

much as two-thirds of production. Key reserves are located in the Caspian's Cheleken oil field. Claims to other Caspian oil reserves are disputed by neighbor Azerbaijan, which could inhibit Turkmenistan's access to a substantial segment of its presumed oil reserves.

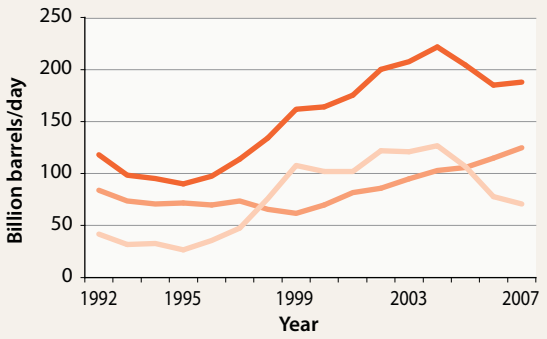
Not as oil endowed as its neighbors, Uzbekistan's oil production tripled during the 1990s, peaked in 1999, and has slid ever since. Today the country is a net oil importer. The majority of proven oil reserves are in the Bukhara-Khiva region, including the Kokdumalak deposit, which accounts for about two-thirds of production. Other fields are located in the Fergana Valley and Ustyurt plateau. Few high-yielding discoveries have been made since 1991. And local experts state more than two-thirds of oil has already been discovered. Lack of adequate investment and technical capacity for new oil field start-up has contributed to Turkmenistan's and Uzbekistan's waning oil production.

Oil Production, Consumption, and Exports/Imports
Billion barrels/day, 1992–2007

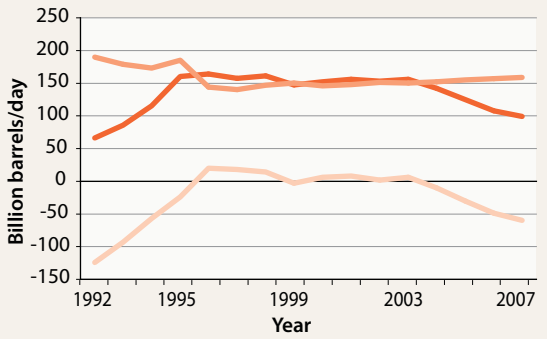
Kazakhstan



Turkmenistan



Uzbekistan



Production Consumption Net Exports/Imports

Notes: 2007 data for consumption and net imports/exports for all countries are forecast values.
Production of crude oil includes lease condensate, natural gas plant liquids, and other liquids, and refinery processing gain (loss).
Consumption includes petroleum products and direct combustion of crude oil.

Net Exports = Total Oil Production − Consumption. Negative numbers are Net Imports.
Source: Based on EIA data, US Government.
http://tonto.eia.doe.gov/country/index.cfm

The Caspian Sea's Newest Prize Catch

Long world famous for its bountiful sturgeon and their delicious caviar, the Caspian Sea region* now attracts world attention for its hydrocarbons. Surveys place proven (economically recoverable) oil reserves between 17 billion and 49 billion barrels, comparable to Libya on the high end. In 2005, oil production for the region was approximately 2.1 million barrels per day (mb/d), and could reach as high as 3.8 mb/d by 2010. Proven natural gas reserves are estimated at 232 trillion cubic feet (tcf), comparable to Nigeria. Regional production reached approximately 4.9 tcf in 2004, as much as the combined production of South America, Central America, and Mexico. In 2010, the governments of the countries in the Caspian Sea region expect their countries to produce a total of 8.1 tcf, more than the 2004 production of the entire Middle East.

*For purposes of measurement, the Caspian Sea region includes shoreline countries Azerbaijan, Kazakhstan, Iran, the Russian Federation, and Turkmenistan, as well as non-shoreline Uzbekistan.

Oil drilling platform in the Caspian Sea.

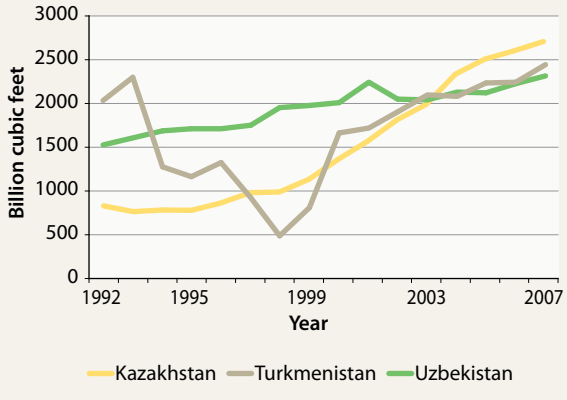
Natural Gas – Vast Potential Waiting to be Tapped

Because natural gas is more evenly spread throughout the region, it may hold even greater potential than oil. In 2005, Kazakhstan, Turkmenistan, and Uzbekistan all ranked among the top 25 world leaders in natural gas production, and top 20 in exports and proven reserves.

Kazakhstan's natural gas reserves measure approximately 100 trillion cubic feet, and are primarily located in the Caspian region. Nearly all gas is in associated (oil and gas) fields, such as the Caspian's Karachaganak and Tengiz fields, which contain the country's largest reserves. Other important fields include the Zhanazhol and Uritau deposits. While Kazakhstan currently consumes about as much gas as it produces, recent rehabilitation of the Karachaganak and Tengiz fields positions the country to become a significant net exporter once adequate pipeline infrastructure comes on line.

In possession of some of the world's largest gas fields, Turkmenistan's proven natural gas reserves are also about 100 trillion cubic feet. The Amu Darya basin is home to the largest deposits, with the giant Dauletabad-Donmez field containing roughly half of all reserves. Additional large reserves are found in the Murgab basin, of which the Yashlar deposit is the largest. There are also reports of new discoveries of deposits in the Deashoguzsky, Lebansky, and Maryinsky regions of the country. Since bottoming in 1998, Turkmenistan's gas production has increased steadily. Today, natural gas supplies virtually all the country's energy needs, and oil and gas together provide 80% of energy exports. Because

Natural Gas Production in Kazakhstan, Turkmenistan, and Uzbekistan
Billion cubic feet, 1992–2007



Source: Based on EIA data, US Government. http://tonto.eia.doe.gov/country/index.cfm (updated 30 June 2008).

Upper: The burning gas crater near Darvaza in Turkmenistan is 60 meters wide and is a result of Soviet gas exploration during the 1950s. **Lower:** Gas pipelines exposed by wind and movement of the desert sands in Gumdag, Turkmenistan.

Gazprom welders work on a pipe during reconstruction works on the pipeline in Alexandrov Gai village at the border between Kazakhstan and the Russian Federation. The pipeline is expected to increase the possibilities of gas transport from Central Asia to Europe.

Turkmenistan relies on the Soviet-era pipeline system, however; most of its natural gas exports are currently restricted to the region or go to the Russian Federation.

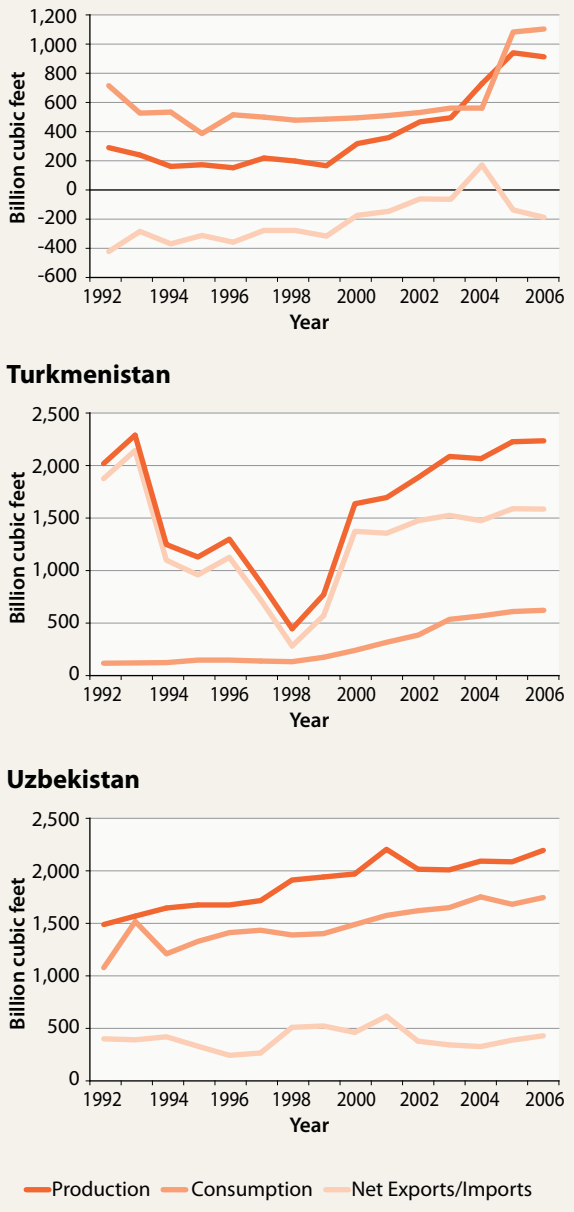
Uzbekistan's natural gas reserves measure roughly 65 trillion cubic feet. About two-thirds of proven reserves are found in nine large deposits, eight of which are under development. The Ustyurt region in the country's northwest holds the greatest promise. Gas provides most of the country's electricity production, and a large portion of the country's gas production is domestically consumed. Natural gas exports go to Kazakhstan, the Kyrgyz Republic, Tajikistan, and the Russian Federation, which purchases the overwhelming proportion of Uzbekistan's gas exports, pumped north through Soviet vintage pipelines.

Energy's Access To Global Markets

Central Asia's energy resources are there. The challenge is getting them out. Most of the region's oil and gas pipelines were constructed in Soviet times. Gas pipelines were built for regional use; oil pipelines, for regional use and for export to the former Soviet Union and Ukraine. This is one reason Kazakhstan is able to sell its oil internationally. Another reason is that because oil can be shipped almost anywhere—by pipeline, ship and truck—it is a true global commodity. By contrast, gas is "stranded" and—unless made liquid for ship transport—must be carried via pipeline networks. Gas without pipeline networks has little export value.

The region's hydropower is "stranded" in much the same way. This is because the Central Asia transmission system was built as a regional electric power grid to export hydropower from the Kyrgyz Republic and Tajikistan to the rest of the region and allow power interchange among all the countries. For the countries of Central Asia to take advantage of the global economy, new electricity transmission networks and gas and oil pipelines are being built, and many more are in the planning stage.

Natural Gas Production, Consumption, and Exports/Imports
Billion cubic feet, 1992–2006



Net Exports = Exports – Imports. Negative numbers are Net Imports.
Source: Based on EIA data, US Government.
http://tonto.eia.doe.gov/country/index.cfm

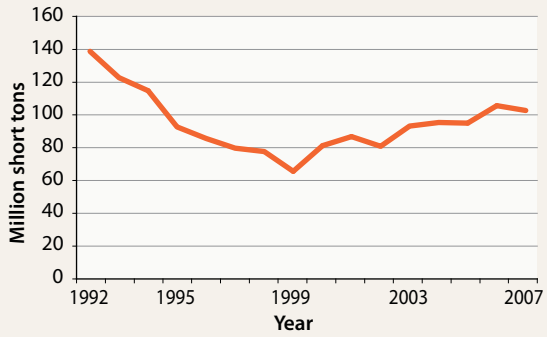
■ Coal mining by the road from Chaek to Song Kul, Kyrgyz Republic. The country produced nearly 5 million tons per year in 1979. Present production is less than a tenth of that amount but large reserves remain.

Coal – Energy Diamond in the Rough

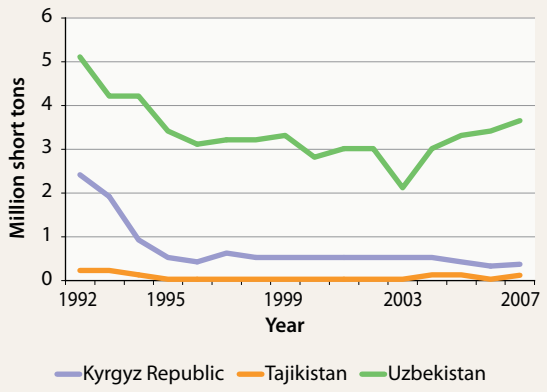
Coal is the most plentiful hydrocarbon on the planet. It is also the most widely distributed, and is likely to remain so for years to come. Coal powered the industrial revolution, and is helping power the growth of many developing nations today. Found throughout Central Asia, it is used to supply electrical power and as local fuel for cooking and heating. It is exported in small quantities as well. Regional coal production declined significantly in the years following the Soviet breakup.

However, Central Asia's coal production and investments are on the upswing. The Kyrgyz Republic and Tajikistan have locally exploitable coal and have shown modest production increases the past few years. The Kyrgyz Republic produced roughly 350,000 short tons of coal in 2007. Its coal is found in three areas: Alai, Alabuka-Chatyrkul, and Yuzhno-Issyk-Kul. Kara-Keche, an open-pit mine in the Dzhumgal district of Naryn region, contains roughly half of the country's deposits. Tajikistan produced about 90,000 short tons in 2007, roughly as much as it consumed. To meet winter demand for electricity and space heating, the Government of Tajikistan has been looking for investment to develop integrated coal mines and power plant complexes. Uzbekistan has nearly 3,307 million short tons of coal reserves, and produced 3.6 million short tons in 2007. There is a significant amount of high-grade black coal. However, roughly 70% of reserves are lower-grade brown coal (lignite). Coal is mined at the Angren deposit, which has brown coal reserves, and Shargun and Boysun deposits, which have black coal reserves. Except for small exports to Afghanistan, coal is used for domestic consumption, with 90% going to the power industry. Uzbekistan plans to increase coal production and coal's share in power production.

Coal Production in Kazakhstan
Million short tons, 1992–2007



Coal Production in the Kyrgyz Republic, Tajikistan, and Uzbekistan
Million short tons, 1992–2007



Note: 1 short ton = 0.907 metric tons.
Source: Based on EIA data, US Government. http://tonto.eia.doe.gov/country/index.cfm (updated 17 October 2008).

The region's largest recoverable coal reserves are found in Kazakhstan—approximately 34,500 million short tons of primarily high-grade, anthracitic and bituminous coal. In 2006, the country produced roughly 106 million short tons

Above: Scientists inspect a nuclear reactor in the Baikal Reactor Research complex in Kurchatov, a facility hidden underground in Kazakhstan's desert region. **Right:** The Nurek hydropower station and reservoir in Tajikistan.

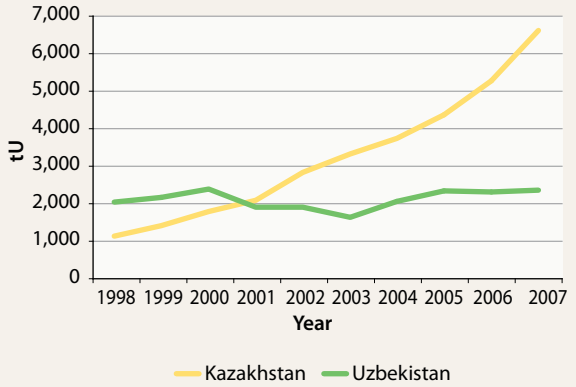
and exported about 28 million short tons, mostly to the Russian Federation and Ukraine. With coal powering more than 80% of Kazakhstan's electricity production, the country was also its own biggest consumer. Kazakhstan has several hundred coal deposits, with brown coal coming from the Karaganda and Ekibastuz region, and higher-grade coal from its Karazhir deposit. Foreign investment is involved with much of Kazakhstan's production, and more will be needed if Kazakhstan is to become a significant coal exporter.

A versatile mineral, coal has advantages: it is inexpensive, safe to transport and store, and is available from many sources. But it has disadvantages as well: it releases huge amounts of sulfurous pollution and carbon dioxide into the skies, and contributes significantly to acid rain and climate change. This makes clean coal production and consumption technologies prime considerations in any coal enterprise. Coal production also requires extensive road and railroad infrastructure, areas that need to be addressed for the region to reap the benefits of its vast coal reserves.

Nuclear Energy – A World Leader in Reserves

First heralded for its limitless potential, and later questioned for its risks to health and environment, carbon-free nuclear energy is once again catching the attention of planners worldwide, for two compelling reasons: world demand for electricity is increasing, and climate change requires a wide range of solutions. Storage of radioactive waste and other issues remain, but the new generations of nuclear reactors hold promise of greener and safer energy, with less residual waste. Nuclear energy already generates one-sixth of world electrical energy, placing it third behind coal and hydropower. Fueling nuclear plants takes uranium, and as the post–Cold War glut of military uranium runs out—possibly by 2010—and new reactors come on line, eyes are turning to the handful of areas with large uranium deposits.

Uranium Production in Kazakhstan and Uzbekistan, tons, 1998–2007



Source: Based on data from World Nuclear Association. www.world-nuclear.org/info/uprod.html (updated July 2008).

Kazakhstan with 15% and Uzbekistan with 2% of world reserves are second and eighth, respectively, among world leaders. Kazakhstan, whose uranium production dates back to 1953, also holds the greatest potential. In 2006, KazAtomProm, Kazakhstan's state-owned nuclear holding company, produced 8% of the world's mined uranium. The company puts uranium reserves at roughly 900,000 tons, and aims to produce 15,000 tons by 2010 and 30,000 tons by 2018.

Virtually all Kazakhstan deposits are located in the Chui-Sarysu and Syr Darya basins, though there are some deposits in the north and in the Caspian region. Kazakhstan has a long working relationship with the Russian Federation, and has signed nuclear agreements with Canada, the People's Republic of China, France, Japan, the Republic of Korea, and the United States. Though all mined uranium is exported, Kazakhstan hopes to develop its own nuclear power industry, and may begin constructing reactors and nuclear power plants.

Uzbekistan production began in the Fergana Valley and now comes entirely from the Kyzylkum district in Central Uzbekistan, where it has been produced since 1961. In the Soviet era, much of Uzbekistan's production went to the Soviet military–industrial complex and peaked in the 1980s. Since independence, there have been swings in production. However, the country has enjoyed production increases estimated at 25% between 2002 and 2007. The Kyrgyz Republic also has uranium reserves under production.

Nuclear infrastructure is costly, but once in place, atomic power can offer an inexpensive, greenhouse gas–free electricity alternative to fossil fuel. On a cautious note, long-term handling and storage of radioactive waste remain problematic. Uranium, like oil and gas, is also finite—at current usage (about 65,000 tons of uranium per year), the world's measured uranium resources (5.5 million tons) would be depleted in a little more than 80 years. And then there is this: short-term reliance on nuclear power could distract policy makers away from long-term renewable energy.

Renewable Energy

SUSTAINABLE HYDROPOWER POTENTIAL

Hydropower has been a key component of Central Asia's energy use for more than a half century. The region's water/energy nexus, however, is a complicated one. Put simply, the energy needs of upstream Kyrgyz Republic and Tajikistan, and the irrigation needs of downstream Kazakhstan and Uzbekistan have not always mixed well.

The Amu Darya and Syr Darya rivers and their tributaries provide the primary hydropower sources for the region. Hydroelectric stations using these sources are largely controlled by the Kyrgyz Republic and Tajikistan. More than 40 hydropower stations are installed among the largest reservoirs along the rivers. Major stations are in reasonably good condition. Largest are the Toktogul station on the Naryn River in the Kyrgyz Republic and Nurek station on the Vakhsh River in Tajikistan. Hydropower provides the Kyrgyz Republic with 83% and Tajikistan with 96% of total electrical energy. But this usage is a small percentage of potential capacity.

Hydroelectric potential for the region has been placed at more than 450 billion kilowatts per year, with an estimated 90% of this presently unused.

To exploit unused potential, the Kyrgyz Republic and Tajikistan are completing large hydropower stations begun during the Soviet era, and constructing new smaller ones. Projects include two Kambarata hydropower stations on the Naryn and a series of stations on the Sary Djaz River in the Kyrgyz Republic, and the Rogun station on the

The Irrigation or Hydropower Dilemma

Distribution of energy resources in Central Asia is highly skewed. The Kyrgyz Republic and Tajikistan possess great hydropower potential, but a scarcity of commercially viable fossil fuels. Kazakhstan, Turkmenistan, and Uzbekistan have significant and varying amounts of oil, gas, and coal.

In terms of actual need, the Kyrgyz Republic and Tajikistan require water in winter to generate power for heat and electricity. By contrast, Kazakhstan and Uzbekistan require water flow for summer irrigation. During Soviet times, water and energy were managed on a regional basis, with primary emphasis on irrigation. Soviet policy, therefore, mandated greater water volume release in summer than winter, leaving insufficient flow for winter power generation. Soviet central authorities managed this discrepancy by sending excess electricity produced in summer to the Central Asian power system so it could be used by Kazakhstan and Uzbekistan, that in turn were required to send fossil fuels to the Kyrgyz Republic and Tajikistan to make up for winter energy shortfalls.

Through mutual agreement, this summer/winter water arrangement still exists. However, with market pricing replacing the Soviet-style resource-trade system, cash-strapped upstream countries, further overburdened by costs from the management and maintenance of water infrastructure, have been unable to pay for thermal resources from their downstream neighbors. Lacking effective regional integration, countries have adopted policies of energy self-sufficiency. This has led the Kyrgyz Republic and Tajikistan to use great amounts of water for winter power generation, causing downstream water saturation problems in winter, and irrigation scarcities in summer that cause economic hardship for farmers.

A solution amenable to all countries is yet to come. Of note, however, is this: economic analysis in the Syr Darya Basin reports that net benefits to the region are significantly higher under an irrigation scheme of greater water release in summer than a power scheme of increased winter releases.

Central Asian Power System

The Central Asian power system comprises interconnected high-voltage links encompassing southern Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. The main transmission lines link the power systems of the five countries for parallel operation. The system shares common operational and service management, planning, information channels, and control, and connects more than 80 power plants, including 29 thermal and 48 hydropower plants, with a total installed capacity of about 25,000 megawatts. The system operates from the united dispatch center in Tashkent, Uzbekistan, which is responsible for maintaining the balanced and synchronized operation of the power transmission and distribution systems of the five countries. Following the dissolution of the Soviet Union in 1991, the countries have maintained synchronized operation, which permits the exchange of electricity among them.

Power lines in the steppe at sunset in Kazakhstan.

Hydroenergy Potential of the Rivers of Central Asia

Country	Hydroelectric Power Plant (HPP) installed capacity, Megawatts	Electricity production and HPP, 2005, Billion kilowatt-hours	Economic hydropower potential, Billion kilowatt-hours/year	Use of hydropower potential, %	Percentage of the hydropower potential of the Central Asian Rivers
Tajikistan	4,037	17.1	317	5	69
Kyrgyz Republic	2,910	14	99	14	22
Kazakhstan	2,248	7.9	27	29	6
Uzbekistan	1,420	6	15	49	3
Turkmenistan	1	0	2	0	0
Total	**10,616**	**45**	**460**	**10**	**100**

Source: Water and Energy Resources in Central Asia: Utilization and Development Issues. April 2008. *EDB Industry Report* no.2. www.eabr.org/media/img/eng/research-and-publications/AnalyticalReports/Report_2_water_and_energy_EDB.pdf

Largest Hydroelectric Power Plant Projects in the Kyrgyz Republic and Tajikistan

Project Name	Location / Country	Status (when completed/under construction)	Capacity, Megawatts	Average annual performance, Billion kilowatt-hours	Estimated cost, Billion $
Rogun HPP	Vakhsh River (Tajikistan)	Project	3600	13.1	2.2
Nurek HPP	Vakhsh River (Tajikistan)	Operational	3600	11.2	
Dashtijum HPP	Pianj River (Tajikistan)	Project	4000	15.6	3.5
Kambarata -1 and -2 HPPs	Naryn River (Kyrgyz Republic)	Project	1900+360	7.0	2.0
Toktogul HPP	Naryn River (Kyrgyz Republic)	Operational	1200	4.4	
Series of 5 HPPs on Sary Djaz	Sary Djaz River (Kyrgyz Republic)	Project	1500	5.0	2.5

HPP = hydroelectric power plant.
Source: Water and Energy Resources in Central Asia: Utilization and Development Issues. April 2008. *EDB Industry Report* no.2. www.eabr.org/media/img/eng/research-and-publications/AnalyticalReports/Report_2_water_and_energy_EDB.pdf

Vakhsh and Dashtijum station on the Pianj River in Tajikistan. These facilities should help ease regional demand, and create opportunities to meet rising demand for electricity in the People's Republic of China, Iran, Pakistan, and the Russian Federation—once export transmission networks are in place.

As with other energy resources, issues surrounding hydropower exist. Increased upstream water usage changes hydrological dynamics, which further affect severely downstream neighbors who may suffer from reduced amount and quality of water. Then there is the wild card called climate change: the region's glaciers are melting at an accelerating pace, making water flow predictions problematic. Still, Central Asia's untapped hydropower potential has much to offer. Managed properly and invested in wisely, it could provide a steady source of clean, sustainable electricity to the region as well as neighboring nations for a long, long time.

Left: This solar furnace in Parkent, Uzbekistan, once used for testing missile components, is now being used for making exotic ceramics. It is claimed to be one of the oldest solar furnaces in the world. **Upper right:** Windmill in Karaganda Oblast, Kazakhstan, used by a farmers' association to generate electricity for remote areas. **Lower right:** A biogas installation in the Kyrgyz Republic.

WIND AND SUN – ALMOST LIMITLESS ENERGY POSSIBILITIES

Most of Central Asia consists of wide open expanses and corridors through which winds highly favorable for energy production blow. To put this in perspective, Kazakhstan, for example, produced 76.3 billion kilowatt-hours (kWh) of electricity in 2007, 85% of which came from coal. In the east of the country, an area called the Djungar Gate—said to have the best wind climate in the world—could alone generate more than 300 billion kWh of electricity annually. Other excellent wind power sites are scattered through the country. Costs of a recent 5-megawatt plant are similar to those of a coal-fired plant and will become relatively cheaper if fossil fuels become taxed for their role in climate change. Kazakhstan has the opportunity to not only replace "dirty" coal with "clean" wind power for its domestic needs but also have a large excess for export.

Conventional solar energy, using photovoltaic cells, and thermal solar power, in which mirrors concentrate sunlight to heat a liquid substrate, which generates steam for thermal power, are also highly feasible options for the region, given its abundant sunlight. Production costs are estimated to be cheaper than for gas and less infrastructure is required. Development can take place in arid areas, offering almost limitless potential.

Despite its massive hydrocarbon reserves, Kazakhstan already has a wind power program and is exploring other energy sources. In Uzbekistan, the focus is on solar power, especially for remote areas where costs of solar power are now often cheaper than constructing high-voltage power lines. Small-scale solar power plants are spreading rapidly in the Kyrgyz Republic as costs relative to carbon-based fuels fall.

Other countries are slower to diversify their energy programs. Turkmenistan, for instance, also has very good areas for wind power generation along the Caspian Sea shores and throughout the central desert. Solar energy potential is also extremely good. Several geothermal reservoirs have been discovered with overall potential of some 6,000 megawatts. Yet, because of the country's abundant gas reserves, alternative energy sources have not been seriously considered. Tajikistan and the Kyrgyz Republic, already relying mainly on hydropower, see this source as having the best future energy potential and plan to augment large hydropower stations with small and micro hydropower plants.

Biofuel is being considered in Uzbekistan, where the big cotton-growing areas produce enough waste to produce up to 10 million gallons of ethanol per year.

Biogas generated from animal and agricultural waste is an energy source being used in the Kyrgyz Republic. Current facilities produce 2 million cubic meters of biogas and 70,000 tons of fertilizer annually. The country has potential for 100 times this amount and more than enough fertilizer to repair the damage caused by past land degradation—at attractive prices.

REAPING BENEFITS FROM ENERGY WEALTH

To ensure sustainable development and protect against effects of global climate change, Central Asia would benefit from focusing on energy efficiency and clean energy, for example, through retrofits for greenhouse gas mitigation, elimination of gas flaring, and development of renewable energy sources. Cleanup of and reduction in pollution from hydrocarbon and mineral extraction are further outstanding needs.

Economic reliance on one or a few resource commodities makes a nation susceptible to global price fluctuations. One way to ward against these and other potential consequences is to diversify energy production to include clean energy sources, particularly thermal solar and wind power.

Mineral Resources

Geologists' Paradise

■ Ust-Kamenogorsk's lead smelter is the largest in Kazakhstan. **Upper right:** Galena (lead sulfide) crystals. **Lower right:** The head of the refining shop at Kazzink JSC Turarbek Azekenov, the largest gold producer in Kazakhstan, shows a gold ingot.

With minerals from A to Z, Central Asia is rich in variety, number, and size of mineral deposits. Arsenic, bauxite, boron, bismuth, copper, chromium, iron, lead, manganese, mercury, salt, silver, titanium, tungsten, uranium, and zinc are just a few of the minerals found in significant quantity. In addition, countries of the region hold some of the world's largest shares of some of these minerals—chromium, gold, and uranium among them.

A Rich Mineral Mix

KAZAKHSTAN

Although its petroleum industry powers economic growth, Kazakhstan's economy depends heavily on mineral production. It is the largest producer of minerals in the region, with extensive reserves of a broad range of industrial minerals and metallic ores and a thriving metallurgical sector. In 2004, mineral extraction accounted for roughly a third of Kazakhstan's gross domestic product. The overall production value of metal and other ores increased more than four and five times, respectively, during 2000–2004.

Kazakhstan is a world leader in reserves of coal, chromite, lead, zinc, and uranium (for coal and uranium, see Energy Resources chapter). In 2005, Kazakhstan's production of ferrous minerals included bauxite, chromite, copper, iron, lead, manganese, and zinc ores; its metallurgical sector produced such metals as beryllium, bismuth,

Production of Mineral Commodities in Kazakhstan, 2005
(Metric tons unless otherwise specified)

Commodity	Production volume
Metals	
Aluminum: bauxite	4,800,000[e]
Arsenic trioxide	1,500
Cadmium, metal	2,000[e]
Chromite	3,579,000
Copper, mine output, Cu content	402,000
Gold: refined (kilograms)	9,788
Iron and steel: Iron ore, Fe content	9,300,000[e]
Lead: Pb content	44,000
Manganese ore, crude ore, gross weight:	2,207,700
Molybdenum, concentrate, Mo content	230
Nickel, Ni content of laterite ore	193
Rhenium (kilograms)	8,000
Silicon	95,000
Silver, mine output, Ag content (kilograms)	832,000[e]
Titanium sponge	19,000
Vanadium, Va content	1,000
Zinc, mine output, Zn content	400,000[e]
Industrial Minerals	
Asbestos, all grades	355,000[e]
Barite	120,000[e]
Boron (thousand metric tons)	30
Cement	3,974,800
Clays, kaolin	70,000
Gypsum	820,000
Phosphate rock, gross weight	230,000[e]

[e]Estimated.
Source: US Geological Survey. 2005. *Minerals Yearbook.* http://minerals.usgs.gov/minerals/pubs/myb.html

Mineral Deposits of Central Asia

1:10 000 000

200 100 0 200

Kilometers

RUSSIAN FEDERATION

KAZAKHSTAN

UZBEKISTAN

TURKMENISTAN

KYRGYZ REPUBLIC

TAJIKISTAN

AZERBAIJAN

IRAN

AFGHANISTAN

PEOPLE'S REPUBLIC OF CHINA

Petropavlovsk
Kostanai
Pavlodar
Oskemen
ASTANA
Karaghandy
Aktobe
Oral
Atyrau
Aktau
Kyzyl Orda
Taraz
Shymkent
Almaty
BISHKEK
Karakol
Talas
Naryn
TASHKENT
Namangan
Jalalabat
Andijan
Fergana
Osh
Gulistan
Khudzand
Djizzak
Samarkand
Navoi
Bukhara
Urgench
Dashkhovuz
Balkanabat
Turkmenabad
Karshi
DUSHANBE
Kulyab
Kurgan-Tyube
Termez
Khorog
Mary
ASHGABAT

Caspian Sea
Aral Sea
Lake Balkhash
Lake Issyk-Kul
Lake Zaisan

55°0'E
75°0'E
50°0'N
40°0'N

N

- National capital
- Provincial/oblast capital
- International boundary
- Rivers and canals

Deposits

Energy materials
- Coal
- Uranium

Ferrous metals
- Chromium
- Iron

Nonferrous metals
- Aluminum
- Copper, lead, zinc
- Gold

Industrial minerals
- Phosphorite

Boundaries are not necessarily authoritative.

Data sources:
Map of Central Asia and Kazakhstan, scale 1: 2,500,000, Ministry of Geodesy and Cartography of the Republic of Uzbekistan, Tashkent, 1995

Projection: Lambert Conformal Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin,
GIS-Service Ltd., Kyrgyz Republic, 2009

■ **Above left:** Smelting pots of antimony, one of many rare minerals found in the Fergana Valley, at the Kadamjai Antimony Complex in Kadamjai, Kyrgyz Republic. **Above right:** The Tarsunzade aluminum smelter in Tajikistan.

cadmium, copper, ferroalloys, lead, magnesium, rhenium, steel, titanium, and zinc. Industrial mineral and nonferrous mineral products included alumina, arsenic, barite, gold, molybdenum, phosphate rock, tungsten, and uranium.

Although the government maintains ownership of a substantial number of mineral production enterprises, there is also significant foreign ownership. The basis for this, as well as development of the mineral sector in general, is Kazakhstan's Constitution and body of laws and regulations that permit and govern private sector access to mineral rights.

KYRGYZ REPUBLIC

Gold dominates Kyrgyz Republic's mineral sector. This is because of the Kumtor gold mine, brought on line in 1997 by a Canadian mining company in one of Central Asia's biggest single foreign investments. Located deep in the Tien Shan mountains, Kumtor is reported to be one of the world's largest gold mines. In 2005, gold accounted for about one-tenth of Kyrgyz Republic's gross domestic product, and a third of its exports. Gold is found elsewhere as well; a government inventory in 2003 listed 19 primary and secondary gold deposits, with 15 deposits already having development licenses.

The Kyrgyz Republic produces other minerals also. Molybdenum and uranium are produced at the Kara-Balta mining and metallurgical complex, and mercury at the Hyderkhan kombinat. Barite, basalt, beryllium, bismuth, facing stone, rare earth elements, tin, and wolfraum (tungsten) are also mined. However, no mineral affects the economy like gold, making the country susceptible to the vagaries of the gold market. Before independence, mercury and antimony metal production topped the country's mineral sector. Opportunities for these and Kyrgyz Republic's other minerals invite investment.

Production of Major Mineral Commodities in the Kyrgyz Republic, 2005
(Metric tons unless otherwise specified)

Commodity	Production
Metals	
Antimony:	
Mine output, Sb content	10
Metal and compounds	500
Gold (kilograms)	16,700
Mercury:	
Mine output, Hg content	200
Metal	250
Molybdenum, mine output, Mo content	250
Industrial Minerals	
Cement	975,100
Fluorspar, concentrate	4,000
Kaolin	400,000[e]
Lime, dead-burned	9,500
Rare earths	NA
Salt	1,100[a]

[e]Estimated, NA = Not available.
Source: US Geological Survey. 2005. *Minerals Yearbook*. http://minerals.usgs.gov/minerals/pubs/myb.html

TAJIKISTAN

Due to its mountainous terrain, much of Tajikistan's mineral potential is in hard-to-reach places. Nevertheless, hundreds of mineral deposits have been explored. Tajikistan's deposits of antimony, boron, lead, and zinc occupied a leading place among reserves found in the former Soviet Union. Other minerals include bismuth, cadmium, copper, gallium, germanium, indium, iron, lead, molybdenum, mercury, salt, selenium, tellurium, thallium, and tungsten. The country is a significant producer of gold, and its Bol'shoy Konimansur deposit in the north is reported to contain one of the largest silver deposits in the world. In all, Tajikistan is said to be currently mining more than 70 types of deposits. The greatest mineral enterprise is the Tajik aluminum smelter (TadAz) in Tursunzade. With a production capacity of more than 500,000 tons, it ranks among the world's largest smelters and provides significant export revenue.

Upper left: Gold necklace from Bukhara, Uzbekistan, studded with precious stones. **Upper middle:** The Chimkent Industrial Union "Fosfor" in Kazakhstan is the largest phosphorus plant in the world, producing 70% of all the former Soviet Union's phosphorus. **Upper right:** Metalwork artisan works on a piece at Saifuddin Caravanserai, a crafts development center in Bukhara, Uzbekistan. **Lower:** Gypsum deposits in the beautiful Koytendag caves, Turkmenistan.

Production of Mineral Commodities in Tajikistan, 2005
(Metric tons unless otherwise specified)

Commodity	Production
Metals	
Aluminum, primary	379,630
Antimony, Sb content of concentrate	2,000
Gold (kilograms)	3,000
Lead, Pb content of concentrate	800
Mercury, Hg content of concentrate	30
Silver, Ag content of concentrate (kilograms)	5,000[e]
Industrial Minerals	
Cement	253,100
Fluorspar	9,000
Gypsum	8,300[r]
Nitrogen, N content of ammonia	45,000[e]

Note: Tajikistan produces other mineral commodities for which information is inadequate to derive estimates, thus not included in the list.
[e]Estimated. [r]Revised.
Source: US Geological Survey. 2005. *Minerals Yearbook*. http://minerals.usgs.gov/minerals/pubs/myb.html

Production of Mineral Commodities in Turkmenistan, 2005
(Metric tons unless otherwise specified)

Commodity	Production
Industrial Minerals	
Bentonite	50,000
Bentonite powder	250
Bischofite	100
Bromine (kilograms)	150,000
Cement	450,000
Ferrous bromide, 51% Br	85
Gypsum	100,000
Iodine	270,000
Lime	16,000
Nitrogen, N content of ammonia	85,000
Salt	215,000
Sodium sulfate	60,000
Sulfur	9,000

Note: In addition to the commodities listed, Turkmenistan produces other mineral commodities for which information is inadequate to derive estimates.
Source: US Geological Survey. 2005. *Minerals Yearbook*. http://minerals.usgs.gov/minerals/pubs/myb.html

TURKMENISTAN

In addition to its substantial oil and gas reserves, Turkmenistan has a broad range of industrial mineral resources that are unevenly dispersed throughout the country. There are more than 150 nonfuel mineral deposits, including barite, bentonite, carbonate material for soda production, celestite, kaolin, marble onyx, mineral salts, natural pigments, and sulfur. Also reported is a host of construction materials, such as facing stone, filling stone, raw materials for cement, and gypsum.

In 2005, all mineral production entities were still state owned. Development of deposits was undertaken by enterprises under the jurisdiction of the state and its ministries. However, the state has recently allowed some foreign involvement through joint-venture arrangements.

UZBEKISTAN

Uzbekistan is a world leader in reserves as well as in the production and export of gold and uranium. It is an important producer and processor of other ores as well, and counts more than 2,800 deposits, containing over 100 types of minerals. Detailed exploration has occurred in more than 100 deposits, leaving much left to explore. Ferrous minerals in production include copper, iron, lead, manganese, and zinc. Production of nonferrous minerals, the leading mineral sector in production, includes bauxite, gold, molybdenum, silver, tungsten, and uranium. Industrial minerals include cement, clays, feldspar, graphite, iodine, nitrogen, phosphate rock, and sulfur.

Two of the largest enterprises in the country are mining and metallurgical-producing complexes: Almalyk complex, which handles copper, gold, lead, and zinc; and the gold- and uranium-producing Navoi complex. Although the state

Production of Mineral Commodities in Uzbekistan, 2005
(Metric tons unless otherwise specified)

Commodity	Production
Metals	
Aluminum, secondary	3,000
Copper, mine output, Cu content	100,000
Gold (kilograms)	90,000
Molybdenum, mine output, Mo content	500
Rhenium (kilograms)	NA
Silver, mine output (kilograms)	83,000
Steel, crude	607,253
Zinc, metal, smelter, primary	30,000
Industrial Minerals	
Cement	5,068,000
Clays, kaolin	5,500,000
Feldspar	4,300
Graphite	60
Iodine (kilograms)	2,000
Nitrogen, N content of ammonia	850,000[e]
Phosphate rock, gross weight	430,000
Sulfur:	
By-product, metallurgy	170,000
Sulfuric acid	740,500

[e]Estimated, NA = Not available.
Source: US Geological Survey. 2005. *Minerals Yearbook*. http://minerals.usgs.gov/minerals/pubs/myb.html

dominates the mining industry and holds monopolies on some minerals, private investment is permitted and has taken the form of joint ventures with the government. In 2004, the share of enterprises that were privately owned topped 90% in the construction material, and ferrous and nonferrous metallurgy sectors.

Impacts of Mineral Extraction

Mining operations can significantly affect the environment. Damage depends mostly on topographical conditions, means of extraction, and soil characteristics. The earth's soil and topography largely evolved through a slow and complex series of changes; biota have adapted accordingly.

World leaders in gold deposits

Throughout history, no mineral has enjoyed more universal value or appeal than gold. It is as precious for its beauty as it is as a hedge in troubled markets. Gold is a leading export of both the Kyrgyz Republic and Uzbekistan, and is mined in Kazakhstan and Tajikistan as well. The region's largest deposits are in the middle and southern Tien Shan gold belt in the Kyrgyz Republic and Uzbekistan. Other major deposits are found in the Makmal gold mining complex and the Sary-Dzhasskiy, Soltan-Sary, and Terek-Sayskiy gold mines.

Uzbekistan's open pit Muruntau gold mine in the Central Kyzylkum area contains one of the largest deposits in the world. Other significant gold deposits are located in the nearby Amantaytau goldfields, and the Zarmitan field in Samarkand. In 2006, Uzbekistan ranked among the world's top 10 gold producers.

Gold ore.

Mineral extraction can unsettle long-established environmental balances within the earth and on its surface. Improper processing and transport of minerals, and poor storage and disposal of mineral waste add to the damage.

Mineral extraction in Central Asia during the Soviet era has caused significant damage to the region. Areas have been scarred by open pit mining and waste has accumulated at the dumps of mining complexes. Problems of safe storage of waste are exacerbated in the Kyrgyz Republic and Tajikistan by natural disasters, such as landslides and earthquakes, which are common occurrences.

Large amounts of uranium waste exist in Central Asia as a consequence of over 50 years of uranium ore mining and processing enterprises after the Second World War. Uranium tailing wastes exceed 100 million tons in the Kyrgyz Republic, Tajikistan, and Uzbekistan, while about 13% of Kazakhstan's territory is contaminated by radionuclides. Dump sites of radioactive waste continue to be sources of radiation and there remains the risk that radiation contamination will spread beyond existing contaminated sites.

Water Resources

Lifeblood of the Region

Water has long been the fundamental concern of Central Asia's peoples. Few parts of the region are naturally water endowed, and it is unevenly distributed geographically. This scarcity has caused people to adapt in both positive and negative ways. Vast power projects and irrigation schemes have diverted most of the water flow, transforming terrain, ecology, and even climate. On the one hand, powerful electrical grids and rich agricultural areas have helped the region flourish; on the other, water, air, land, and biodiversity have been degraded.

In this chapter, major river basins, inland seas, lakes, and reservoirs of Central Asia are presented. The substantial economic and ecological benefits they provide are described, along with the threats facing them—and consequently the threats facing the economies and ecology of the country themselves—as a result of human activities.

The Amu Darya River in Karakalpakstan, Uzbekistan, with a canal (left) taking water to irrigate cotton fields. **Upper right:** Irrigation lifeline, Dostyk main canal in Makktaaral Rayon in South Kasakhstan Oblast, Kazakhstan. **Lower right:** The Charyn River in the Balkhash Lake basin, Kazakhstan.

Major River Basins in Central Asia

1:10 000 000

200 100 0 200

Kilometers

N

55°0'E

75°0'E

50°0'N

40°0'N

RUSSIAN FEDERATION

KAZAKHSTAN

ASTANA

Lake Zaisan

Lake Balkhash

PEOPLE'S REPUBLIC OF CHINA

UZBEKISTAN

BISHKEK

KYRGYZ REPUBLIC

TASHKENT

TURKMENISTAN

TAJIKISTAN

DUSHANBE

ASHGABAT

AZERBAIJAN

Caspian Sea

Aral Sea

IRAN

AFGHANISTAN

1

2

- National capital
- International boundary
- Rivers and canals

River basins

- Amu Darya
- Balkhash-Alakol
- Ob-Irtysh
- Syr Darya
- Ural
- 1 Chui-Talas
- 2 Zarafshan

Boundaries are not necessarily authoritative.

Data sources:
IUCN-The World Conservation Union, the International Water Management Institute (IWMI), the Ramsar Convention Bureau, and the World Resources Institute (WRI). 2003. Watersheds of the World_CD. http://multimedia.wri.org/watersheds_2003/index.html
National Hydro-meteorological Service of Tajikistan, Map of Main River Basins in Tajikistan, Dushanbe, 2003
Institute Kazgiprovodhoz, Map of Main River Basins in Kazakhstan, Almaty, 2004

Updated by GIS-Service Ltd., 2009

Projection: Lambert Conformal Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd., Kyrgyz Republic, 2009

River Basin Facts

	Amu Darya	Syr Darya	Lake Balkhash	Chui-Talas	Ob-Irtysh	Ural	Zarafshan
Central Asian countries in basin	Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan	Kazakhstan, Kyrgyz Republic, Tajikistan, Uzbekistan	Kazakhstan	Kazakhstan, Kyrgyz Republic	Kazakhstan	Kazakhstan	Tajikistan, Uzbekistan
Source	Pianj and Vakhsh rivers, fed largely by water from melted snow	Naryn and Karadarya rivers	Ili, Karatal, Aksu, Lepsi, Chui-Sarysu, Kapal, Koksu rivers	Chui River, fed mainly by glaciers and melting snow; and Talas River, formed by the confluence of the Karakol and Uchkosha rivers.	Irtysh River (chief tributary of the Ob); Tobol and Ishim (tributaries of the Irtysh River).	Ural River	Most upstream weir of the irrigation system for the Karakul Oasis, considered the "mouth" of the Zarafshan River
Recipient	Aral Sea	Aral Sea	Lake Balkhash	Desert sink	Arctic Ocean	Caspian Sea	Desert sink
Basin area (square kilometers)	534,739	782,617	512,015	Chui: 62,500, Talas: 52,700 Total: 115,200	1,673,470	244,334	12,200
Share of irrigated cropland (% of basin area)	0.4	5.4	1.9	Chui: 3.0, Talas: 3.0, Total: 6.0	3	0.9	No data

Sources: International Union for Conservation of Nature (IUCN), the International Water Management Institute (IWMI), the Ramsar Convention Bureau, and the World Resources Institute (WRI). 2003. *Watersheds of the World.* http://multimedia.wri.org/watersheds_2003/index.html

United Nations Economic Commission for Europe 2007. *Our Waters: Joining Hands Across Borders.* www.unece.org/env/water/publications/pub76.htm

ADB. 2007. Final Report—RETA 6163: Improved Management of Shared Water Resources in Central Asia. Volume I: Improving Trans-Boundary Water Management on a Pilot Basis (Chui and Talas River Basins). Manila.

River Basins

Seven major basins feed the region: the Amu Darya, Balkhash, Chui and Talas, Ob and Irtysh, Syr Darya, Ural, and Zarafshan. Most water resources come from the Amu Darya and Syr Darya rivers, along whose banks farmers have planted for millennia.

Over the past century, the nature of these rivers has changed as a result of increasing human activities. Large dams and reservoirs in upstream parts of the Amu Darya and Syr Darya have significantly affected downstream flow regimes. Diversion of huge volumes of water for agriculture and industry further changed the hydrological regimes downstream and diminished river deltas.

Renewable groundwater forms naturally in catchment areas and by filtration in irrigated lands. The return flow from fields to rivers adds significant volumes to water resources, but it also takes salts and pollutants into the rivers, reducing the productivity of natural land areas, rivers, and reservoirs.

Global climate change has also affected the river basins throughout Central Asia. Mountain glaciers are gradually melting and resulting in significant changes in river flows as well as changing the ecology of the basins themselves.

Flood damage, both from glacier melt and untimely release of waters from reservoirs for hydropower generation, is a serious transboundary problem. Cooperative water management among the region's five countries is key to protecting water resources. It must provide for the sustainable, multipurpose use of transboundary watercourses for such vital interests as irrigation, urban/communal water supply, hydropower, and fishing.

The Ural River in West Kazakhstan.

Upper: The Amu Darya River shortly before drying out in the Aral Sea in Moynaq town, former fishing port on the Aral Sea, now 180 km from the sea. **Lower:** Water comes to the desert with the Karakum Canal; photo taken in the 1970s.

AMU DARYA RIVER BASIN

The Amu Darya River, called the Oxus in the ancient Greek period, begins in Tajikistan as the confluence of the Pianj River (which begins in Afghanistan and forms its border with Tajikistan for several hundred kilometers) and Vakhsh River (which begins in the Kyrgyz Republic). The Amu Darya basin—534,700 square kilometers in all—unfolds westward from the mountains of the Kyrgyz Republic and Tajikistan, descending and contracting into the Karakum Desert of Turkmenistan and Uzbekistan as the river arcs gradually clockwise to the southern end of the Aral Sea, a total distance of 2,400 kilometers. The river splits into a delta with numerous arms as it approaches the Aral Sea. But in dry years since the 1960s, its waters, exhausted from diversion for irrigation, do not reach the sea.

Near the river's entrance into Turkmenistan, the Soviets built the Karakum Canal, the longest such structure in the world, that takes a third of the Amu Darya's water and sends it to the parched southwestern parts of Turkmenistan to irrigate expanding cotton-growing areas.

Various other transboundary rivers, including the Pamir, Kafirnigan, Surkhan Darya, and (formerly) Zarafshan rivers, flow into the Amu Darya basin. All the rivers in the basin influence the system to some extent. Some of the Pianj River's water, for example, is diverted for irrigation. Its catchment includes the dangerous Sarez Lake, described below. On the Vakhsh River in Tajikistan, the planned extension of a mining and aluminum processing plant in Tursunzade could have

Amu Darya River Basin Facts

Basin area (square kilometers)	534,739
Average population density (people per square kilometer)	39
Cities (100,000 or more people)	9 (Bukhara, Chadzhev, Dushanbe, Kashi, Mazar-E Sharif, Navoi, Nuku, Samarkand, Urgench)
Land Cover and Use	**Area, % basin area**
Forest	0.1
Grassland, savanna, and shrubland	57.3
Wetlands	0.0
Cropland	22.4
Irrigated cropland	7.5
Dryland	77.8
Urban and Industrial	3.7
Loss of original forest cover	98.6
Economy	Agriculture: cotton, wheat, rice, silkworm breeding, cattle breeding. Industry: hydropower, mining and aluminum processing, chemical industry, light industry.
Environmental Issues	Heavy disturbance by water management activities in Surkhan Darya tributary. Sarez Lake is a potential threat to population living near the middle and lower Amu Darya. Mineralization as a result of discharge of collector-drainage waters. Soil salinity, decreased soil fertility. Drought.

Sources: International Union for Conservation of Nature (IUCN), the International Water Management Institute (IWMI), the Ramsar Convention Bureau, and the World Resources Institute (WRI). 2003. *Watersheds of the World.* http://multimedia.wri.org/watersheds_2003/index.html

United Nations Economic Commission for Europe. *Our Waters: Joining Hands Across Borders.* 2007. www.unece.org/env/water/publications/pub76.htm

Amu Darya Basin

- National capital
- Provincial/oblast capital
- Rivers and canals
- International boundary

Hydropower plant

- < 1 million kilowatts
- 1–3 million kilowatts
- Under construction or suspended
- Amu Darya River Basin

Boundaries are not necessarily authoritative.

1:7 000 000

100 50 0 100 200

Kilometers

Data sources:
IUCN-The World Conservation Union, the International Water Management Institute (IWMI), the Ramsar Convention Bureau, and the World Resources Institute (WRI). 2003. Watersheds of the World_CD. http://multimedia.wri.org/watersheds_2003/index.html.
Updated by GIS-Service Ltd., 2009

Projection: Equidistant Conic
Datum: WGS 1984

GIS/Cartography: V. Sibagatulin, GIS-Service Ltd., Kyrgyz Republic, 2009

repercussions on users downstream, not least because a large reservoir is needed for hydropower to run the plant.

As the Amu Darya travels through Turkmenistan and then Uzbekistan, it receives returned water from irrigation and groundwater, which add pollutants from agriculture (pesticides and fertilizer), industry (toxic chemicals), and domestic sources. Health problems from drinking the water are common.

Soil erosion from upstream countries causes sediments to build up downstream along the river and Karakum Canal, and almost complete silting up of the Kalif lakes. The average capacity of the canal and the reservoirs on the river has fallen by more than half as a result. The sediments also damage irrigation infrastructure. The new Zeid reservoir is expected to take up much of the sedimentation in the Karakum Canal. But there are other issues: parts of the canal have not been maintained and huge losses from seepage and leakage occur; also the flood approach to irrigation results in salinization of the soil and returned water to the canal.

Upper: The meandering Syr Darya River in the Kyzyl Orda region, Kazakhstan. **Lower:** Sunset along the Syr Darya River near the city of Kyzyl Orda.

SYR DARYA RIVER BASIN

The Syr Darya River has its origins in the Fergana Valley, where two large rivers—the Naryn and Karadarya—that flow down from the Tien Shan Mountains in the Kyrgyz Republic into Uzbekistan, meet in the eastern part of the valley in Uzbekistan. From Tajikistan, the Syr Darya enters Kazakhstan where it makes a long counterclockwise arc into the northeastern edge of the Aral Sea, marking the northeasterly edge of the Kyzylkum Desert.

The Syr Darya basin covers some 800,000 square kilometers, over the river's course, a distance of about 2,200 kilometers. However, only a quarter of that area provides water into the system and its annual flow of roughly 37 cubic kilometers is small compared to that of its sister, the Amu Darya (97 cubic kilometers), which has a smaller basin area.

Syr Darya River Basin Facts

Basin area (square kilometers)	782,700 (of which 218,400 are in Kazakhstan)
Average population density (people per square kilometer)	26
Cities (100,000 or more people)	11 (Andizhan, Bishkek, Dhambul, Dzhizak, Fergana, Kyzyl Orda, Namangan, Osh, Shymkent, Tashkent, Zhezkazgan)

Land Cover and Use	**Area, % basin area**
Forest	2.4
Grassland, savanna, and shrubland	67.4
Wetlands	2.0
Cropland	22.2
Irrigated cropland	5.4
Dryland	93.7
Urban and industrial	3.2
Loss of original forest cover	45.4

Economy	Agriculture: cotton, wheat, rice; cattle breeding. Industry: hydropower, manufacturing, chemical industry, light industry.
Environmental Issues	Changing hydrological river regime. Soil salinity, decreased soil fertility. Drought. In downstream, frequent flooding of human settlements during winter. Water pollution by industrial wastewater and agriculture in Kazakhstan, Tajikistan, and Uzbekistan. Mineralization as a result of discharge of collector-drainage waters.

Sources: International Union for Conservation of Nature (IUCN), the International Water Management Institute (IWMI), the Ramsar Convention Bureau, and the World Resources Institute (WRI). 2003. *Watersheds of the World.* http://multimedia.wri.org/watersheds_2003/index.html

United Nations Economic Commission for Europe. 2007. O*ur Waters: Joining Hands Across Borders.* www.unece.org/env/water/publications/pub76.htm

Syr Darya Basin

- National capital
- Provincial/oblast capital
- Rivers and canals
- International boundary

Hydropower plant

- < 1 million kilowatts
- 1–3 million kilowatts
- Under construction or suspended
- Syr Darya River Basin

Boundaries are not necessarily authoritative.

1:7 000 000

100 50 0 100 200

Kilometers

Data source:
IUCN-The World Conservation Union, the International Water Management Institute (IWMI), the Ramsar Convention Bureau, and the World Resources Institute (WRI). 2003. *Watersheds of the World*_CD. http://multimedia.wri.org/watersheds_2003/index.html
Updated by GIS-Service Ltd., 2009

Projection: Equidistant Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd., Kyrgyz R epublic, 2009

In the basin headwaters, the Naryn River already contains pollutants from industrial and domestic wastes, discharges from livestock breeding, and wastes from ore mining. The Syr Darya's waters change further as they pass through the Fergana Valley. In both Tajikistan and Uzbekistan, industrial wastewater and agricultural return water from irrigation cause significant pollution, which only increases as the river continues through industrial areas, croplands, and livestock breeding areas of Kazakhstan.

The Syr Darya's course is punctuated by hydropower stations and large reservoirs, such as the Kajrakkum and Chardarin. Much of its water is used for irrigating the major cotton-growing areas of the region. Nevertheless, downstream flooding occurs in winter, particularly in Kyzyl Orda, Kazakhstan, due to water release from the Toktogul Reservoir in the Kyrgyz Republic for hydropower production. Yet, floods become droughts: there is sometimes not enough water to satisfy irrigation and other human needs.

Reservoir on the Naryn River, before it joins the Karadarya River to become the Syr Darya.

Above: Beach on Lake Balkhash contrasts with industry from the city of Balkhash. Lake Balkhash could face a similar fate as the Aral Sea if water management in flowing rivers is not improved. **Right:** Lake Balkhash seen from the space shuttle Discovery.

LAKE BALKHASH BASIN

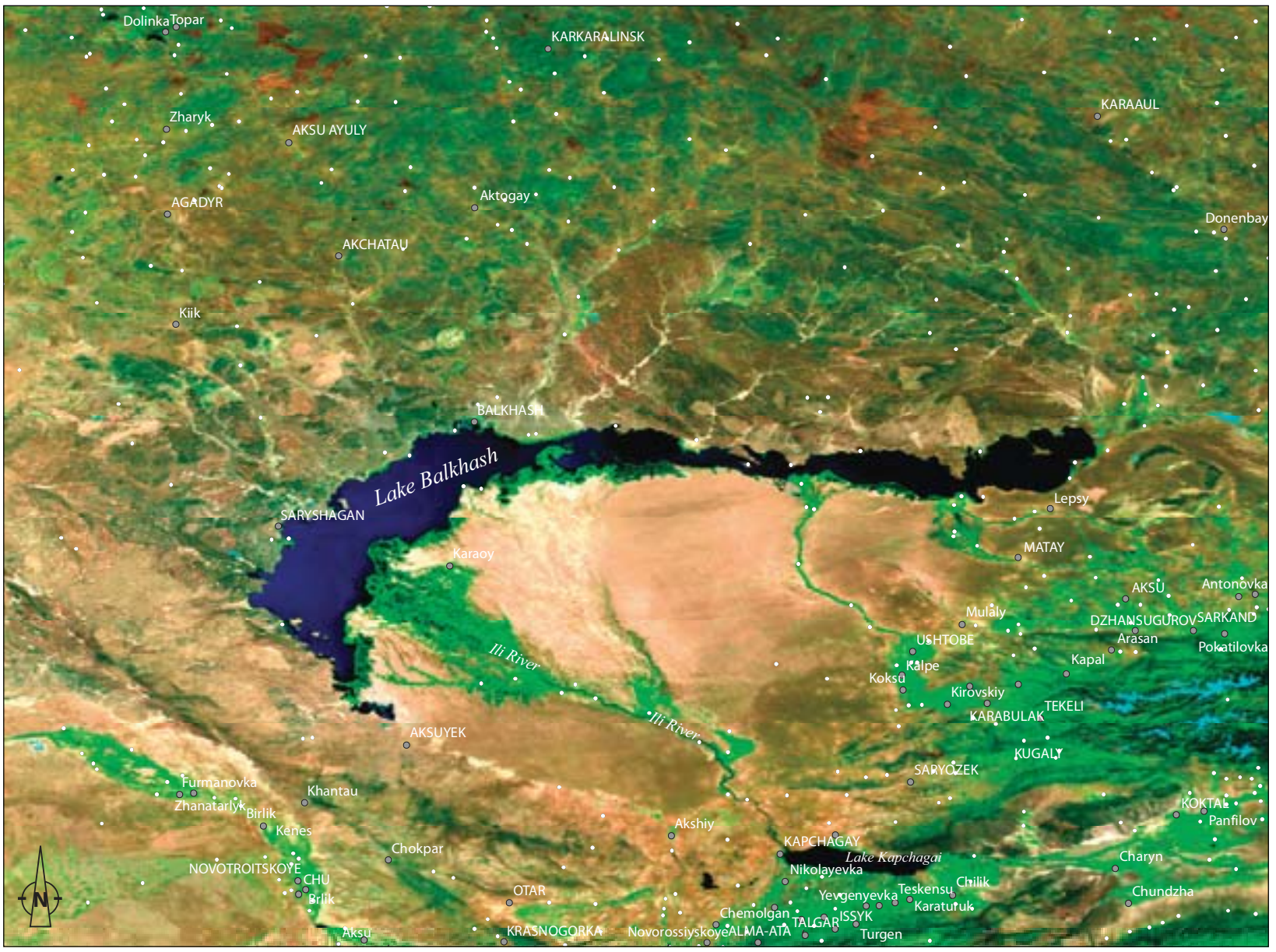
Sharing its area rather equally between south-eastern Kazakhstan and northwestern People's Republic of China, Lake Balkhash basin is one of the planet's largest lake ecosystems. Its varying elevation levels are also the most diverse of any basin in Central Asia. Three major rivers in the basin drain into crescent-shaped Lake Balkhash. Chief among them is the Ili, which provides 80% of the lake's river flow. Lake Balkhash is an important fishery and reservoir, and the Ili forms a large lake delta with wetlands that are rich in biodiversity and forage for animals. Other rivers, including the Karatal, provide surface and subsurface flow. All help feed the more than 24,000 lakes and reservoirs found in the basin.

Lake Balkhash Water Basin Facts	
Basin area (square kilometers)	512,015
Average population density (people per square kilometer)	11
Cities (100,000 or more people)	2 (Almaty, Taldykorgan in Kazakhstan)
Land Cover and Use	**Area, % basin area**
Forest	4.0
Grassland, savanna, and shrubland	61.1
Wetlands	4.7
Cropland	23.2
Irrigated cropland	1.9
Dryland	94.5
Urban and industrial	1.5
Loss of original forest cover	26.3
Economy	Agriculture: rice, cattle breeding, poultry, and pig farming. Mining.
Environmental Issues	Unsustainable water use. Desertification, loss of agricultural lands and productivity. Ecologically disruptive mining. High level of water pollution due to industrial wastes. Overall decline in biodiversity, declining ecosystems.

Sources: International Union for Conservation of Nature (IUCN), the International Water Management Institute (IWMI), the Ramsar Convention Bureau, and the World Resources Institute (WRI). 2003. *Watersheds of the World.* http://multimedia.wri.org/watersheds_2003/index.html

Kreuzberg, E. 2005. Ecosystem Approach in Basin Management in Central Asia: from Theory to Practice (on the Example of Ili-Balkhash basin). CAREC: Almaty. p2.

Lake Balkhash



60 30 0 60 Kilometers

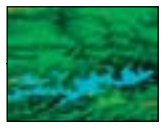
1:4,500,000

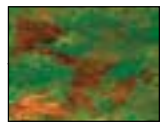
City
Town

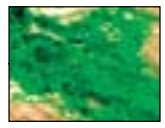

Bare Area/
Sparsely Vegetated


Pastureland


Pastureland


Mixed Vegetation/
Snow


Pastureland/
Burnt Area


Irrigated Land


Desert

Satellite Image: MODIS (MOD09GA, 500m)
Image Acquisition Date: 28 August 2008
Projection: Geographic, WGS84

Prepared by C. Y. Ji, 2009

This ready supply of water has brought increasing agriculture and industry to the area. Today, more than 3 million people live in the basin, over 600,000 of them in Almaty, Kazakhstan's business center and former capital. Economic development has meant construction of dams and reservoirs, and irrigation projects for hydropower, freshwater, and irrigation.

While there is more than enough water to support current agricultural practices, the irrigation and drainage systems used in Kazakhstan for growing rice and other crops have affected the hydrology of Lake Balkhash, compounded by decreases in Ili River flow caused by increased water use from an expanding population in the parts of the basin in the People's Republic of China. This has led to degradation of the lake's coastal areas, and aquatic and wetland ecosystems. It is also resulting in diminishing lake size and salinization, placing Lake Balkhash in jeopardy of becoming a second Aral Sea. Lake Balkhash plays an important role in maintaining the region's natural and climatic balance, making its protection a vital concern for all.

Upper left: A serene Chui River.
Lower left: Irrigation canal in Chui oblast.
Right: Rapids in the upper Chui River.

CHUI AND TALAS RIVER BASINS

The Chui and Talas river basins rest within the eastern section of the Turan depression and northern Tien Shan Mountains. The Chui River basin encloses 62,500 square kilometers, of which 35,900 are in Kazakhstan and 26,600 in the Kyrgyz Republic. The length of the Chui Valley is 1,186 kilometers (km), with 850 km in Kazakhstan. The Talas basin encloses 52,700 square kilometers—41,270 in Kazakhstan and 11,430 in the Kyrgyz Republic. The Talas River is 444 km long, with 217 km in the Kyrgyz Republic.

The climate of the basins changes as the rivers descend from an elevation of 2,400 meters in highly mountainous and mountainous steppe zones in the Kyrgyz Republic to mountainous steppe, desert-steppe, and desert zones at 500 meters elevation in Kazakhstan. Water resources for the two basins come from surface, subsurface, and return waters, with average annual flows of 6.64 and 1.62 cubic kilometers for the Chui basin and Talas basin, respectively.

The combined population of the basins is approximately 1.6 million, with a population density in the Chui basin—which contains the Kyrgyz Republic's capital Bishkek—far higher than that in the Talas basin. Agriculture plays a dominant role in the economy of each basin. More than two-thirds of total agricultural production come from irrigated lands, flood plains, and pastures. Agricultural processing, construction, and mining are the primary industries.

Water quality of both surface and subsurface water in the basins is considered satisfactory, but the basins are not without problems. Biodiversity is decreasing. There is soil erosion in foothill valleys and damage to riverbeds during flooding in the Kyrgyz Republic. Discharges of the Chui and Talas rivers have fallen in Kazakhstan, degrading delta lake systems, flood plains, and meadows. Pollution from domestic and livestock discharges, mining and processing industries, and transport is also a factor. Projected increasing socioeconomic development in the region between 2010 and 2020 could result in decreased water availability and even water deficits, making it vital to begin planning and implementing measures to protect the resources of these important basins.

Chui and Talas River Basin Facts

Basin area (square kilometers)	Chui: 62,500 Talas: 52,700 Total: 115,200
Average population density (people per square kilometer)	14
Economy	Agriculture. Industry: mining, agricultural processing, construction enterprises. Hydropower, underdeveloped.
Environmental Issues	Deforestation, decrease in biodiversity. Intensive soil erosion. Decreases in environmental discharges resulting in degradation of lake systems. Water pollution. Worsening status of water protection zones.

Sources: ADB. 2007. Final Report - RETA 6163: Improved Management of Shared Water Resources in Central Asia Volume I: Improving Trans-boundary Water Management on a Pilot Basis (Chui and Talas River Basins). Manila.

United Nations Economic Commission for Europe. 2007. *Our Waters: Joining Hands Across Borders.* www.unece.org/env/water/publications/pub76.htm

OB BASIN AND IRTYSH SUB-BASIN

The Ob River combines with its main tributary, the Irtysh, to form the Ob-Irtysh basin. This massive basin, which stretches from Mongolia to Western Siberia, empties into the Arctic Ocean. It falls mainly within the Russian Federation (73.8%), and Kazakhstan (24.7%), with the remaining 1.5% in the People's Republic of China and Mongolia. Included in the Ob basin is the Irtysh sub-basin. The catchment within the sub-basin marks Kazakhstan's primary contribution to the greater basin. The Irtysh River, 4,248 kilometers in length, begins in Mongolia's Altai Mountains and flows through the People's Republic of China and Kazakhstan (1,200 kilometers) before joining the Ob River in the Russian Federation. The Irtysh is fed by the Tobol and Ishim rivers, which begin in Kazakhstan.

Within Kazakhstan, the Irtysh is regulated by large hydroelectric power stations and serves as a transportation artery for the country's interior. Within the People's Republic of China, the Irtysh is used for irrigation, which severely decreases its flow. A proposed 300-kilometer irrigation canal there will further divert Irtysh water, and could result in economic and ecological damage in the greater basin.

The Irtysh River is severely affected by pollution from irrigation, mining, and wastewater. And it is primarily for this reason that Kazakhstan and the Russian Federation have embarked on joint projects to protect the river. Involving the People's Republic of China in the management of Irtysh waters is the next step. The Irtysh sub-basin is the main source of water for central Kazakhstan and its health is essential to the well-being of the region.

Ob-Irtysh River Basin Facts	
Water basin area square kilometers)	1,673,470
Average population density (people per square kilometer)	11
Cities (100,000 or more people)	12: Astana, Kamenogorsk/Oskemen (Kazakhstan), Sverdlovsk (Ukraine), Tyumen (Russia), Colyabinks, Kurgan, Kostanay, Kokshetau, Petropavlovsk, Omsk, Pavlodar, Semipalatinsk, Ust', Astrakhan (Russia)
Land Cover and Use	**Area, % basin area**
Forest	17.0
Grassland, savanna and shrubland	14.0
Wetlands	7.7
Cropland	51.4
Irrigated cropland	3.0
Dryland	—
Urban and industrial	5.4
Loss of original forest cover	52.0
Economy	Agriculture. Oil and gas. Hydroelectric power production. Water transport.
Environmental Issues	Decreased water flow because of high withdrawals for industry in the People's Republic of China. Severe water pollution from industry, mining, and agriculture.

Sources: International Union for Conservation of Nature (IUCN), the International Water Management Institute (IWMI), the Ramsar Convention Bureau, and the World Resources Institute (WRI). 2003. *Watersheds of the World*. http://multimedia.wri.org/watersheds_2003/index.html

United Nations Economic Commission for Europe. 2007. *Our Waters: Joining Hands Across Borders.* www.unece.org/env/water/publications/pub76.htm

Kostarev, S. 2008. Russian-Kazakh Transboundary Water Management Skills (the Irtysh River Basin). Paper presented at the conference on Water Resource Systems Management under Extreme Conditions, Moscow, 4–5 June. www.inbo-news.org/euro-riob/moscow/papers/2008_06_05_ECWATEK_Kostarev.pdf

Upper: The Irtysh River in spring in Pavlodar, Kazakhstan; the Blagoveshchensky Cathedral in the background. **Lower:** The city of Astana behind the Ishim River embarkment. The river is one of the tributaries of the Irtysh River.

Bridge over the Ural River at sunrise in Atyrau, Kazakhstan. The Ural separates Europe from Asia.

URAL BASIN

The Ural basin comprises some 244,000 square kilometers—more than 60% of which is in Kazakhstan—and stretches from the headwaters of the Ural River in the southeastern Ural Mountains of the Russian Federation to Kazakhstan's Caspian Sea Depression. Of the Ural River's 2,428 kilometers length, nearly half, 1,082 kilometers, is in Kazakhstan. The basin includes about 240 lakes, plus the human-made Iriklin Reservoir, which has a surface area of 260 square kilometers and storage capacity of 3,260 cubic kilometers.

The basin's living resources include the sturgeons. As the only unregulated river flowing into the Caspian Sea, the Ural River holds special advantages for these prized fish. For one, there are no large dams or weirs, so migrating sturgeon can swim unobstructed to upstream breeding grounds. For another, the river's meandering course and mostly natural floodplain offer ideal places for fish, especially sturgeon, to spawn. And it is why the transboundary Ural Basin Project has been set up to create and manage an International Ural Sturgeon Park. The park aims to preserve Ural sturgeon populations and provide a basis for restocking in other regions.

But the Ural River faces threats: major industrial pollution from the Russian Federation, and wastewater discharge from the Kazakh cities of Uralsk and Atyrau. Also contributing to pollution are surface water runoff, seepage from sewage ponds, and surface runoff from Caspian Sea oil sites. Somewhat mitigating this is spring snow melt, which releases large quantities of water into the river to flush contaminants accumulated during the rest of the year. And though overall pollution increased in the 1990s, there seems to have been a slight decrease in pollution since 2000—a very good sign.

Ural Water Basin Facts

Water basin area (square kilometers)	244,334
Average population density (people per square kilometer)	15
Cities (100,000 or more people)	4: Atyrau, Uralsk, Aktyubinsk (Kazakhstan), Orenburg (Russia)
Land Cover and Use	**Area, % basin area**
Forest	2.3
Grassland, savanna and shrubland	33.4
Wetlands	0.2
Cropland	59.3
Irrigated cropland	0.9
Dryland	100
Urban and industrial	4.2
Loss of original forest cover	32.3
Economy	Agriculture: fisheries. Industry: oil and gas.
Environmental Issues	High water pollution due to industry, municipal wastewaters, and surface runoff during flooding. Silting of Ural River mouth. Poaching of sturgeon.

Sources: International Union for Conservation of Nature (IUCN), the International Water Management Institute (IWMI), the Ramsar Convention Bureau, and the World Resources Institute (WRI). 2003. *Watersheds of the World.* http://multimedia.wri.org/watersheds_2003/index.html

Stolberg, F., O. Borysova, I. Mitrofanov, and P. Eghtesadi. 2006. *Caspian Sea, GIWA Global Regional Assessment.* Kalmar, UNEP. www.giwa.net/publications/r23.phtml

Anonymous. 2002. Identification of Priority Issues. In *Seven Major River Basins In Kazakhstan: Problem Identification And Prioritisation Workshop In Atyrau For The Ural-Caspian Basin Workshop Protocol.* 9 August. www.worldbank.org/eca/kazakhstan/water/Ural_eng.pdf

ZARAFSHAN RIVER BASIN

The Zarafshan, or Zeravshan, River basin has the honor of being Central Asia's most ancient seat of agriculture; the region's earliest cities were founded there.

But the nature of the Zarafshan River basin has changed over the past half century. Formerly, it was a sub-basin of the Amu Darya basin but its connection was lost as more and more water from the river and its 70 tributaries was diverted for irrigation.

Third largest river in Uzbekistan, the Zarafshan begins under the name of Mostchokh-Darya in a high glacier in Tajikistan and winds its way down the 180-kilometer long Zarafshan inter-mountain depression. The river continues through Tajikistan for a further 120 kilometers and then flows through the Zarafshan Valley, in the Samarkand area of Uzbekistan.

Tajikistan uses only about 8% of the river's discharge. Virtually all the remainder is used to irrigate more than 600,000 hectares in Uzbekistan, supporting its second most important agricultural center—in a country where agriculture is the main livelihood of the rural population. There are many dams and barrages along the way, and a great number of canals for irrigation and water supply. Formerly, the river connected the cities of Samarkand, Navoi, and Bukhara but now it no longer reaches Bukhara. What water remains flows out into and is swallowed by the desert, and well before the Zarafshan can connect with the Amu Darya.

Zarafshan River's waters—the only source of drinking water in the Samarkand area—have not been managed well. Pollution from irrigation return water and waste waters from cities, such as Samarkand, Kattakurgan, and Navoi, have reduced the water quality, while Uzbekistan's irrigation systems are in urgent need of rehabilitation if agricultural productivity losses through increasing leakage and poor drainage are to be overcome. This will become increasingly important in the future because Tajikistan is planning to tap the upper reaches of the Zarafshan for hydropower generation, which could further affect Uzbekistan's agricultural output.

Zarafshan River Basin Facts

Basin area (square kilometers)	12,200*
Average population density (people per square kilometer)	Densely populated*
Cities (100,000 or more people)	Bukhara, Navoi, Samarkand
Economy	Agriculture (Uzbekistan). Industry: mining (Tajikistan).
Environmental issues	Deterioration of water quality (high salinity, polluted waters) due to return water from irrigation and wastewaters from Samarkand, Kattakurgan, and Navoi.

*It is difficult to determine the size of the catchment area; this estimate is based on total area of the mountain part of the catchment.

Sources: United Nations Economic Commission for Europe. 2007. *Our Waters: Joining Hands Across Borders.* www.unece.org/env/water/publications/pub76.htm

Lal, R. et al. 2007. *Climate Change and Terrestrial Carbon Sequestration in Central Asia*. Routledge. USA.

Urchinov, Z.U. 1995. Fisheries in the Zarafshan River Basin. In *FAO Fisheries Circular* No. 894 FIRI/v9529. Rome. www.fao.org/docrep/V9529E/v9529E06.htm

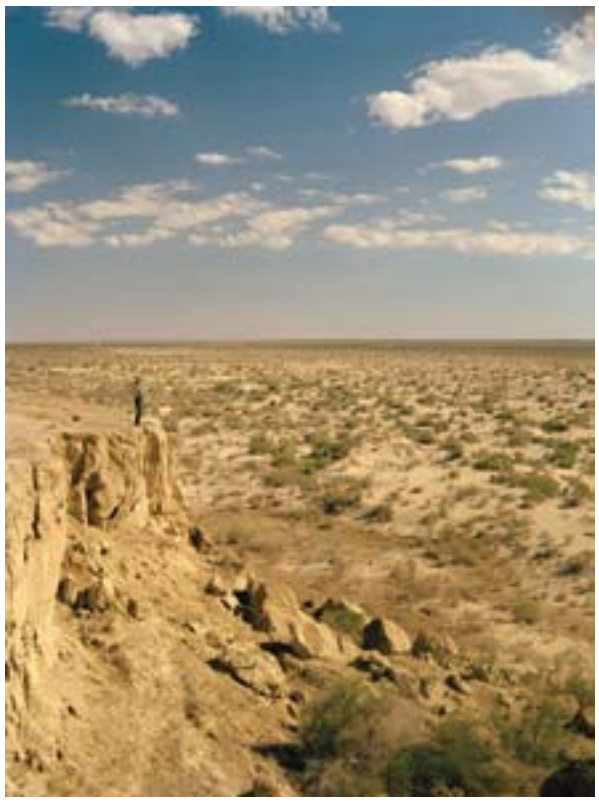
Upper: A helicopter takes tourists over the frozen upper reaches of the Zarafshan. **Lower:** The Zarafshan River in the Ayni district of Tajikistan.

Above: Salt-encrusted wastelands from the present shore of the Aral Sea. **Lower:** A person standing on a cliff near Moynaq town on the former shore of the Aral Sea, now 180 km away.

Two Inland Seas

ARAL SEA

Sharing its area with Kazakhstan and Uzbekistan, the Aral Sea was fed primarily by the Amu Darya and Syr Darya rivers. The Chui, Murgabi, Tadjen, and Talas rivers are also part of the Aral Sea basin. Their waters, however, are used for irrigation or lost in the plains and never reach the Aral Sea. And little of the Amu Darya water reaches there; most is diverted to irrigation, especially through the Karakum Canal in Turkmenistan.



In some ways there are two Aral Seas: the Aral Sea that was—the world's fourth largest inland lake, and the Aral Sea that is—a shrunken body of water that is gradually drying up. The Aral Sea that was existed until the late 1950s. It covered an area of 68,300 square kilometers, had a water surface of 66,100 square kilometers, a water volume of 1,066 cubic kilometers, and was teeming with life. It supported sea ports and a thriving commercial fishing industry, which peaked at an annual catch of 46,000 tons in the 1960s.

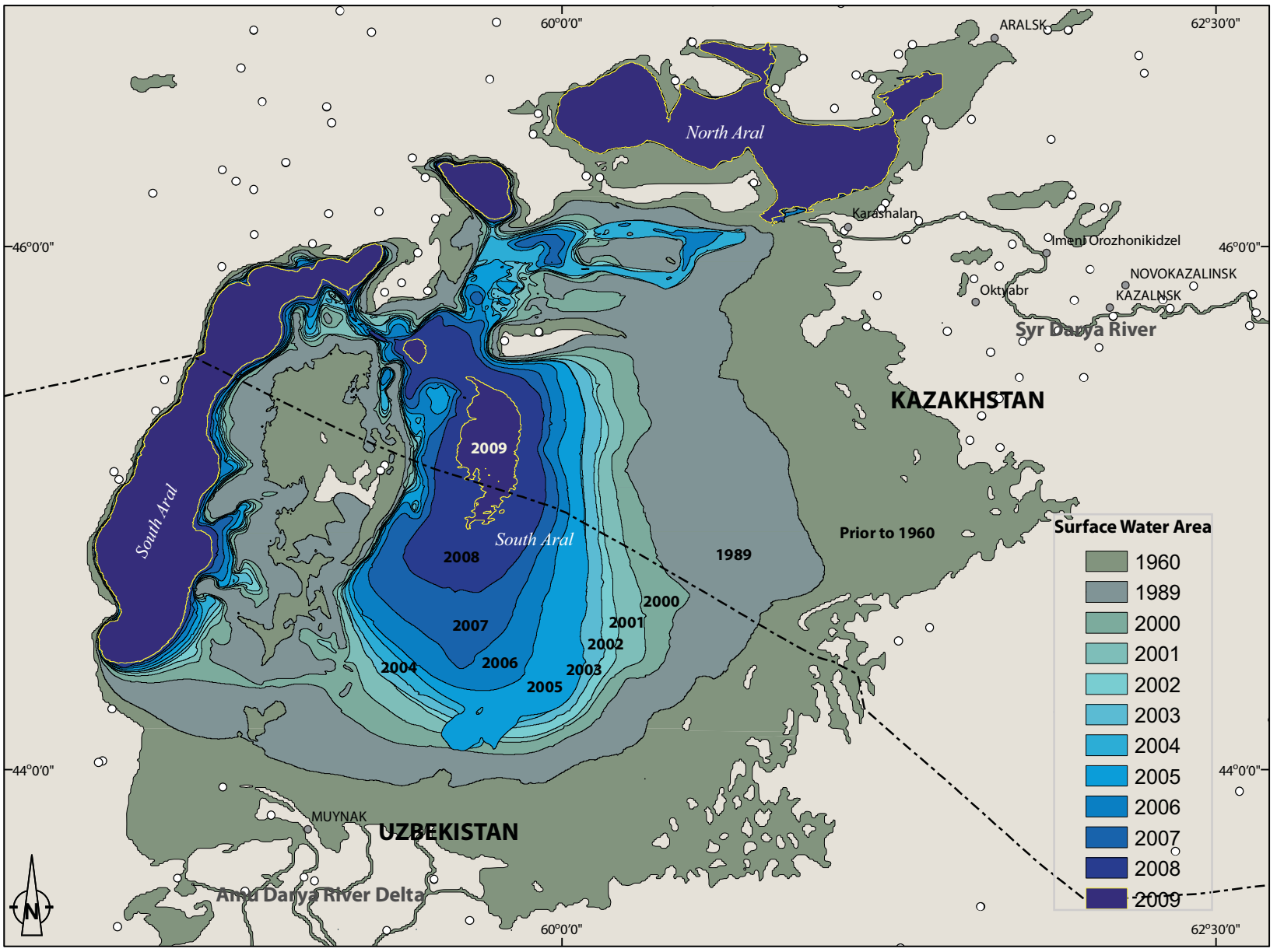
Formation of the Aral Sea that is began in the same decade, when much of the water from its primary tributaries, the Amu Darya and Syr Darya rivers, began to be diverted for power generation and irrigation for 7 million hectares of agricultural land—primarily planted to cotton. By the 1980s, water from the basins that feed these rivers was completely utilized and the Aral Sea began to shrink. By 1986, the sea had split into two bodies of water: the Big and Small seas. By 2002, water level in the Big Sea had fallen by 22 meters. By 2005, the Aral Sea had shrunk to half its former size and its water volume had diminished by 75%.

The incredible retreat of the Aral Sea shoreline has left towns and villages that were once thriving fishing ports stranded tens of kilometers inland. The once vibrant commercial fishing industry has virtually ceased to exist as reduced river flow to the Aral Sea, combined with pollutants from irrigation runoff, have killed plant and animal life, and left most of the sea virtually dead.

But the Small Sea, or North Aral Sea, in Kazakhstan is now recovering, thanks to the 13-kilometer

■ Large fishing vessels lie beached on what was once the shore of the Aral Sea.

Aral Sea



Boundaries of surface water area:
Prior to 1960: IUCN Elevation and Rivers Dataset
1989: Landsat TM
2000–2009: MODIS

Prepared by C. Y. Ji, 2009

Right: People walk across the Kokaral Dam on the North Aral Sea in Kazakhstan.

Kokaral dam completed in 2005, to separate it from the rest of the sea, and hydrological improvements in Kazakhstan's part of the Syr Darya River, which flows into the North Aral Sea. Four years later, the North Aral Sea surface area is already 50% higher than the lowest level and water is creeping back toward the former fishing town of Aral, 100 kilometers from the shore in 2005 and now only 35 kilometers away. There are plans for more dikes and canals to increase water levels further. Fish are returning and catches increasing dramatically as salinity levels fall to more normal conditions. At issue, however, is whether these works will worsen conditions in the rest of the Aral Sea.

CASPIAN SEA

To say the Caspian Sea is the world's largest inland body of water does not capture its immensity. To put its size in proportion, it is larger in area than America's Great Lakes or Africa's Lake Victoria, and contains 40% of the world's inland waters—some 78,100 cubic kilometers of water. It measures about 1,200 kilometers in length, 196-495 kilometers in width, and has an area of 378,000 square kilometers. It provides immense resources and invaluable shipping routes to the countries that share its 7,000-kilometer coastline: Armenia, Azerbaijan, Iran, Kazakhstan, the Russian Federation, and Turkmenistan.

The Caspian was once a part of the ancient Tethys Sea, which subsumed the Mediterranean, Black, and Aral seas. It became completely isolated during the mid-Pliocene Epoch, roughly 1 million years ago. The present sea is shallow in the north, with an average depth of 5 meters, and reaches a maximum depth of more than 1,000 meters in the south. More than 130 streams and rivers feed the Caspian, with a total annual inflow estimated at 300 cubic kilometers. Five rivers account for most of the freshwater inflow: the Kura, Sulak, Terek, Ural, and Volga. The Volga provides roughly 80% of the Caspian's total inflow. However, the Volga's water is heavily used for industrial and agricultural purposes, such that the flow into the Caspian now is only a tenth of the natural flow rate.

For almost a full century, the water level of the Caspian Sea slowly fell, until it began to rise again suddenly in 1977—and is still slowly rising—for reasons unknown. This natural cycle has masked the loss of river flow input. Thus, the Caspian remains apparently immune to humanity's efforts to tame it but its future is an uncertain one, which complicates development around its shores and efforts to rehabilitate inflowing river systems.

The sea's once-flourishing fisheries have declined due to damming of most rivers—which prevents some commercial species, including sturgeons for which the sea is famous, from migrating upriver to their spawning grounds—and pollution from agriculture, land-based industry, and the oil industry on the sea itself. Oil platforms dot the Caspian.

Fishing still provides a source of income for countries around its shores, but the greatest Caspian revenue comes from extraction of hydrocarbons. Estimates for Caspian region oil are as high as 49 billion barrels, while proven gas reserves are estimated at 232 trillion cubic feet. Both Kazakhstan and Turkmenistan contribute large amounts of oil-related and agricultural pollution to the Caspian. A major concern on the Kazakhstan coast is radioactive uranium waste in open pits: the Koshkarata dumping ground near the sea contained more than 400 million tons of toxic and radioactive waste by 1965.

Rehabilitation may be around the corner. A European Union–funded Regional Water Quality Monitoring Programme and Pollution Action Plan for specific areas included surveys of Kazakhstan and Turkmenistan waters in the Caspian. But workable and enforceable solutions still seem far off, given the Caspian countries' reluctance to cooperate on these matters so far.

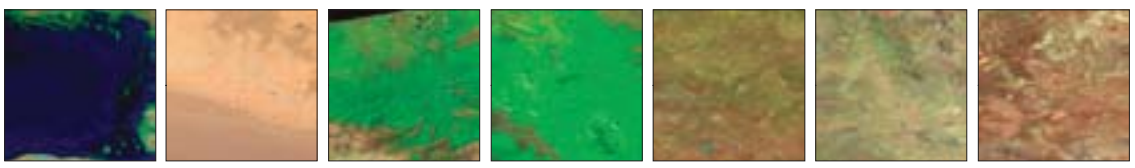
Top: Caspian Sea shore, Turkmenbashi, Turkmenistan. **Middle:** Housing development area in Aktau, on the Caspian Sea in southwestern Kazakhstan. It is now a center of oil and gas industry. **Bottom:** The Caspian Sea shore at Aktau.

Caspian Sea

80 40 0 80 Kilometers

1:6,000,000

International boundary



Water | Bare Area | Irrigated Land | Irrigated Land | Pastureland | Pastureland | Pastureland

Satellite Image: MODIS MOD09A1 (500m)
Image Acquisition Date: September 2008
Projection: Geographic WGS84

Prepared by C. Y JI, 2009

Left: Blocking the Kara-Bogaz-Gol sea gulf to build the dam separating the gulf from the sea in 1980. **Upper right:** Lake Aydarkul. **Lower right:** Lake Issyk-Kul is the second largest alpine lake in the world and the most popular summer holiday destination in Central Asia.

Outstanding Lakes

KARA-BOGAZ-GOL

Although named Kara-Bogaz-Gol or "mighty strait lake" in Turkmen language, this enormous gulf basin can more correctly be considered the world's largest lagoon. Situated in Uzbekistan on the Caspian Sea's eastern coast, it is separated from the Caspian by a strait of sandbars. Under natural conditions, the basin serves as an evaporative sink for the Caspian. Around 1900, when Caspian sea level was high, annual outflow from the Caspian to the Kara-Bogaz-Gol stood at roughly 30 cubic kilometers of water. Later falls in the Caspian's sea level reduced outflow by half. A solid dam was built across the strait in 1980 to arrest declines from evaporation. After the closure, sea level in the Caspian rose more than 11 centimeters. But it also accelerated evaporation of the highly saline Kara-Bogaz-Gol until parts of it came to resemble a salt bowl. The dam was breached in 1984 to allow replenishment of the gulf basin, and was completely removed in 1992.

LAKE AYDARKUL

Numerous lakes are found in the low-lying regions of the Aral Sea basin. The largest lakes are created by drainage water, principally irrigation effluent. Of these lakes, Aydarkul, with a surface area of 30 square kilometers, is the biggest. Lake Aydarkul rests in the Arnarsay depression astride the border of Kazakhstan and Uzbekistan. It owes its existence primarily to winter discharge from the Toktogul water reservoir. Drainage from irrigated fields in the Kazakh and Uzbeki Golodnaya steppe also contributes water to the Aydarkul.

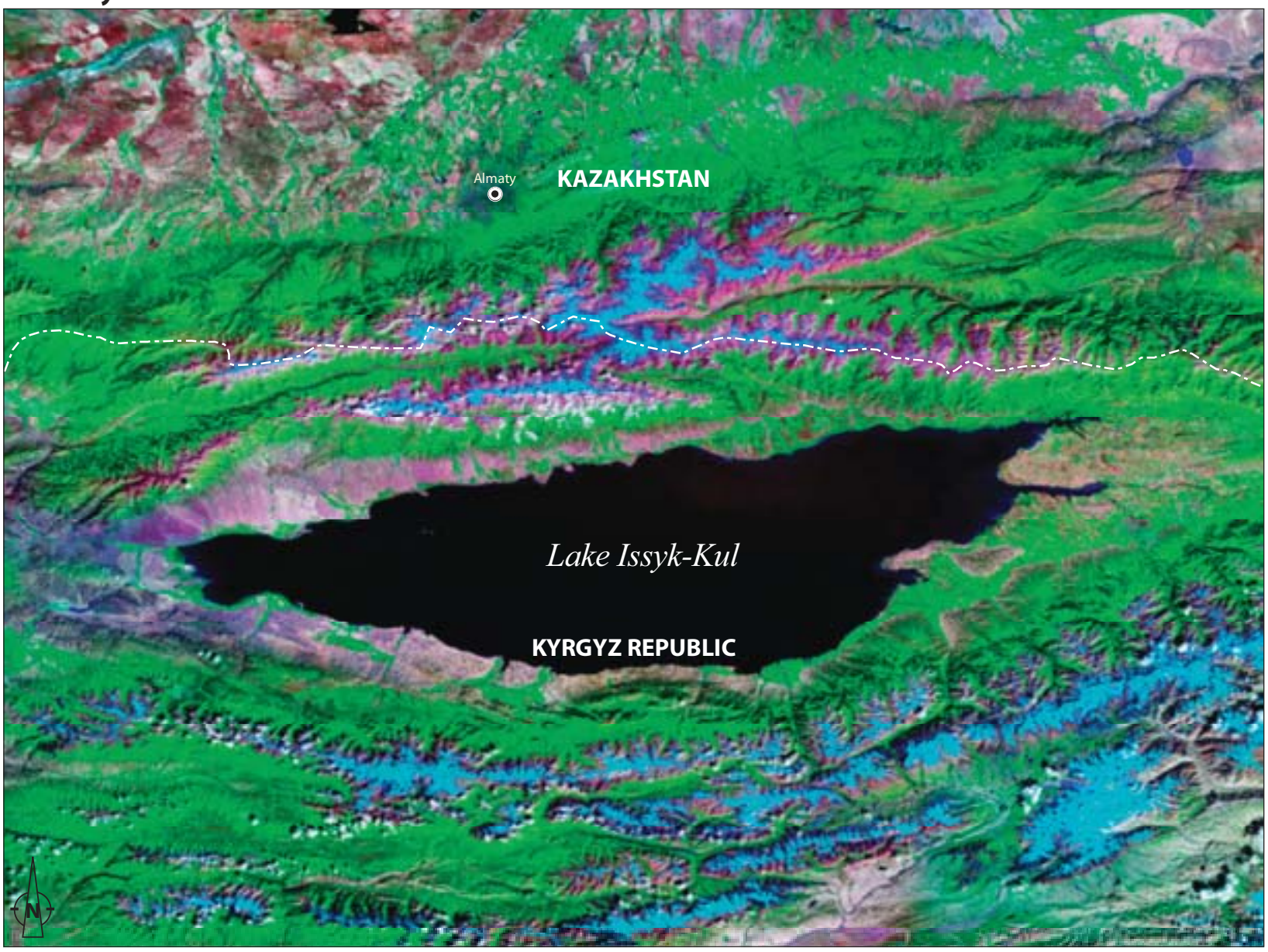
Given its source, Aydarkul would appear to be less than inviting. However, it is actually quite beautiful. Turquoise in color and home to many species of fish, it offers a welcome contrast to the desert and steppe that surround it. Its excellent beaches are eye-catching, as are the pink pelicans, swans, and white herons that thrive in its less than pristine waters.

LAKE ISSYK-KUL

Lake Issyk-Kul is located high in the northern Tien Shan of eastern Kyrgyz Republic. Noted for its natural and cultural heritage, long history as a site for recreation and spas, and clear, clean blue waters, Issyk-Kul ranks high in global lists of special categories. It is the world's ninth largest lake by volume, second largest lying above 1,200 meters, and one of the planet's 20 rare ancient lakes, having been formed roughly 25 million years ago.

Measuring 180 kilometers in length and 60 kilometers in width at its widest point, Issyk-Kul has an average depth of 200 meters, and a maximum depth of 668 meters. Of the 118 streams and rivers that flow toward Issyk-Kul, 49 drain into it. Lake volume is 1,738 cubic kilometers and, as may be expected, water level varies by season, rising in spring and summer from snow and glacial melt, and falling in autumn and winter. High salinity keeps the lake from freezing (Issykl-Kul—Ysyk Köl, Issyk-kol—means "warm lake" in Kyrgyz language), making it a vital winter stopover for migratory birds.

Lake Issyk-Kul

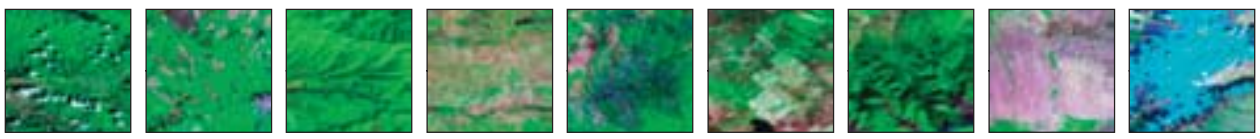


25 12.5 0 25 Kilometers

1:1,500,000

Provincial capital

International boundary



Satellite Image: Landsat ETM+ (15m)
Image Acquisition Date: circa 2000 (+/- 3 years)
Projection: Geographic, WGS84

Prepared by C. Y. Ji, 2009

Increasing development and resource exploitation, however, put the lake at risk. Diversion of water has resulted in water level drop of some 2.5 meters in the last few decades. Poor agricultural practices, mining, and introduction of non-native species have all compromised the lake's natural biodiversity. In response, the Government of the Kyrgyz Republic created the Issyk-Kul Biosphere Reserve. The goal for creating this 43,000-square kilometer-protected area is conservation as well as support for long-range social and economic development geared toward restoring the lake's natural resources.

A long pier extends into Lake Issyk-Kul.

Lake Sarez

5 2.5 0 5 Kilometers
1:300,000

Satellite Image: Landsat ETM+ (15m)
Image Acquisition Date: circa 2000 (+/- 3 years)
Projection: Geographic, WGS84

Prepared by C. Y. JI, 2009

LAKE SAREZ

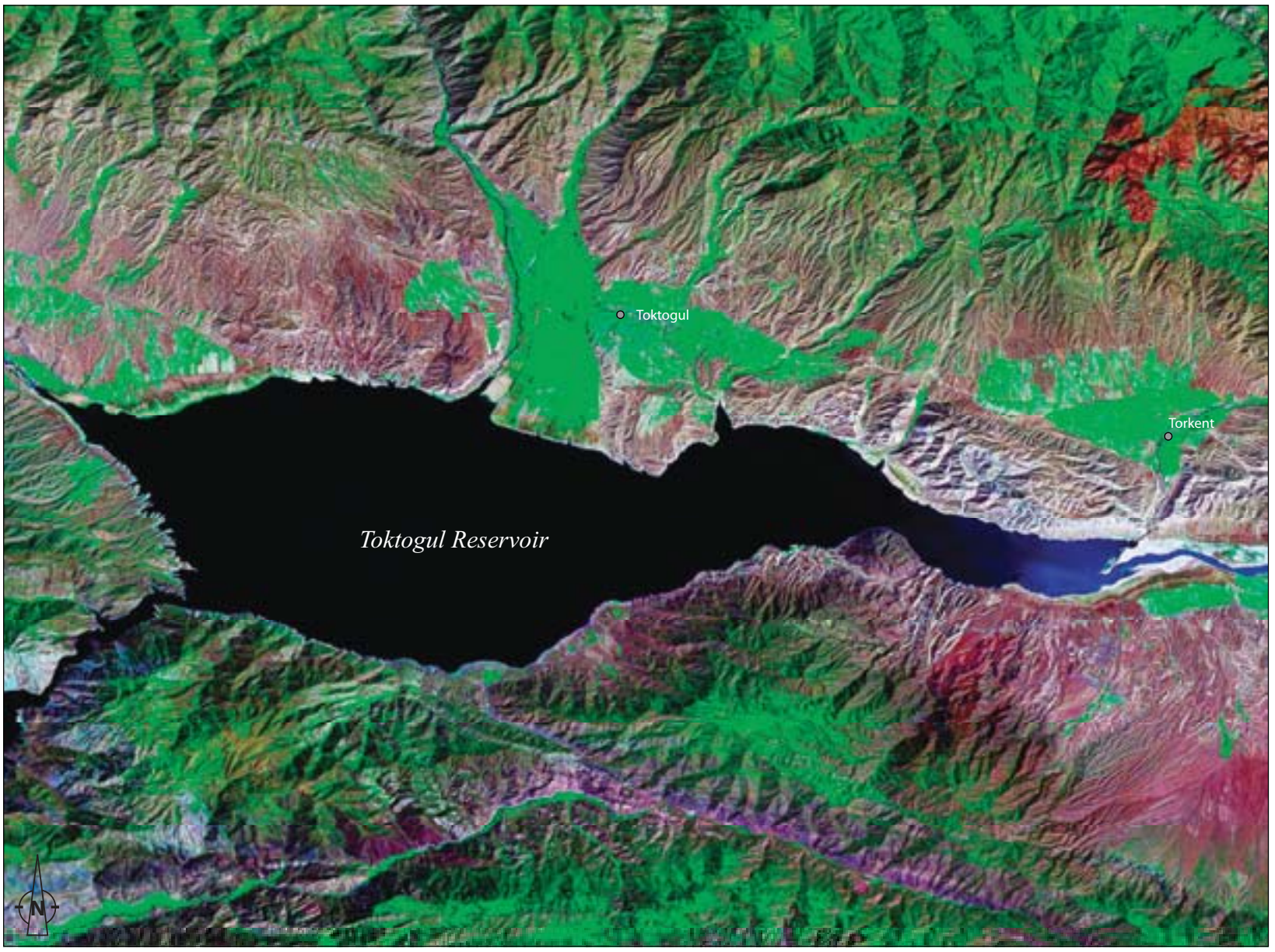
In February 1911, an earthquake shook the Murgab River valley in the East Pamir mountains in what is now Tajikistan. Giant rock masses hurtled down mountain slopes, blocking the Murgab River with a 5-kilometer wide, 200-meter-high natural dam (Usol Dam)—Lake Sarez was born. Central Asia is home to several rock-dammed lakes of which Sarez is the largest. Ominously, the waters of Sarez are constantly rising. Recent reports suggest its volume is approaching 16 billion cubic meters and growing steadily. This poses incredible danger.

The lake's growing size—which builds pressure behind the dam—and the area's highly seismic nature create devastating potential. The canyon surrounding the lake is eroding at an annual rate of 30–40 meters, and seepage through the dam has significantly increased. Should a debacle occur, a catastrophic flash flood would roar down from the lake's 3,200-meter height, engulfing 70,000 square kilometers and 6 million people in Tajikistan, Turkmenistan, and Uzbekistan. To minimize this risk, the Government of Tajikistan, with the aid of international donors, has launched a safety program. It includes a monitoring and early-warning system that came on line in 2005.

Lake Sarez, looking toward the dam. A diversion tunnel has been proposed that would relieve some pressure on the dam and generate hydropower.

Beautiful, clear, and dangerous, the 60-kilometer long and 3-kilometer-wide Lake Sarez sits high up in the mountains of Pamir. The lake was formed in 1911 as the result of a powerful earthquake.

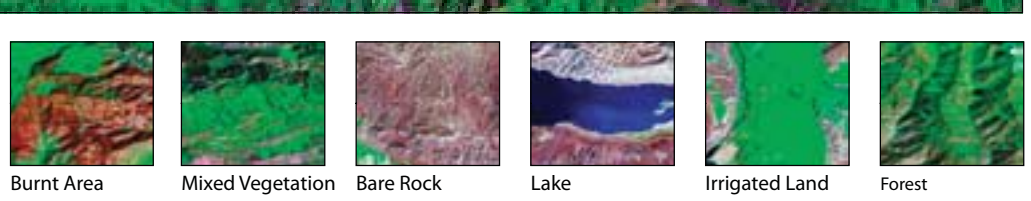
Toktogul Reservoir



5 2.5 0 5 Kilometers

1:250,000

City



Satellite Image: Landsat ETM+ (15m)
Image Acquisition Date: circa 2000 (+/- 3 years)
Projection: Geographic, WGS84

Prepared by C. Y. Ji, 2009

■ **Right: Mountains climb into the distance behind Toktogul Reservoir.**

TOKTOGUL RESERVOIR

The Toktogul Reservoir is the largest of a string of reservoirs built along the Naryn River in the Kyrgyz Republic. It has a capacity of 19.5 cubic kilometers. Completed in 1976, it was designed to irrigate lands in the Syr Darya basin. It has helped bring approximately 400,000 formerly unused hectares of land into production, and improved irrigation for roughly 1 million hectares in downstream Kazakhstan and Uzbekistan. Ideally, the reservoir is guided by a fixed irrigation schedule: water is allowed to accumulate in winter and early spring and released during the growing season.

This schedule worked well under Soviet centralized water management, when costs borne by the Kyrgyz Republic for the maintenance of the Toktogul hydropower plant and of the republic's lower Naryn plants were offset by receipt of supplies of equipment, fuel, and goods from the former Soviet Union. When the Soviet Union disintegrated, however, supplies to the Kyrgyz Republic stopped and effective water management coordination has presented an ongoing challenge to the region ever since.

■ **Toktogul Reservoir.**

Living Resources

Great cormorants *(Phalacrocorax carbo)* in the Amu Darya tugai forest. **Inset:** Sunset over Lake Sultankeldi in Korgalzhyn Nature Reserve.

Maintaining our living resources, the countless types of plants and animals that exist on earth, is vitally important for our own survival. We depend on this biological diversity, or biodiversity, not only for food but also as sources of enzymes, genes, chemicals, resins, and fibers that we can exploit to cure disease, provide substances, and create economic wealth—not to mention the essential ecological services that plants especially provide, such as keeping enough oxygen in the air and absorbing carbon dioxide that would otherwise quickly poison us. To maintain biodiversity, we must also conserve the areas where plants and animals live, their habitats.

Central Asia is amazingly diverse in its habitats, from inland seas and deserts below sea level to fertile valleys to snow-covered mountains that are among the tallest in the world. Its wide biodiversity reflects this variety of habitats. Some parts of the region can be considered "crossroads" for Asian and Mediterranean species; other areas are unique centers of endemic species, those that occur naturally nowhere else in the world.

The region's fauna include over 900 vertebrate species—172 of them mammals, 540 birds, 106 reptiles, 14 amphibians, and about 150 fishes. More than 20,000 types of invertebrates have been documented, and this is believed to be only a portion of the total fauna present. Some well-known animals in the region are the snow leopard, Tien Shan (Himalayan brown) bear, Marco Polo sheep, and Przewalski's horse.

Central Asia is home to about 7,000 higher plant (angiosperm) species. Best known are the region's fruits and nuts. Many fruits and nuts now farmed worldwide have their origin in wild varieties of Central Asia—think of almonds, cherries, pears, plums, and walnuts, to name only a few.

Ecosystems and Ecoregions

The habitats that underpin the survival of the world's biodiversity can be grouped into ecosystems: areas where the interactions between the different residents—animals and plants—are much stronger than their interactions with nonresidents that is, residents of neighboring ecosystems. Central Asia contains a wide range of aquatic, wetland, desert, and montane ecosystems.

At a higher level are ecoregions, groups of interacting ecosystems in which there are shared species and similar ecological processes and environmental conditions. To represent the original distribution of plants and animals on earth, the World Wildlife Fund (WWF) divided the entire planet into 867 terrestrial ecoregions. In Central Asia, 112 ecoregions were identified: 30 in mountainous and hilly areas in desert zones, 5 in mountainous areas in steppes, 29 in desert plains, 39 in steppe plains, and 7 in river valleys.

Worldwide, WWF selected 200 ecoregions—the Global 200—deemed the most outstanding for their biodiversity and other attributes. WWF Global 200 ecoregions that are within, or fall partially, in Central Asia are

- Middle Asian montane steppe and woodlands, Global 200 No. 111, which includes the terrestrial ecoregions Gissaro-Alai open woodlands (PA0808), Pamir alpine desert and tundra (PA1014), Tien Shan montane conifer forests (PA0521) Alai-Western Tien Shan steppe (PA0801), Tien Shan montane steppe and meadows (PA1019), and Tien Shan foothill arid steppe (PA0818)
- Central Asian deserts, Global 200 No. 134, which include the terrestrial ecoregions Central Asian riparian woodlands (PA1311), Central Asian northern desert (PA1310), and Central Asian southern desert (PA1312))

Biodiversity

Biological diversity, or biodiversity, simply means the variability among living organisms wherever they are found. It is usually measured as numbers of species in a locality, but it also means the variability within species, known as genetic diversity. Biodiversity also applies to habitat diversity—the variety of places where life exists.

Ecoregions in Central Asia

1:10 000 000

200 100 0 200

Kilometers

N

55°0'E

75°0'E

50°0'N

40°0'N

RUSSIAN FEDERATION

PEOPLE'S REPUBLIC OF CHINA

KAZAKHSTAN

UZBEKISTAN

TURKMENISTAN

KYRGYZ REPUBLIC

TAJIKISTAN

AZERBAIJAN

IRAN

AFGHANISTAN

ASTANA

TASHKENT

BISHKEK

DUSHANBE

ASHGABAT

Caspian Sea

Aral Sea

Lake Balkhash

Lake Issyk-Kul

Ural

Irtysh

Ishim

Syrdarya

Ili

Chu

Naryn

Kafirnigan

Karakum Canal

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

- National capital
- Rivers and canals
- International boundaries

Boundaries are not necessarily authoritative.

Data source:
WWF-World Wide Fund For Nature.
Global Ecoregions, 2004

Projection: Lambert Conformal Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd.
Kyrgyz Republic, 2009

- Volga River Delta, Global 200 No. 157, a freshwater ecoregion (in the Russian Federation and partially in Kazakhstan)
- Tibetan Plateau Steppe (Global 200 No. 110), which includes Central Asia, north of the Himalayas: Afghanistan, the People's Republic of China, India, Pakistan, and Tajikistan

Agricultural development has drastically altered the region's landscape since the second half of the 20th century; many habitats have been destroyed. The dissolution of the Soviet Union in 1991 led to dramatic changes in the sociopolitical and economic life of the region, that have had further enormous consequences for biodiversity conservation.

These anthropogenic pressures have put much of the wild flora and fauna of Central Asia under threat, with many already rare and endangered. The famed Caspian tiger (*Panthera tigris virgata*) was declared extinct within the last century and the Asian cheetah (*Acinonyx jubatus*) may have recently vanished in Central Asia.

Upper: A flock of greater flamingos *(Phoenicopterus roseus)* about to take off. The Kurgalzhino Nature Reserve in Kazakhstan is an important breeding ground for this migratory species.
Lower: A Caspian tiger killed in Northern Iran, early 1940s.

The Global 200

The Global 200 ecoregions were chosen from outstanding examples of each terrestrial, freshwater, and marine major habitat type. Ecoregions that represent the most distinctive examples of biodiversity for a given major habitat type were chosen, based on the following parameters:

- species richness;
- endemism;
- higher taxonomic uniqueness (e.g., unique genera or families, relict species or communities, primitive lineages;
- extraordinary ecological or evolutionary phenomena (e.g., extraordinary adaptive radiations, intact large vertebrate assemblages, migrations of large vertebrates); and
- global rarity of the major habitat type.

Only the biodiversity values of ecoregions sharing the same major habitat type were compared because the relative magnitude of parameters, such as richness and endemism, varies widely among them.

Ecoregions

Temperate Grasslands, Savannas, and Shrublands

1 Kazakh steppe (PA0810)
2 Emin Valley steppe (PA0806)
3 Gissaro-Alai open woodlands (PA0808)
4 Pontic steppe (PA0814)
5 Kazakh forest steppe (PA0809)
6 Kazakh upland (PA0811)
7 Tien Shan foothill arid steppe (PA0818)
8 Altai steppe and semidesert (PA0802)
9 Alai-Western Tien Shan steppe (PA0801)

Temperate Conifer Forests

10 Tien Shan montane conifer forests (PA0521)
11 Altai montane forest and forest steppe (PA0502)

Montane Grasslands and Shrublands

12 Altai alpine meadow and tundra (PA1001)
13 Tien Shan montane steppe and meadows (PA1019)
14 Pamir alpine desert and tundra (PA1014)
15 Kopet-Dag woodlands and forest steppe (PA1008)

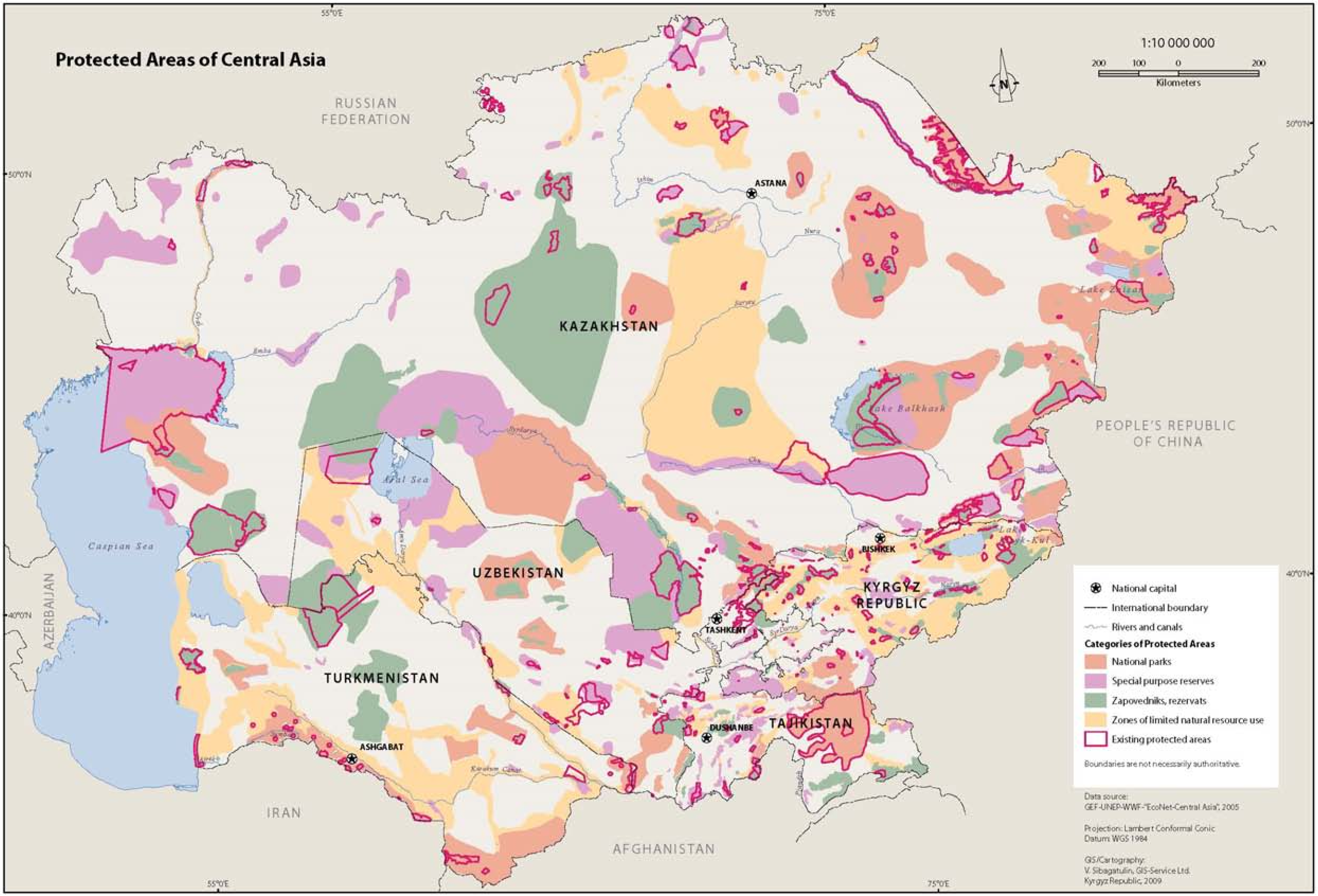
Deserts and Xeric Shrublands

16 Central Asian northern desert (PA1310)
17 Caspian lowland desert (PA1308)
18 Badghyz and Karabil semidesert (PA1306)
19 Central Asian riparian woodlands (PA1311)
20 Central Asian southern desert (PA1312)
21 Junggar Basin semidesert (PA1317)
22 Kazakh semidesert (PA1318)
23 Kopet Dag semidesert (PA1319)

Rock, Ice

24 Rock and ice

Protected Areas of Central Asia



Data source:
GEF-UNEP-WWF-"EcoNet-Central Asia", 2005

Projection: Lambert Conformal Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd.
Kyrgyz Republic, 2009

Protected Areas in Central Asia

	Existing System of Protected Areas (% of the territory of the country)				Planned Econet—PA Categories (% of the territory of the country)					Planned Econet—Ecological Network Categories (% of the territory of the country)			
	Zapovedniks	National Parks	Other PAs	Total	Zapovedniks	National Parks	Other PAs	Areas of Sustainable Development	Total	Core Areas	Ecological Corridors	Buffer Zones	Total
Kazakhstan	0.39	0.55	6.3	7.2	11.3	11.9	7.5	9.6	4.3	9.9	18.9	11.5	40.3
Kyrgyz Republic	1.8	1.5	1.8	5.1	14.1	11.6	4.6	52.8	83.3	16.0	29.5	37.8	83.3
Tajikistan	0.7	16.4	1.9	19.1	4.5	19.8	14.2	7.7	46.2	18.2	24.1	3.9	46.2
Turkmenistan	2.4	0.0	2.3	4.7	9.9	6.9	1.8	30.8	49.5	19.5	23.3	6.7	49.5
Uzbekistan	0.4	1.1	3.7	5.2	10.9	7.5	9.3	15.0	42.7	9.8	13.3	19.6	42.7
										12.1	18.9	12.8	44.0

PA = protected area.
Source: ECONET. *Web for Life*. Central Asia. Moscow, March 2006. p. 50.

Biosphere Reserve: An international conservation designation given by the United Nations Educational, Scientific and Cultural Organization (UNESCO) under its program on Man and the Biosphere. Biosphere reserves innovate and demonstrate approaches to conservation and sustainable development. They are under national sovereign jurisdiction, yet share their experience and ideas nationally, regionally, and internationally within the World Network of Biosphere Reserves. There are 531 sites worldwide in 105 countries.

World Heritage Site: An area or object inscribed on the UNESCO World Heritage List. The sites are designated as having "outstanding universal value"—cultural or physical significance—under the Convention Concerning the Protection of the World Cultural and Natural Heritage. This convention, which the UNESCO adopted in 1972, provides a framework for international cooperation in preserving and protecting cultural treasures and natural areas throughout the world. Each site is the property of the state on whose territory the site is located, but preserving each site is considered in the interest of the international community.

Wetlands besides Lake Tengiz in the Korgalzhyn State Nature Reserve.

Protected Areas

Ecoregions follow natural boundaries, not political ones. Protecting the unique nature and special biodiversity of ecoregions, especially those in the Global 200, needs cooperation among countries to establish mutually agreed protection mechanisms. The Econet, or ecological network, approach has been adopted in Central Asia as a way of conserving vital natural areas while allowing sustainable use of parts of them.

An Econet has three parts. Central is a large, specially protected "core" area of an ecoregion capable of supporting ecological balance and preserving a natural level of biological and landscape diversity. The core area contains animal habitats and landscapes of high importance to nature conservation. Linking core areas are transit areas, or ecological corridors, that allow migration of animals or interaction between core area populations. Buffer zones surround these core areas and corridors to protect them, while allowing compatible, sustainable land use in nearby areas. In general, the approach is designed to provide the ecological conditions for sustainable human social and economic development.

The approach is based on a proposal by World Wildlife Fund (WWF) in the 1998 document "Biodiversity Conservation in Central Asia—An Analysis of Biodiversity and Current Threats and Initial Investment Portfolio," which was approved by environmental authorities in all countries and integrated into the Framework Convention on Environmental Protection for Sustainable Development in Central Asia. In 2007, an agreement was signed between the Interstate Sustainable Development Commission and WWF on transboundary Econet implementation. Already, model projects by WWF are under way in Kazakhstan and Tajikistan and more are planned.

When fully implemented, Econet will have increased coverage in the region of specially protected areas from 5% to 31%. Including the buffer zones, this provides some environmental protection for 44% of the region.

Following are some outstanding Central Asian ecoregions with unique biodiversity.

Upper: The wetlands in Naurzum State Nature Reserve, Kazakhstan.
Lower: Feather-grass steppe in Naurzum.

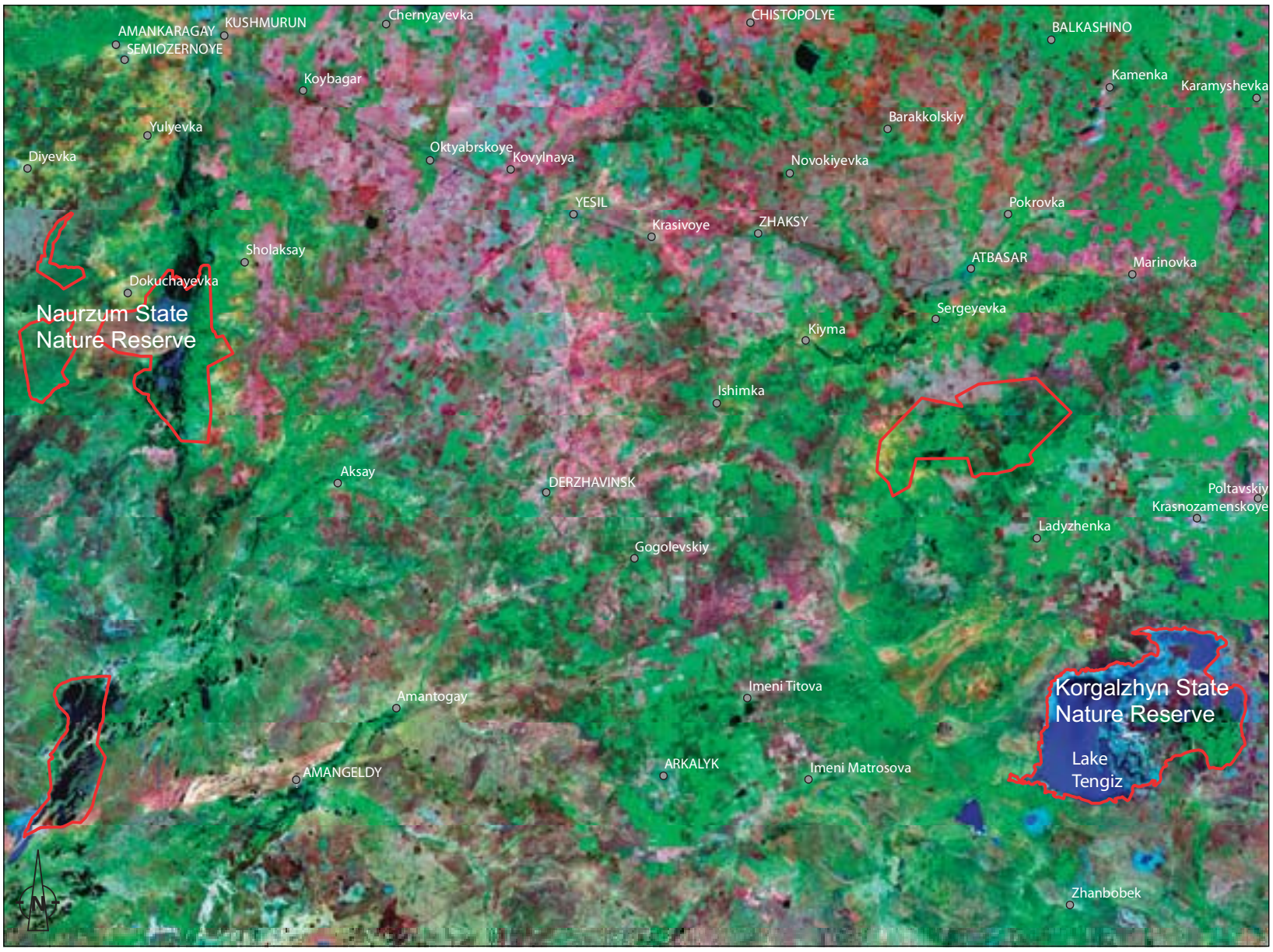
Selected Regions of Unique Biodiversity

STEPPES

Saryarka–Steppe and Lakes, Northern Kazakhstan

The Saryarka ecoregion is an area of the Central Asian steppe with both freshwater and saltwater lakes in northern Kazakhstan. A World Heritage Site, it is outstanding for its wetlands that receive millions of water birds migrating between Africa, Europe, and South Asia and their breeding areas in Siberia. It has two protected areas—Naurzum State Nature Reserve and Korgalzhyn State Nature Reserve—covering 450,344 hectares. Among the birds are globally threatened species, such as the extremely rare Siberian white crane, the Dalmatian pelican, and Pallas's fish eagle. The Korgalzhyn-Tengiz lakes provide feeding grounds for up to 15 million–16 million birds, including flocks of up to 2.5 million geese. They also support up to 350,000 nesting waterfowl, while the Naurzum lakes are home for up to 500,000 nesting

Saryarka World Heritage Site

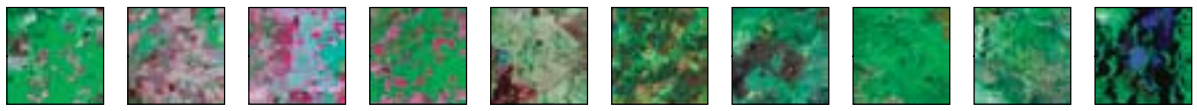


20 10 0 20 Kilometers

1:2,000,000

City

Protected Area



Satellite Image: Landsat ETM+ (15m)
Image Acquisition Date: circa 2000 (+/- 3 years)
Projection: Transverse Mercator

Prepared by C. Y. Ji, 2009

The Saryarka Steppe and Lake World Heritage Site consists of two separate nature reserves: Korgalzhyn State Nature Reserve and Nauzum Nature Reserve. The former is also designated as a wetland of International Importance (Ramsar).

waterfowl. The wetlands are key stopover points on the Central Asian flyways for migratory birds, while the 200,000-hectare steppe area is a valuable refuge for over half the species of the region's steppe flora, threatened bird species, and critically endangered Saiga antelope.

The site's steppes and lakes contain almost pristine biological, ecological, and hydrological processes, whose seasonal dynamics, along with the associated diverse fauna and flora, are of global significance and scientific interest.

View of the Naurzum State Nature Reserve.

Top: Sand dunes in the Karakum Desert. **Middle:** Panorama of the Kyzylkum Desert in Karakalpakstan, Uzbekistan. **Bottom:** A camel-borne ranger patrols the dunes of the Repetek Desert Reserve Station in the KaraKum Desert.

DESERTS

The Central Asian Southern Desert is the richest desert complex, in terms of its biodiversity, in the whole Europe–Asia landmass. The climate is milder and dryer than that of the more northerly deserts. Precipitation, totaling 70–125 millimeters, is greatest during the winter and spring, with a long summer drought. Snow cover is generally confined to December–February.

The ecoregion includes several mainly sandy deserts—Caspian coastal plains, southern part of the denuded Ustyurt Plateau, Krasnovodsk Plateau, Karakum sandy deserts, and the southern part of Kyzylkum sandy desert—that stretch from the eastern shore of the Caspian Sea to the lower Syr Darya River and to the foothills of the Central Asian mountains. Also included are the low alluvial and delta-alluvial plains of Amu Darya, Tedzhen, Murgab, and Zarafshan rivers. There are some low mountains (760–920 meters high) on Paleozoic rocks in the Kyzylkum.

The large Karakum Desert deserves special mention. It occupies more than two-thirds of Turkmenistan and covers some 350,000 square kilometers. To the west is the Caspian Sea. In the north, the Karakum is separated from the Kyzlkum Desert by the Amu Darya, Central Asia's most important river. The Karakum includes sandy, sandy-gravel, gravel, loess, and takyr soils. From the Hindu Kush mountains to the south flow the Murgab and Tejen rivers, which empty into the Karakum Desert and provide water for irrigation. Under its arid surface are rich oil, gas, and sulfur deposits that are now being fully exploited.

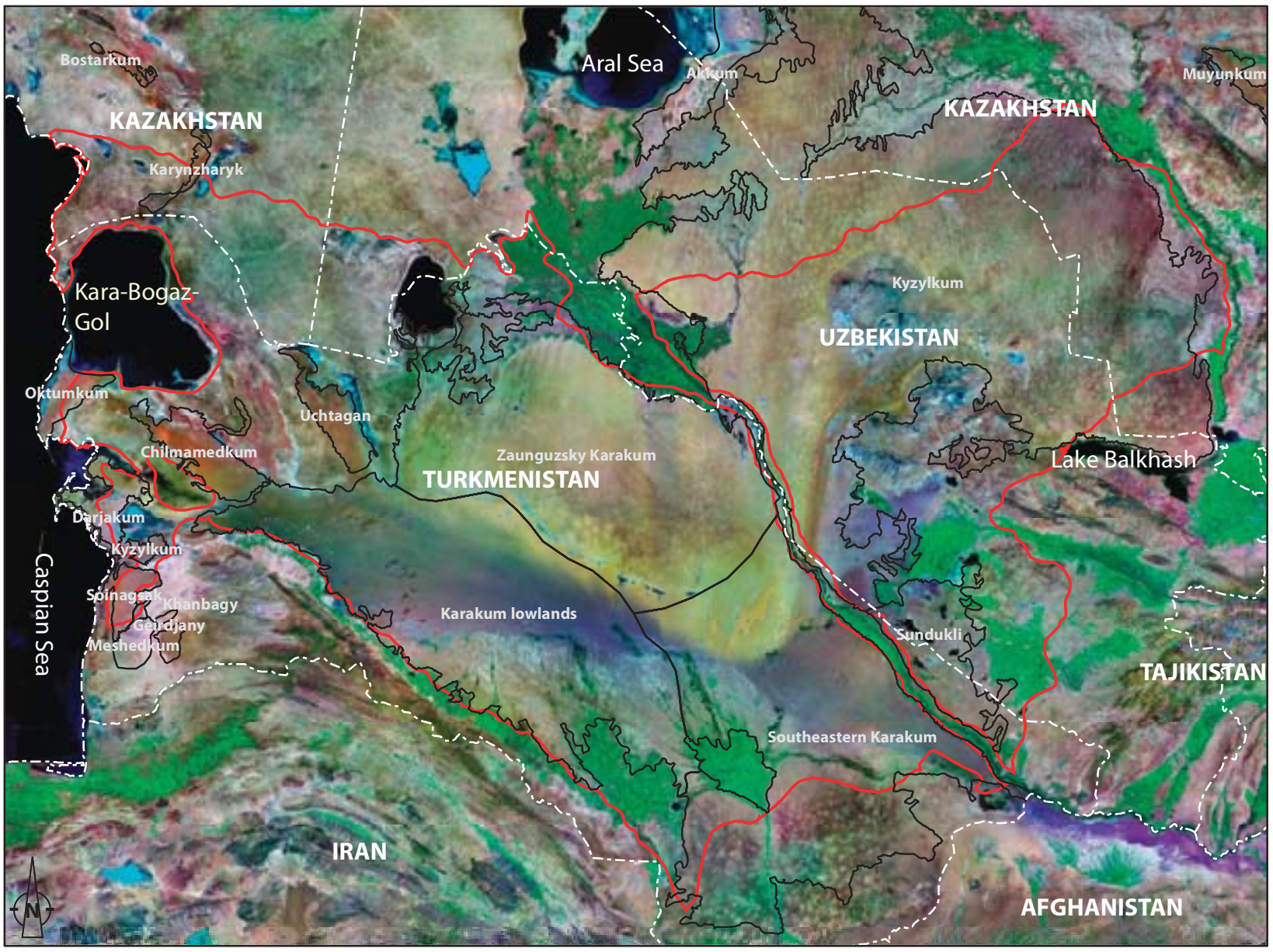
Among the flora of this ecoregion, white saxaul *(Haloxylon persicum)* and black saxaul *(Haloxylon aphyllum)* trees occupy large areas on the sands. Endemic plants include *Salsola richteri, S. subaphylla, Ephedra strobilacea,* and *Ferula foetida*. Sandy acacia (*Ammodendron conollyi*) grows on sandhills. There is a high diversity of other shrubs, particularly types of buckwheat. On thin sandy soils and loamy sands, white salsola (*Salsola arbuscula*) and endemic sagebrush communities are widespread. Desert plants, especially the endemic legume *Astragalus vilosissimus* and shrub bindweed (*Convolvulus hammada*), are characteristic in the eastern part of the ecoregion. Perennial saltworts dominate on clay soils.

The desert fauna also include many endemic species, particularly in sandy deserts. There is a wide variety of insects, numerous reptiles (snakes and lizards), and several amphibians (toad agamas). Most common among the mammals are hedgehogs, the *tolai* hare, and rodents, such as gerbils and jerboas. Rare mammals include the honey badger, sand lynx (*Felis caracal*), sand cat (*Felis margarita*), onager (*Equus hemionus*), goitered gazelle (*Gazella subgutturosa*), and marbled polecat (*Vormela peregusna*). Prominent bird fauna include the houbara bustard, cream-colored courser, eagles, saker falcon, grouse, saxaul jay, larks, desert raven, desert shrike, desert sparrow, Egyptian vulture, desert warbler, and wheatears.

The spread of agriculture in the ecoregion, especially irrigated cotton farming, is the main threat to the desert's biodiversity. Also damaging is the unsustainable use of plants, especially from saxaul forests, for firewood and silk production. Areas of forest left bare become covered in desert moss, which has no use as fodder and prevents reestablishment of other plants. Hunting and poaching, overgrazing by livestock, and encroachment by roads also threaten the stability of the ecoregion. Capture for zoos and collectors has dramatically reduced the numbers of both common and rare reptiles.

Turkmenistan, much of which is occupied by the Central Asian Southern Desert, is making efforts to rehabilitate the ecoregion, for example, through forest planting and providing gas for heating and cooking to minimize fuelwood use.

Central Asian Southern Desert



110 55 0 110 Kilometers

1:6,500,000

Desert boundary
Central Asia Southern Desert
International boundary

Satellite Image: Landsat ETM+
Image Acquisition Date: circa 2000 (+/- 3 years)
Projection: Transverse Mercator

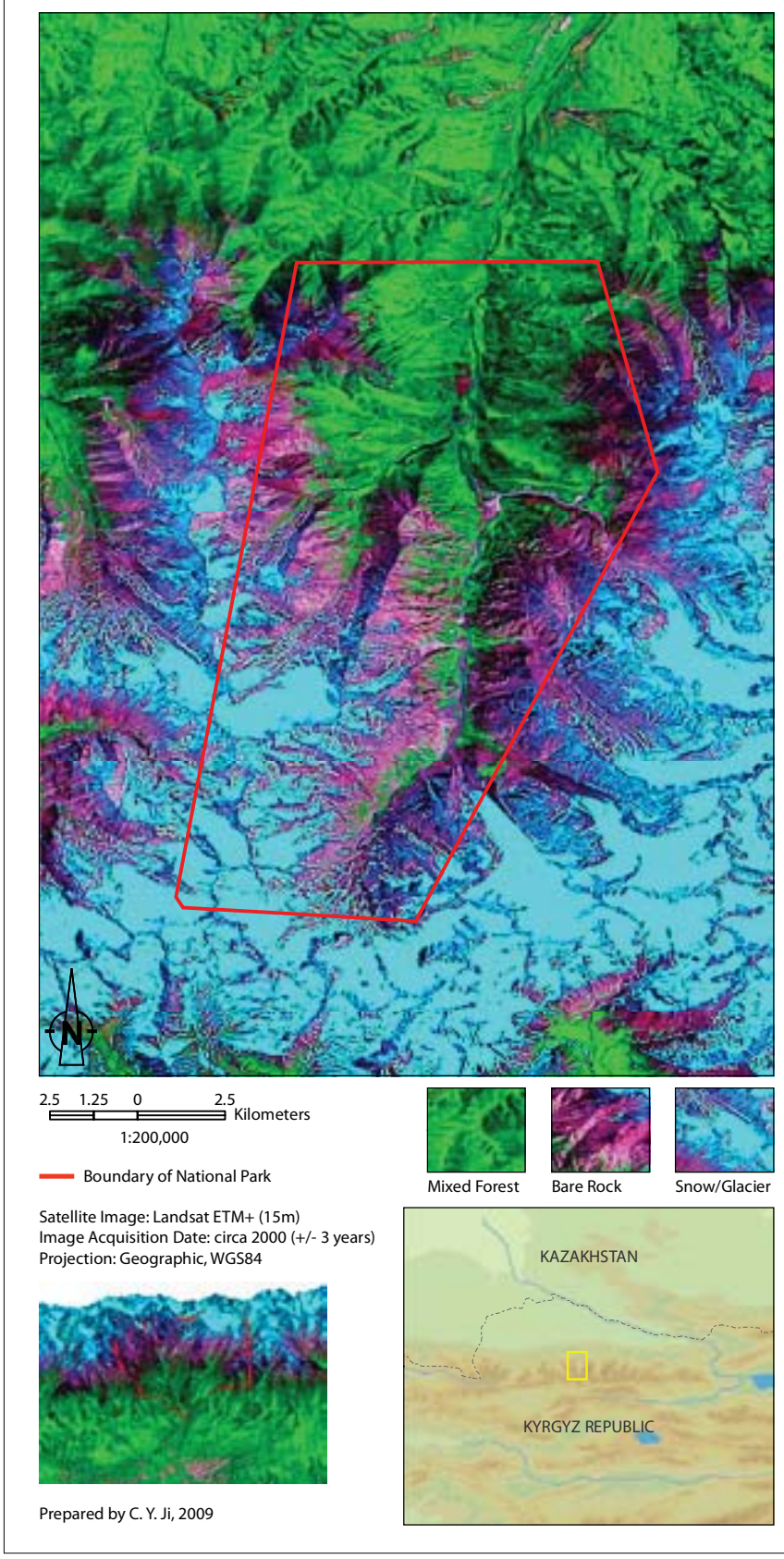
Prepared by C. Y. JI, 2009

Repetek Biosphere Reserve, Turkmenistan

The 34,600-hectare Repetek Biosphere Reserve is classified as a cold winter desert and semidesert ecosystem in the East Karakum Desert, consisting of a sand plain with large sand ridges and valley-shaped depressions. It has traveling sand dunes *(barkhans)* with only sparse vegetation but is one of the few places in the Karakum Desert where black saxaul forest has been preserved.

The area is lightly populated (about 350 persons in 2003). Cattle breeding and fuelwood collection are the major livelihoods. Long-term studies on the dynamics of the sandy desert have led to restoration of overgrazed pastures and stopping further sand encroachment. The Government of Turkmenistan continues to monitor and protect the reserve's biodiversity.

A lane of saxaul trees in Repetek Reserve.



Ala Archa National Park.

MOUNTAINS

Ala Archa National Park, Kyrgyz Republic

The Kyrgyz Republic established the 200-square-kilometer Ala Archa National Park in 1976. It was named for the juniper trees, which are held in esteem by the Kyrgyz people, who traditionally use smoke from burning wood to banish evil spirits.

The park ranges in altitude from about 1,500 meters at the entrance to 4,895 meters. More than 20 small and large glaciers and some 50 mountain peaks are within the park; two rivers, Adygene and Ak-Sai, are formed from the glaciers. The misty Adygene Gorge is a beautifully wooded valley graced by waterfalls, springs, and abundant Amu Darya trout. The very rare snow leopard lives here, as do wild goats, roe deer, and marmots.

Pamir Alpine Desert and Tundra

Locally known as the Bam-i-dunya, or Roof of the World, Tajikistan's Pamir is a complex mountainous ecoregion that forms a plateau and covers more than 70,000 square kilometers at the crossroads of several of Asia's largest mountain ranges: the Himalayas, Karakoram, Hindu Kush, and Tien Shan. The average altitude is around 4,000 meters. The highest peak, Pik Ismoili Somoni, rises to 7,495 meters, not very far below that of Mount Everest (8,848 meters). The Western Pamir is highly glaciated and includes the Fedchenko Glacier, which, at 75 kilometers long, is one of the world's two longest glaciers outside of the polar regions. The plateau forms a biogeographic barrier between Central, middle (Mediterranean-influenced), and South Asia.

Cold, arid, and windy, it is nevertheless home for a wide variety of fauna and flora because of the convergence of several mountain ranges. Its Mediterranean-type gravelly desert in the lowest parts is dominated by salt-tolerant flora, replaced at higher elevations first by prickly cushion plants (*Acantholimon*), wormwoods (*Artemisia*), and needle grass (*Stipa*), and then by needle grass and fescue grass (*Festuca*). The highest and most extensive area is alpine sedge-meadow (*Kobresia* and *Carex* species), with many broad-leaved herbs (forbs), similar to the vegetation over most of the Tibetan Plateau and the Tien Shan. Vegetation becomes very sparse by 4,400 meters, which is near the upper limit of vegetation.

The unique nature of the Western and Eastern Pamirs is protected in the Tajik, or Pamir National Park, which occupies more than 2.6 million hectares (11% of the area of Tajikistan). The Tajik refuge includes lakes KaraKul and Sarez; the Zorkul refuge with the Zorkul lake system; the Muzkol refuge, and the Sanglyar refuge. The park contains over 400 small lakes, hundreds of small rivers, and some of the largest glaciers of Central Asia. Disturbingly, the glacier area of the Eastern Pamir

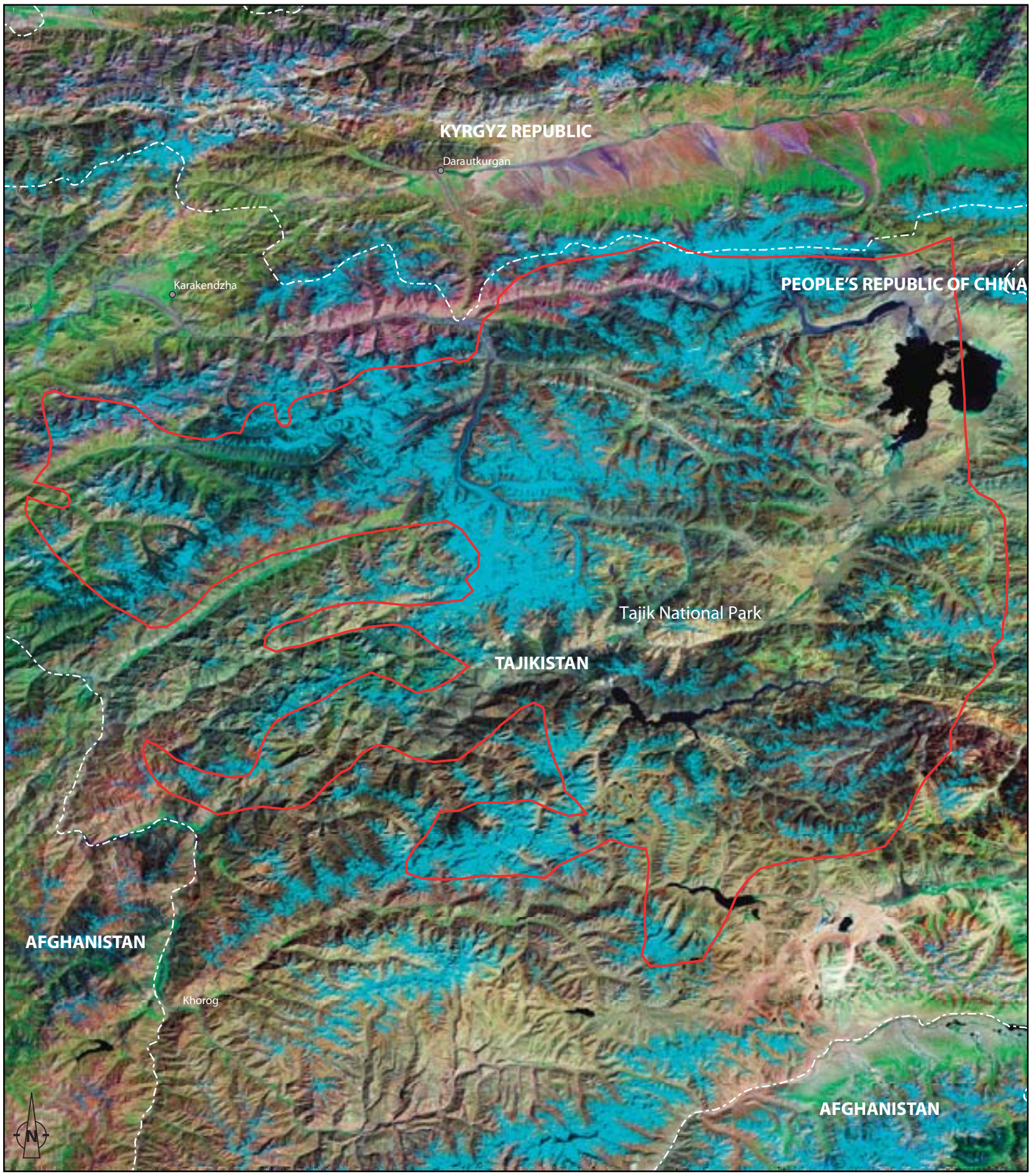
range decreased 7.8% during the 1980s and further decreased 11.6% in the 1990s. As the glacier fronts retreat, they leave debris-covered zones and new lakes.

The Tajik National Park offers an insight into the breadth of biodiversity in the Pamirs. The park has more than 2,100 species of higher plants, many of which are endemic, rare, and endangered. The dominant landscapes are saxaul and wormwood deserts.

The fauna of Tajik National Park include 162 species of birds. Common species are the Pamir casarca, Mongolian falcon, golden eagle, snow griffin, short beak plover, chough, Alpine daw, red and pearl reel, larks, and snow sparrow. Colonies of mountain goose, redheaded seagull, Tibetan river tern, and masses of migrating waterfowl and wading birds frequent Lake Karakul. Mammals include tolai, big eared, and red pika hares; rodents, like the red marmot, grey hamster, silvery and pamir field voles; Pamu argali and Siberian ibex; and predators, such as the river otter, fox, grey wolf, red wolf, snow leopard, and a white-clawed subspecies of brown bear. Many of these birds and mammals are rare or endangered.

From forests and lakes to alpine desert and glaciers, the Pamirs provide a wide variety of habitats that host equally diverse and unique fauna and flora.

Pamir Alpine Desert and Tundra



20 10 0 20 Kilometers

1:1,300,000

City

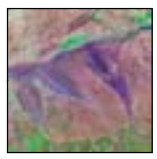
Boundary of National Park

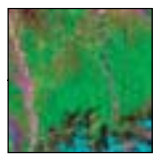
International boundary

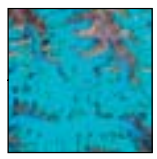

Desert


Lake


Alpine Meadow/ Desert

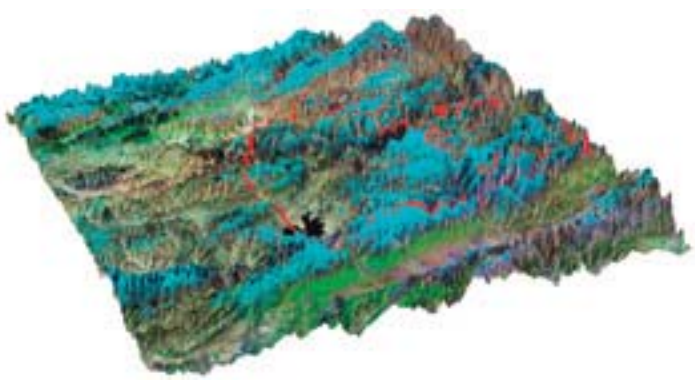

Bare Rock


Pastureland


Snow\Glacier

Satellite Image: Landsat ETM+ (15m)
Image Acquisition Date: circa 2000 (+/- 3 years)
Projection: Geographic, WGS84

Prepared by C. Y. Ji, 2009



WETLANDS

Issyk-Kul Biosphere Reserve, Kyrgyz Republic

Issyk-Kul Biosphere Reserve in the Kyrgyz Republic is 4.3 million hectares of land and water at altitudes of 1,600–7,500 meters, surrounded by the Tien-Shan mountain range. The biosphere reserve, designated in 2001, has many types of ecosystems, from deserts to lakes to alpine tundra. Its name derives from the massive Lake Issyk-Kul, which occupies more than a tenth of the reserve and is a Ramsar Wetland site (see below). There is a core area of 145,000 hectares, a buffer zone of 3.5 million hectares, and a transition area of approximately 665,000 hectares. Among the reserve's flora and fauna are many endangered species in its unpopulated areas, including Marco Polo sheep, Siberian ibex, and snow leopard.

The ecosystem types are semideserts and deserts in the foothills (1,600–2,400 meters); foothill steppe ecosystems—meadows and juniper and spruce forests (2,000–3,000 meters); high mountain tundra (2,700–3,500 meters); aquatic ecosystems (Lake Issyk-Kul and mountain rivers); and areas of forestry, pastureland, mining, agriculture, and settlements.

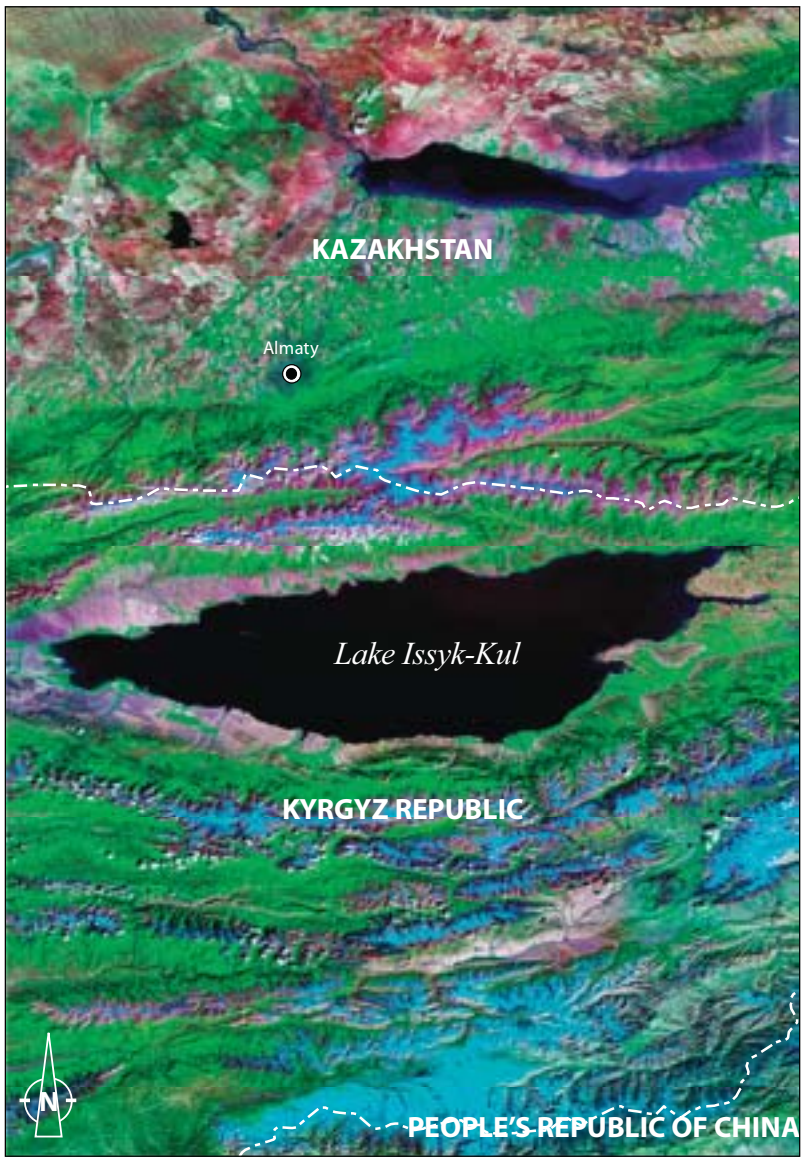
Many Kyrgyz families move to the mountain meadows in summer to raise their cattle and nearly half a million people live in the biosphere reserve. Tourism in the north part of the reserve is economically important; the major gold mining company is active here also.

The government has set up an information center and projects on sustainable agriculture, particularly on managing livestock grazing and preventing soil erosion. Germany has been an active supporter in all phases of the biosphere program.

Issyk-Kul State Reserve with the Lake Issyk-Kul Ramsar Site

Issyk-Kul Lake covers an area of 623,600 hectares, the second largest high-altitude lake in the world. Issyk-kul means "hot lake" because, although it is at a high altitude (1,609 meters), it does not freeze over; its average temperature is 22°C and popular hot springs can be found at Aksu. Lake Issyk-Kul Ramsar Site was first designated in 1976. It is a wintering site for up to 50,000 migratory waterbirds, including the whooper swan, mute swan, and common pochard, as well as small colonies of nesting storks. The lake also yields commercial fish harvests.

Issyk-Kul Biosphere Reserve



20 10 0 20 Kilometers

1:2,500,000

Provincial capital

International boundary

Satellite Image: Landsat ETM+ (15m)
Image Acquisition Date: circa 2000 (+/- 3 years)
Projection: Geographic, WGS84

Prepared by C. Y. Ji, 2009

Issyk-Kul as seen from the southern shore looking north toward the Alatau mountains and Kazakhstan.

Upper: A great egret *(Casmerodius albus)*, grey heron *(Ardea cinerea)*, and several mallard ducks *(Anas platyrhynchos)* flying over *tugai*. **Lower:** A Bukhara deer in the Badai Tugai Nature Reserve, Uzbekistan.

Tugai Forest of the Amu Darya Delta

Tugai or riparian forests are those growing along river floodplains. The largest remaining *tugai* forest is the 30,000-hectare Badai Tugai in the Amu Darya delta joining the southern Aral Sea. The present forest is only about a tenth of the original *tugai* forest in the delta and is heavily fragmented. Smaller patches can be seen in the image on p. 107 along the right bank of the river and along the edges of the northeastern part of the delta.

The breadth of diversity of Amu Darya *tugai* flora is impressive. Reed communities line the shores; on land are dense forests dominated by poplars and willows; and beyond the forests are shrubs and trees characteristic of the surrounding deserts: tamarisk shrubs, and saxaul trees. Many plant species are endangered.

Equally outstanding are the fauna of these *tugai* forests: 28 mammal, 58 reptile, 91 bird, and 26 fish species. Among the mammals are the highly endangered Bukhara deer, of which fewer than 400 remain in the wild; and the endangered goitered gazelle, or djeiran. Other mammals are the grey wolf and golden jackal, red and corsac foxes, several wildcats, the Eurasian badger, Indian porcupine, and numerous rodents.

The wetlands of the *tugai* ecosystem, with their flowing waters, reed communities, and sand and mud banks, host nesting birds, such as the rare Khiva pheasant, and flocks of many migratory birds, such as the Dalmatian pelican, whiteheaded duck, marbled teal, and ferruginous duck.

Many fish and reptiles are endemic. Of global conservation value are the gray monitor lizard, Central Asian tortoise, snake (*Rhynococephalus rossikovi*), shovel-nosed sturgeons—which are critically endangered—and several kinds of carp. Some fishes that disappeared from the Aral Sea as its salinity rose, such as pike-perch, bream, barbel, and a roach subspecies, now survive only in the Amu Darya and Syr Darya deltas.

The Amu Darya delta has been an area of extensive irrigated agriculture for millennia but the retreat of the Aral Sea and its environmental consequences have made life difficult for the population, now under the Republic of Karakalpakstan, an autonomous entity that covers western Uzbekistan. A large project is under way to conserve and restore these *tugai* ecosystems in view of their great social, economic, and ecological importance. A national park is being created that will include protected areas and buffer zones to ensure sustainable use of the delta's natural resources.

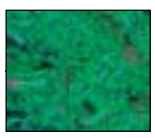
Tugai Forests, Amu Darya Delta

10 5 0 10 Kilometers

1:1,000,000

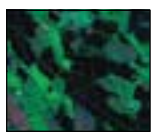
- City/Town
- Boundary of *tugai* forest
- Boundary of protected area
- International boundary


Irrigated Land


Irrigated Land


Solonchak


Desert


Irrigated Land/ Rice Fields

Satellite Image: Landsat ETM+
Image Acquisition Date: circa 2000 (+/- 3 years)
Projection: Geographic, WGS84

Prepared by C. Y. Ji, 2009

■ One of the last *tugai* forests in the Tajik Pamirs, Shakhdara Valley, Gorno Badakhshan Autonomous Oblast, Tajikistan.

Spruce forest surrounding KolSay Lake, Alatau Range, Almaty region, Kazakhstan.

Forest Resources

PLAYING A VITAL ROLE

Forests are essential to the well-being of our planet. They offer refuge to more than half of the world's plants and animals. They play a primary role in the fight against climate change by storing carbon. And they provide sources for human sustenance—economic, cultural, and spiritual. For millennia, they have served as backdrop to countless myths and legends. They enrich everything they touch. So while Central Asia is one of the least forested regions in the world, the benefits its forests provide far outweigh the scant 3.1% of the land they occupy.

Central Asian mountain forests bear wild fruit and are genetic centers of origin for varieties of cultivated apple and pear eaten around the world. Saxaul scrub forests of desert lands are important for fuelwood and provide shade for animal grazing. The walnut forests of the Kyrgyz Republic, pistachio forests of Turkmenistan, and wood plantations of Kazakhstan provide substantial cash crops. Forests safeguard the environment as well, protecting watersheds, providing sand control, ensuring water quality, stabilizing vegetation, and putting a brake on human-caused and natural hazards, such as soil erosion, desertification, landslides, and floods. And they offer marvelous venues for recreation.

FOREST TRENDS

In 2007, about 12 million hectares of the region were classified as forestland, the proportion varying from country to country. Kazakhstan has the lowest proportion of forestland (1.2%); however, its more than 3.3 million hectares place it second in the region only to Turkmenistan whose forest cover is 8.8% and 4.1 million hectares.

According to the Food and Agriculture Organization of the United Nations, between 1990 and 2005 forestland increased by 1.6% across the region, showing little or no change in the Kyrgyz Republic, Tajikistan, and Turkmenistan, falling 3.5% in Kazakhstan, but increasing 8.2% in Uzbekistan.

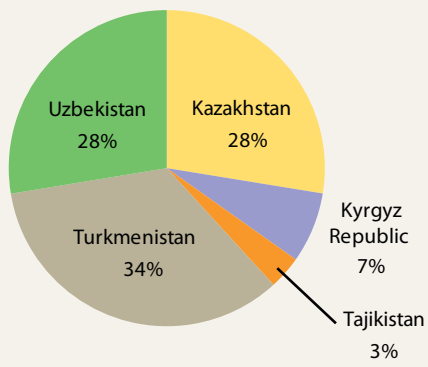
While these numbers represent official figures, discrepancies as to what classifies a forest must be weighed. Increases in Uzbekistan's forest cover fall into the category of classification changes. Turkmenistan lists saxaul (*Haloxylon spp.)* as its dominant forest species, which suggests some areas designated as forest may really be "other wooded land." Were other wooded land to be included in Kazakhstan's assessment, its forest cover would jump to roughly 7% of its land area.

In assessing the state of the region's forestland, the Food and Agriculture Organization's inclusion of areas "temporarily unstocked" (areas that normally form part of the forest but are at least

partially denuded as a result of human intervention or natural causes but are expected to revert to forest) should also be considered. There are reports that illegal felling of trees exceeds reafforestation. In Uzbekistan alone, felling may have meant the loss of more than 1 million hectares of forestland since 1996. In the Kyrgyz Republic, it may have resulted in a decrease of 50% of wooded areas in the western Tien Shan area over the last half century.

In fact, although limited felling is authorized for sanitary reasons and prohibited for economic reasons, felling exceeds authorized limits in all countries. Also on the negative side is the region's 10.6% decline in forest plantations between 2000 and 2005, which suggests an increased use of wood products, without replacement of resources.

Shares of Each Country in Total Forestland in Central Asia, 2007



Source: FAOSTAT. http://faostat.fao.org (updated April 2009).

Extent of Forest in Central Asia

Country	Forest '000 hectare	Forest % of land area	Total land area '000 hectare
Kazakhstan	3,325.8	1.2	269,970
Kyrgyz Republic	873.7	4.6	19,180
Tajikistan	410.0	2.9	13,996
Turkmenistan	4,127.0	8.8	46,993
Uzbekistan	3,328.2	7.8	42,540
Total Region	12,064.7	3.1	392,679
Total World*	3,937,326.3	30.3	13,009,115

*May include official, semi-official or estimated data.
Source: FAOSTAT. http://faostat.fao.org (updated April 2009).

NEED FOR BALANCED DEVELOPMENT

There are, however, bright spots. Uzbekistan has implemented a national program for growing poplars around villages and farms to increase the supply of construction timber; this has become an important source of wood supply. Kazakhstan's growing stock of 109 cubic meters per hectare is quite high. And if "other wooded land" is considered, then Kazakhstan should be commended for afforestation that has resulted in increases of more than 800,000 hectares between 2000 and 2005. In addition, Kazakhstan and Turkmenistan are greening their capitals.

Upper: Villagers are cutting down precious *tugai* forests for fuel in gasless areas, Karakalpakstan. **Lower:** The tugai sparrow also needs *tugai* trees for its habitat.

■ **Upper left:** Kazakhstan forest in winter. **Upper right:** Autumn colors in a forest near Bishkek, Kyrgyz Republic. **Lower:** Birch trees in the fall, near Almaty, Kazakhstan.

These examples illustrate the need for balanced development, with equal emphasis given to production, protection, afforestation, and social and cultural benefits of forests.

MAJOR FOREST TYPES

Central Asia has relatively few broad-leafed tree species. In Kazakhstan, Turkmenistan, and Uzbekistan, saxaul trees are common in desert and semidesert areas. Aspens, birch, and firs grow in the mountainous areas of Kazakhstan and Kyrgyz Republic's Tien Shan, as do walnut-fruit forests. Flood plain *tugai* forests follow major rivers in dryland regions. Each forest area provides a hot spot for biodiversity.

Saxaul Forests

Forests composed primarily of white and black saxaul trees are found in some arid areas of Central Asia. The biggest saxaul forests are in southern Kazakhstan where they cover 15 million hectares. Turkmenistan has some 6 million hectares and small areas of saxaul forest are in southern Tajikistan, totaling about 10,000 hectares.

Where they occur, saxaul trees are important for protecting soil and helping prevent sand from filling channels and covering roads. They provide fuelwood and offer benefits to spring and autumn pastures by providing shade and increasing pasture productivity. Saxaul forests are home to a sparrow named saxaul sparrow (*Passer ammodendri*) after its close association with these forests.

Tugai Forests

Forests were once widespread along the floodplains of rivers flowing through the dry steppes and deserts of Central Asia. Called *tugai* forests, they have been largely cut down for

■ **Above:** Walnut resin-blackened hand of a walnut grower in Jalal-Abad, Kyrgyz Republic.

their timber and only fragments remain in the basins of the ri vers Atrek, Murgab, Tedgen, Tarim, Chui, Ili, Zarafshan, Syr Darya, and Amu Darya. The remainder are crucial to the biodiversity of the surrounding arid lands, and feature a dense growth of trees entwined in climbing plants, grassy clearings, and sporadic wetlands. They provide a lifeline for resident and migratory wildlife, especially wintering birds from western Siberia and Kazakhstan. And lucky observers may even gain a glimpse of rarely seen jungle cats.

Fruit and Nut Forests

On the eastern mountain slopes of the Fergana Valley in the southern Kyrgyz Republic are found the largest areas of natural walnut-fruit forests in the world, composed mainly of walnut and other fruit tree and shrubs, including varieties of apple, pear, and plum. The forests have extremely rich biodiversity—more than 5,000 plant species—with some 180 tree species that harbor around 150 bird and 40 mammal species.

These forests, totaling about 230,000 hectares, are important internationally because they are considered to be the place of origin of walnut—scientists have found over 300 walnut varieties alone—as well as of some other fruit trees and shrubs that are economically significant around the world.

The region also has large forests dominated by juniper trees, some 600,000 hectares, and pistachio trees, about 80,000 hectares in Tajikistan.

Apart from their valuable genetic resources, these forests have a soil-protection and water-regulating role. They are currently threatened due to cattle grazing, land cultivation, and fuelwood cutting.

Change in Extent of Forest and Wooded Land in Central Asia, 1990–2005

	Forest						Wooded land	
	Area		Annual change rate				Area	
	1990	2005	1990–2000		2000–2005		1990	2005
Country	('000 ha)	('000 ha)	('000 ha)/ year	%	('000 ha)/ year	%	('000 ha)	('000 ha)
Kazakhstan	3,422	3,337	(6)	(0.2)	(6)	(0.2)	13,049	15,622
Kyrgyz Republic	836	869	2	0.3	2	0.3	283	313
Tajikistan	408	410	n.s.	n.s.	0	0	142	142
Turkmenistan	4,127	4,127	0	0	0	0	0	0
Uzbekistan	3,045	3,295	17	0.5	17	0.5	—	904
Total	**11,838**	**12,038**					**13,474**	**16,981**

— = data not available, ( ) = negative number, ha = hectare, n.s. = not significant.
Source: FAO, Global Forest Resources Assessment 2005.

Upper: Snow leopard. **Lower:** Marco Polo sheep in the Pamir mountains, Tajikistan.

Flora and Fauna

Among Central Asia's remarkable biodiversity, some animals and plants stand out almost as icons of the region, in some cases icons of past glory only, as many of their populations are heavily depleted by habitat destruction for agriculture and infrastructure such as roads and townships. But their future may be brighter: recognition of their plight in the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, the database of the Convention on International Trade in Endangered Species (CITES) of Wild Fauna and Flora, and the Convention on Migratory Species of Wild Animals offers ways to let their numbers grow once again. Here are some of the region's unique fauna and flora.

TERRESTRIAL FAUNA

Snow Leopard *(Uncia uncia or Panthera uncia)*

The snow leopard, regarded as the most charismatic and symbolic animal of Asian mountain fauna, lives a solitary life in the remote mountain areas of Central Asian and neighboring countries. Adapted to the sheer precipices and jagged ridges of the mountains, it can jump more than 16 meters. Its thick, patterned gray fur allows it to blend perfectly with the rocky slopes. It stalks its prey—mainly mountain ibex and blue sheep—and is able to kill animals thrice its weight. However, it is among the most endangered animal species in the region, with perhaps only 3,500 remaining in the wild, mainly because of illegal hunting for its highly prized fur—which can be sold illegally for a small fortune—as well as the organs and bones, which are used in traditional Chinese medicine. Snow leopards are also killed by locals for preying on their livestock. Thus, the snow leopard has been listed as an endangered species since 1974 in the IUCN Red List of Threatened Species. National legislation across countries is geared toward protecting and saving these last remaining animals. It is listed in CITES, making it illegal to transport snow leopard parts across international borders. The Snow Leopard Trust works with governments and communities in

snow leopard countries to strengthen conservation policies and programs.

Marco Polo Sheep *(Ovis ammon polii)*

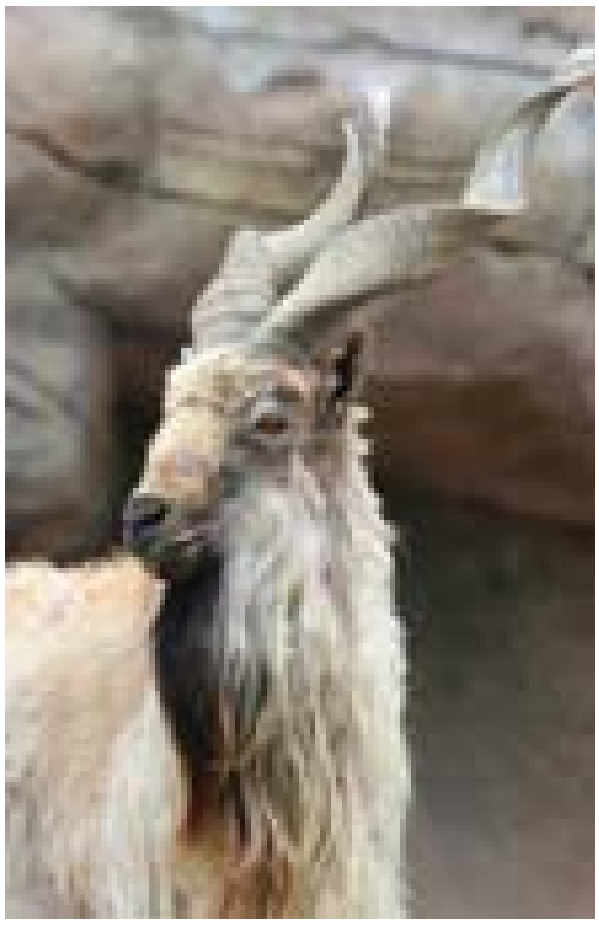
The Marco Polo sheep roams the rolling hills of the Pamir mountains of Afghanistan, the People's Republic of China, Pakistan, and Tajikistan. This subspecies of argali or mountain sheep was first described by the explorer Marco Polo in 1273: "There are great quantities of wild sheep of huge size. Their horns grow to as much as six palms in length." Marco Polo sheep hold the record for the longest horns on any sheep at 1.85 meters, making it a coveted and almost mythical status symbol for trophy hunters. As a result of hunting and competition from domestic livestock for prime pastures, its numbers have been decreasing during the past 2 decades. It is recognized as Vulnerable on the IUCN Red List of Threatened Species. The four countries that are home to this sheep have agreed to promote a transboundary conservation area or "peace park."

Tien Shan Bear *(Ursus arctos isabellinus)*

The endangered Tien Shan bear, also known as the Himalayan brown bear, is endemic to the mountains of Central Asia and is commonly found on the Uzbekistan side of the Tien Shan Mountains. This subspecies, a relative of the Kamchatka and Alaskan brown bears, is distinguished by its long white claws. It typically inhabits high mountain areas, moving to the forest line during summer to forage for fruits, berries, and bulbs. During the year it may complete long journeys from the foothills to the high mountain glaciers in search of other food, mainly marmots, pikas, and other rodents. Before the first deep snows, it builds a den in the cliffs of alpine forests and goes into hibernation through winter. Populations of the Tien Shan bear were large until the beginning of the 20th century. Due to illegal poaching and habitat destruction, it is now very rare except in nature reserves in Kazakhstan and the Kyrgyz Republic, although some 300 bears still live in the Dzhungar Alatau mountains in Kazakhstan.

Markhor *(Capra falconeri)*

Distinguished by its tightly curled corkscrewed horns, somewhat reminiscent of a snake's winding body (hence the name markhor, which means "snake eater" in Persian), this rare mountain goat, one of the region's large mammals, grazes in the sparsely wooded mountainous regions of the western Himalayas at altitudes of 600–3,600 meters. In Central Asia, the subspecies *Capra falconeri heptneri* is found in the mountains of the upper Amu Darya and the Pianj rivers spanning Tajikistan and Turkmenistan. Hunting has decimated its population and fewer than 2,500 remain. It was declared Endangered in the Red List of the International Union for Conservation of Nature (IUCN) in 2008.



Upper: Tien Shan bears courting. **Lower left:** Markhor. **Lower right:** Male goitered gazelle.

Goitered Gazelle *(Gazella subgutturosa subgutterosa)*

The goitered gazelle's common name came from the goiter-like swelling of the throat, distinctive of male gazelles during the rut and allowing the male to emit loud bellows during the breeding season. Also known as the *djeiran*, this subspecies is very different from all other species of the genus *Gazella*. Females are generally hornless and males are much heavier than the other species of the genus. It is also the only gazelle that can survive in a desert climate with long periods of extreme cold. It is a migratory species integral to the desert and semidesert landscapes of the region, indeed a plentiful game animal over the centuries until the 1930s. Large-scale poaching has since decimated its numbers. The remaining populations have been saved by nature reserves in most Central Asian countries. It is classified as Vulnerable in the IUCN Red List 2008 and protected under the Convention on Migratory Species.

■ **Upper left:** Saiga antelope. **Upper right:** Bukhara deer. **Lower:** Przewalski's horse.

■ **Next page. Left:** Saker falcon. **Right:** Houbara bustard.

Saiga Antelope *(Saiga tatarica)*

As the buffalo is central to the American prairie and the wildebeest to the Serengeti, the saiga antelope is to the Central Asian steppe, migrating around areas of the Russian Federation, Central Asia, and the People's Republic of China. The saiga antelope is a living relic of the ice age, having once roamed the earth with the mammoth and saber-toothed cats. With its body like a deer and head like a camel, it is a symbol and inspiration for the nomadic people who have shared its habitat for millennia. These people valued saiga meat and hide, and the male saiga's translucent amber horns were traded for use in Chinese traditional medicine. With widespread unemployment and poverty during the breakdown of the Soviet Union, saiga poaching became an alternative source of food and income. Saiga populations fell by 95% over the past 2 decades from more than 1 million to 50,000 individuals, most of them now in Kazakhstan. Saiga were listed as Critically Endangered by IUCN in 2003. They are also listed in the Convention on International Trade in Endangered Species and in the Convention on the Conservation of Migratory Species. National legislation protecting saiga is now in place in some countries as well as protected areas across its range.

Bukhara Deer (*Cervus elaphus bactricanus*)

The Bukhara deer makes its home in the lush *tugai* forests of the Central Asian deserts and semideserts. These graceful animals were revered by Central Asian peoples and called "hangul" which means "the King's flower." As cows are considered holy in India, Bukhara deer were under the special protection of the feudal kings. But they are at risk because of human threats, mainly from declining natural water sources, habitat destruction, and illegal hunting and poaching. By the late 1980s, only 900 animals were left in the wild—600 animals in natural populations and 300 in artificially created populations—throughout Central Asia. As poaching increased with increased poverty after Soviet Union's collapse, the number of deer dropped to a mere 350 by the end of the 1990s. World Wildlife Fund started a Bukhara deer restoration project in 1998, which increased the deer population to 1,000 by 2007.

Przewalski's Horse (*Equus ferus przewalskii)*

Przewalski's horse has roamed the steppes of Asia and Europe since prehistoric times, as evidenced by drawings made over 20,000 years ago in rock engravings, cave paintings, and decorated tools. Przewalski's horse is smaller than its domesticated counterparts and has a short, muscular body. It is the last surviving subspecies of wild horse. From the 1960s to 1996, it was classified as Extinct in the Wild by the International Union for the Conservation of Nature (IUCN) primarily due to a loss of genetic diversity caused by interbreeding with domesticated horses. With its successful reintroduction in several sites across Mongolia, it was reclassified in 2008 as Critically Endangered. Their total population now, however, is some 1,800, largely in zoos or reserves. Fewer than 50 mature horses survive in the wild.

Saker Falcon *(Falco cherrug)*

Diving for its prey of medium-sized mammals, especially rodents, and other birds at up to 300 kilometers per hour, this large, powerful, and ferocious bird hunts on open grassy landscapes, such as steppes and arid montane areas. However, it faces an alarming 70% decline in its population mainly due to illegal trade for falconry—juvenile sakers are specifically targeted for training. Of grave concern are the extreme declines in its numbers in Kazakhstan (90%), the Kyrgyz Republic (68%), and Uzbekistan. It is now listed as Endangered on the IUCN Red List in many states. Also listed in the Convention on International Trade in Endangered Species (CITES), a trade ban was imposed on the United Arab Emirates in 2002. Captive breeding programs have been developed in some countries as an alternative to wild-caught birds for falconry.

Houbara Bustard *(Chlamydotis undulata macqueenii)*

Don't be fooled by this unassuming turkey-like bird found in the sandy and stony semideserts. The male houbara bustard becomes a magnificent spectacle during courtship with its long black and white feathers and ornate bristles on its head and neck. Found throughout Central Asia, it migrates from Arabia through Iran and Pakistan to Turkmenistan, Uzbekistan, and Kazakhstan, with the largest population in Kazakhstan. The houbara bustard was traditionally the game bird hunted by Middle Eastern falconers. Up to now, falconers frequent Central Asia, spending large amounts of money to hunt the houbara. Habitat loss and degradation also threaten this species. As a result, and despite some captive breeding programs, its global population has shrunk by 35% in the last 20 years. It is now a protected species in most countries where it occurs, listed in CITES and the Convention on Migratory Species of Wild Animals. It is recognized by IUCN as Vulnerable.

Top: Desert monitor lizard.
Middle: Central Asian tortoise.
Bottom: Cliff racer snake.

Reptiles

During the Soviet period, capturing of snakes was for the most part under government control. But with the opening of borders and a ready market for wildlife products, venomous snakes have become highly vulnerable to international traders. Venom is valued for its medicinal use (viper venom, for example, is used to develop a blood-clotting substance); it is harvested from a variety of snakes that are often "milked" dry and left to die. This has led to a marked decrease in the more common viper species (*Vipera lebetina*) as well as rare species of cobra (*Naja sp.*) and sand echis (*Echis carinatus*). Habitat destruction, particularly plowing and development of pasturelands, and outright killing by fearful people also account for decreasing snake populations.

The cliff racer *(Coluber rhodorhachis),* a whip snake, is found in the Boralday, Maly, and Karatau mountains, in the Kyrgyz Range, and in the northern part of the Aral Sea Basin. Part of its core habitat is included in the planned Karatau Reserve. It has been listed as Rare in the Kazakhstan Redbook.

Tortoise *(Testudo horsfieldii)*

The Central Asian tortoise, also known as the Russian tortoise, inhabits the arid regions of the deserts and the steppes, at elevations of 1,500 meters or higher. It is commonly found near springs and brooks where vegetation is relatively abundant. It is among the threatened species, with a Vulnerable status in the Red List of the International Union for the Conservation of Nature (IUCN). Decreasing numbers are due mainly to heavy exploitation for food by locals and its export by the pet trade. Being listed in Appendix II of the Convention on International Trade in Endangered Species (CITES) helps regulate the numbers that can be exported. For example, the CITES annual export quota for Uzbekistan is 22,000 live specimens and for Tajikistan 17,000 wild-taken tortoises.

Desert Monitor *(Varanus griseus)*

Central Asia's largest lizard, reaching 1.5 meters long and weighing up to 3 kilograms, the desert monitor (*Varanus griseus*) is classified as Vulnerable in the Red Book of IUCN and in the regional Red Data Books of the Central Asian countries. This giant lizard is the only representative of its family found in the Kyzylkum Desert. It plays an important role in the desert ecosystem, preying on gerbil colonies, nesting birds, snakes—even poisonous ones—and various invertebrates. In recent decades, development has reduced its habitat almost by half; hunting is also decreasing its numbers. To conserve the desert monitor lizard, a reserve area in the eastern Kyzylkum Desert is needed, along with captive and artificial breeding.

AQUATIC FAUNA

Much of the region's aquatic biodiversity resides in the Caspian Sea, a unique environment because this sea became separated from the Mediterranean in Tertiary times and its salinity gradually became lower than that of marine waters by, on average, two-thirds. This led to the evolution of many new species. Now there are more than 400 endemic

species in the Caspian. Most prominent is the Caspian seal (*Pusa caspica*), one of only two freshwater species. There are 115 fish species, some of which are anadromous, that is, they migrate into freshwater rivers to spawn. Best known of these are six sturgeon species. Illegal fishing has reduced the numbers of some of them to the point where one—the ship (*Acipenser nudiventris*)—is now in the International Union for the Conservation of Nature Red Book of threatened species in some countries, along with other threatened Caspian species: white fish (*Coregonus albula*), a roach (*Rutilus frisii kutum*), and Caspian salmon species.

The Caspian's seabed has 124 mollusk species in residence; 119 are endemic or subendemic, belonging to 2 bivalve families and 7 gastropod families. And the coasts of the Caspian Sea are seasonally lined with countless gulls, terns, and waterfowl. The northeastern coasts are on a major migration route between Europe and Asia. Tens of millions of birds pass over the area twice a year, and a large number nest there. Overwintering birds include the coot, goldeneye, long-tailed duck, mute swan, whooper swan, flamingo, grey-lag goose, mallard duck, teals, and diving ducks. Also present are the sandwich tern, great black-headed gull, and three eagle species.

The Aral Sea, deprived of most of its freshwater inflow over the past 50 years, is almost biologically dead. Its biodiversity was always low because the present-day sea was formed only about 10,000 years ago. A total of 20 fish species in 6 families, 195 species of free-living invertebrates, 12 species of higher plants, and 82 species of lower plants have been recorded in the sea. Most native species were carps and they disappeared

Upper left: Caspian seal.
Upper right: Several sturgeon, including beluga, Russian, and stellate, caught by Kazakh fishers in the Ural River.
Lower left: The spotted thicklip loach *(Triplophysa strauchi)* reaches a length of 25 centimeters; it is found in river basins in Kazakhstan as well as in the People's Republic of China and Mongolia.
Lower right: The Knipfish *(Knipowitschia caucasica)* is a small (5 centimeters) goby that lives in the shallow area in fresh-, brackish-, and seawater from the Caspian to the Mediterranean.

in the 1980s as the sea's salinity rose. They also included once-abundant populations of the famous Fringebarbel sturgeon, the Aral barbel, and the Aral trout. All endemic fishes were migratory and some species still survive in the Amu Darya and Syr Darya river basins. The Amu Darya River hosts nearly 40 native species, including 6 endangered Aral basin species. The Syr Darya's waters are also home to about 40 fish species, including 2 surviving endemics from the Aral Sea.

Lake Issyk-Kul's waters are home to a diverse group of both endemic and introduced fish species, many of which are valued commercially. In recent years, catches have declined due to overfishing, and increased pollution due to more settlements and industry around the lake, and fertilizers and pesticides used in agriculture. Looking toward making fisheries more productive, many new fish species were introduced, drastically changing the composition of Issyk-Kul's fauna and to the detriment of many endemic species. The naked osman *(Dyptichus dybowskii)* is on the verge of disappearing and the Issyk-Kul chebak *(Leuciscus schmidti)*, Issyk-Kul chebachok *(L. bergi)*, and Issyk-Kul marinka *(Schizothorax pseudaksaiensis issyk-kuli)* are also threatened.

Upper: Dried fruits and nuts at Osh bazaar in the Kyrgyz Republic. **Lower:** Families get together in the Kyrgyz Republic to harvest walnuts.

FLORA

Fruit and Nut Biodiversity

Central Asia has been renowned for centuries for its superior fruits and nuts. In the 7th century, the Kingdom of Samarkand in present-day Uzbekistan sent a gift of golden fruit (possibly apples) to the emperor of the Tang dynasty of China. Turkmen melons were highly valued in past centuries, adorning the feasts of kings and aristocrats and even exchanged for gold and silver. Apples, apricots, berries, cherries, grapes, nectarines, oranges, peaches, pears, plums, and watermelons, as well as nuts like pistachios, almonds, walnuts, and hazelnuts are among the region's top agricultural produce and have an undeniable place in the food culture of the region. Many ancestors of today's domestic fruit and nut varieties grow wild in the region, making Central Asia a storehouse for wild genetic diversity, and a critical resource for plant breeding.

Receiving global attention are the highly threatened relict walnut-fruit forests that are unique to Central Asia. These ancient forests—with some walnut trees estimated at 800 years old—are found primarily on the northern slopes of the Ferghana, Chatkal and Darvaz ranges of the Tien Shan, and on the southern slopes of the Gissar range in the southeast. The forests hold almonds, cherries, maples, pears, and plums in addition to walnuts.

Almaty, Kazakhstan's largest city, translates to "place of the apples" and it is little wonder that Kazakhstan is the world's center of wild apple biodiversity. Scientists believe that the cultivated apple (*Malus domestica*) originated from the wild apple (*Malus sieversii*) in the Tien Shan mountains of Kazakhstan and the People's Republic of China. The favorable environmental conditions in the region allowed whole valleys to become forested with apple trees while varied microclimates allowed for their diversification. Travelers of the renowned Silk Road are also believed to have carried apple seeds to the Middle East and Europe where varieties then adapted to new environs. Rare genes and genotypes, as well as the continued diversification of new apple varieties in nature,

remain concentrated in the remnant wild fruit forests of Central Asia. In Turkmenistan, sweet melons or muskmelons are the reason for a national holiday and nationwide festivities on the second Sunday of August each year. The country hosts almost 400 varieties of melon.

Above left: Blossoms of the iconic saxaul tree. **Above right:** Greig's tulip in the Aksu Jabagly Nature Reserve. **Lower left:** There are hundreds of melon varieties in the region. **Lower right:** Nuts of the pistachio tree.

Tulips

Some 16 endemic species of tulips *(Tulipa* spp.*)* thrive in the steppes and meadows of the region. Their beautiful blooms are sought after for horticulture and decoration, which has led to the decline of many species. The largest tulip, also known as the "king of the tulips," is the rare, brilliant orange-red Greig's tulip (*Tulipa greigii*), found only in western Tien Shan. Another species, *T. kaufmanniana*, from the same area has beautiful white blooms suffused with orange and gold. The two species served as genetic stock for two groups of commercial tulips that are now widely cultivated and known around the world.

Saxaul Trees

The saxual tree or bush—it assumes the character of both—has the amazing ability to grow in the deep sands of the deserts. It grows extremely slowly above ground but has extensive root systems reaching down as deep as 10 meters to find moisture. Its slow growth results in extremely hard yet brittle wood. Saxaul trees grow up to 12 meters high and live up to 100 years.

Saxaul forests have contributed to making Central Asia's harsh environments habitable. They provide a source of cheap fuelwood and charcoal. By squeezing the spongy bark, saxaul trees can be used as an emergency supply of drinking water. They are important for creating sheltered pastures and providing feed for livestock. Moreover, saxaul forests play a critical role in protecting fragile desert soils from erosion; they protect oases, channels, and roads from sand filling; and help regulate water supply.

Agriculture

A Sector in Transformation

Agriculture plays a pivotal role in the social and economic life of the people of Central Asia. It accounts for much of the employment and gross domestic product (GDP) in all countries in the region. It drives most of the region's industrial production and domestic trade and demand, and provides jobs for most of the region's poor. Nonetheless, agriculture in these fragile and arid lands does not come easy. Extreme temperatures and low and variable rainfall have long presented challenges.

Like people in similar environments, Central Asia's earliest inhabitants learned to adapt thousands of years ago. Taking advantage of the region's vast rangelands they turned to nomadic pastoralism, moving livestock seasonally between winter and summer pasture. Livestock still plays an important part in the cultural fabric of Central Asia. However, for more than half a century, the region's crop farming area has increased at the expense of grazing land.

Crop production in the region dates back millennia to farming settlements around oases, which developed remarkably efficient irrigation systems. They were concentrated near natural water bodies and rivers, especially the Amu Darya and Syr Darya, and were relatively small in comparison with today's widespread irrigated agricultural systems that drain these rivers.

Over the past 100 years, there has been a huge increase in irrigated crop agriculture, beginning in Tsarist times and spreading dramatically in the Soviet era, when massive irrigation projects—most beginning in the 1950s—became the norm. Quickly, the land and the people's relationship to it were transformed. During Soviet central management, the region's republics were required to specialize in the production of farm products that met the perceived needs of a command economy. Production and distribution followed prescribed trade and economic relationships. In 1991, these arrangements ended almost overnight, resulting in an immediate downturn as the region's newly independent states faced uncertain futures.

Countries in the region made food security a top priority. They have also, except Uzbekistan which still practices much state control, moved toward more market-driven economies. This has resulted in major changes in farm production environments and technologies: giant state-run farms have given way to smaller, private farms. Emphasis is away from the high-input and highly mechanized production methods of the past and toward development of systems most appropriate for smallholdings and family-operated production units. These processes are ongoing and experiencing varying levels of success.

Overall, the agriculture sector needs to overcome the environmental damage from improper irrigation and poor grazing management, grow a wider range of crops, create new markets for high-value crops, increase productivity, improve regional cooperation, and help farmers become more business oriented. Should these challenges be met, Central Asia would not only be able to meet its national needs but would also become an even more important player in world agricultural markets. Already the region's chief commodities—cotton, wheat, livestock, and fruits and vegetables—are making an impact; and as greater commodity diversification is introduced the potential should grow even more.

Men collecting hay for the winter. Issyk-Kul, Kyrgyz Republic. **Inset:** A woman weeding out her vegetable garden, which provides additional income to her family.

Land Cover

225 112.5 0 225 Kilometers

1:15,000,000

International boundary

Original dataset: Central Asia Land Cover (CALCOVER - Version 1)
Data source: ADB CALCILM Programme
Satellite data: MODIS NDVI Time Series Dataset (MOD13Q1, 250m)
Acquisition date: January 2008–December 2008
Projection: Transverse Mercator

Central Asia Land Cover (CALCOVER Version 1) is produced by ADB CACLIM Programme using MODIS monthly NDVI time series data acquired in 2008. The original land cover product includes some 20 land cover classes compatible with the UN Land Cover Classification System (LCCS). The map presented here is highly generalized and only includes major land cover classes.

Prepared by C. Y. Ji, 2010

Land Cover Classes

- Alpine/Subalpine grassland
- Irrigated cropland
- Regularly flooded grassland/woody vegetation
- Sparse grassland/shrubland
- Rainfed cropland
- Water body
- Forested land
- Close to open grassland
- Bare area
- Permanent snow/ice

Basic Agricultural Indicators for Central Asia

Country	% Share of Agriculture in GDP, 2007	% of Labor Force Employed in Agriculture, 2006
Kazakhstan	5.8	29
Kyrgyz Republic	32.0	33
Tajikistan	22.4	66
Turkmenistan	20.3	43
Uzbekistan	24.0	29

Note: GDP data for the Kyrgyz Republic and Turkmenistan are from 2006. Labor force data for Turkmenistan are from 2004 and Uzbekistan from 2005.

Source: ADB. 2008. *Key Indicators 2008*. www.adb.org/statistics.

Agricultural Lands

More than 70% of the region is classified as agricultural. This includes rainfed and irrigated cropland as well as permanent pastureland. Agricultural land makes up 33%–77% of the total area of the countries, the highest being in Kazakhstan (77%), with about 208 million hectares. Tajikistan has both the lowest total (4.6 million hectares) and proportion (33%) of agricultural land.

The map opposite shows how these lands are distributed: a concentration of irrigated areas along the course of the two major rivers—the Amu Darya with its Karakum Canal, and the Syr Darya—and

Agricultural Land in Central Asia, 2007 ('000 hectares)

	Land Area	Arable Land Total	Permanent Crops	Permanent Meadows and Pastures	Total	Share of Land Area (%)
Kazakhstan	269,970[a]	22,700[a]	100[a]	185,098[a]	207,898[a]	77
Kyrgyz Republic	19,180[a]	1,280[c]	73[c]	9,375[c]	10,729[c]	56
Tajikistan	13,996[a]	710[a]	101[c]	3,770[a]	4,581[a]	33
Turkmenistan	46,993[a]	1,850[a]	63[a]	30,700[a]	32,613[a]	69
Uzbekistan	42,540[b]	4,300[a]	340[a]	22,000[a]	26,640[a]	63
Region	392,679	30,840	677	250,943	282,461	72

[a]Manual estimation, [b]Data reported on country official publications, websites, or trade country files, [c]Official data reported on FAO questionnaires from countries.
Source: FAOSTAT, 2009. Available: http://faostat.fao.org (updated April 2009).

Upper: Farming on the Pamir mountains in Roshorv, Gorno Badakhshan Autonomous Province, Tajikistan. **Lower:** Tobacco growing near Osh, Kyrgyz Republic.

in the water-rich southeastern parts of the region; rainfed agricultural lands, primarily in northern Kazakhstan; vast pasturelands of the Kazakhstan steppes; and the dominance of deserts with their sparse pasturelands reaching out across the region.

From 1995 to 2005, the total area of agricultural land in the region changed only slightly, down from about 289 million hectares to 284 million hectares. However, this tells only part of the story; much of the land is in a degraded state. Principle causes include overgrazing; declining soil fertility and loss of soil structure; salinization; elevated water tables in irrigated areas; inefficient water use; and expansion of plowed land into marshes, forests, and steppe unsuitable for sustainable agriculture. All have led to less than optimum agricultural productivity and profitability. Discounting degraded land, a regional environmental assessment put the remaining agricultural land area in 2004 as only 150 million hectares.

The map on the next page gives a broad-brush view of how Central Asia's agricultural lands are used: cereal and cotton farming in irrigated areas; cereal farming with livestock raising in many rainfed areas; relatively small vegetable- and fruit-growing areas; and almost everywhere else, even in the deserts, some form of livestock raising or pastureland for livestock. Details follow.

Irrigated Farmland

In the early 20th century, Shar'ia law formed the basis for water distribution. Water was considered a common good and was shared according to need. Subsequently, in the Soviet period, massive systems for irrigation and drainage were installed, chiefly to increase cotton and later wheat production. These systems were built to accommodate the requirements of large-scale, state-run farms for which water usage was centrally

Agricultural Lands of Central Asia

1:10 000 000

200 100 0 200

Kilometers

55°0'E

75°0'E

50°0'N

40°0'N

RUSSIAN FEDERATION

KAZAKHSTAN

ASTANA

Ishim

Irtysh

Nura

Ural

Volga

Syrdarya

Chu

Aral Sea

Caspian Sea

Lake Zaisan

Lake Balkhash

Ili

PEOPLE'S REPUBLIC OF CHINA

Lake Issyk-Kul

BISHKEK

KYRGYZ REPUBLIC

TASHKENT

UZBEKISTAN

TURKMENISTAN

ASHGABAT

DUSHANBE

TAJIKISTAN

AZERBAIJAN

IRAN

AFGHANISTAN

- National capital
- International boundary
- Rivers and canals

Boundaries are not necessarily authoritative.

Projection: Lambert Conformal Conic
Datum: WGS 1984

Data source:
Digital Geographical Maps of the World, 2008, Russia

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd.
Kyrgyz Republic, 2009

controlled. Now that state farms have been divided into smaller units, individual countries have been left to develop their own water-sharing schemes, with varying levels of success. Irrigation is now used on large areas of arable land in the region. Three sources of water prevail in the region: river diversion, pumping of rivers, and reservoir storage. The Amu Darya and Syr Darya rivers are the major primary sources, with almost all of their water exploited. Large irrigation reservoirs include the Tengiz Reservoir in Kazakhstan, Toktogul Reservoir in the Kyrgyz Republic, and Kayrakkum Reservoir in Tajikistan.

Upper: Field. **Lower:** A view of the Karakum Canal in Turkmenistan near the village of Nichka.

Agricultural Lands

- Alpine pasture livestock farming (horse, yak, etc.) in combination with other land use in mountain valleys
- Cereal farms (rice and corn) in combination with cotton on irrigated lands and meat and dairy farming
- Cereal farms (wheat, corn), meat, and dairy farming
- Cereal farms (wheat, millet, rice, and corn) in combination with cotton and livestock
- Cereal rice farms on irrigated lands
- Cereals, bean, oil, and other crops in combination with vegetable, watermelon, melon, and pasture livestock
- Forests with occasional land use and livestock
- Land use in oases (wheat, corn, palm trees, vegetables, and fruits)
- Less cultivated and not populated areas with occasional land use; livestock farming and others
- Livestock farming (cattle, sheep, and goats) with occasional land use
- Meat and dairy farming, and sheep breeding in mountains and other land use in mountain valleys
- Meat-wool farming and sheep breeding
- Nomadic and semi-nomadic livestock (cattle, sheep, goats, and camels)

The Osh Bazaar, Kyrgyz Republic, one of the busiest and most colorful markets in Central Asia, with a wide variety of produce.

Irrigated Crops

Major irrigated crops across the region are cotton and cereals, primarily wheat. Kazakhstan's leading irrigated crops are fodder (mainly alfalfa), cereals, cotton, fruits, potatoes, rice, and sugar beets. Fodder crops are often grown in areas where salinity and poor drainage conditions prohibit the growth of other crops. Kyrgyz Republic's major irrigated crops are cereals, mainly wheat, and fodder, which account for 37% of the irrigated crop area; major irrigated export crops include cotton, fruits, and vegetables. The major irrigated crops in Tajikistan are cotton—grown on about 50% of irrigated farmland—and fodder, fruits, cereals, and vegetables. Fruits are gradually replacing cotton as the number one crop. Cotton and fruits, especially grapes, are the most important export crops. In Turkmenistan, the major irrigated crops are cereals, mainly wheat, and cotton and fodder, with the most important export crops being cotton and vegetables. In Uzbekistan, cotton is by far the major irrigated crop, with the country consistently ranking among the world's leading cotton exporters. Other important crops include fodder, wheat, and fruits.

Proportion of Arable Land Equipped for Irrigation, 2007 (%)

Country	Land Equipped for Irrigation ('000 hectares)	Arable Land ('000 hectares)	Share in Arable Land (%)
Kazakhstan	3,556[a]	22,700[a]	15.7
Kyrgyz Republic	1,021[b]	1,280[b]	79.8
Tajikistan	722[c]	710[a]	101.7
Turkmenistan	1,800[a]	1,850[a]	97.3
Uzbekistan	4,281[a]	4,300[a]	99.6
Total	**11,380**	**30,840**	**36.9**

[a] Manual estimation, [b] Official data reported on FAO questionnaires from countries, [c] Expert sources from FAO (including other divisions).
Source: FAOSTAT. 2009. http://faostat.fao.org (updated April 2009).

Upper: A woman selling melons and gourds at the Osh Bazaar. **Lower:** Pomegranate farmer in Tajikistan with a prize specimen.

Top left: A wheat field in Kerbulak oblast in Kazakhstan. **Top center:** Grain elevators on the steppes of Kazakhstan. **Upper right:** Wheat in transit in Aktau, Kazakhstan's only seaport, on the Caspian Sea. **Middle left:** Wheat products in a local Kazakhstan market. **Middle right:** Naan sellers at the market in Khojand, Tajikistan Bottom: Grain storage in Kerbulak oblast in Kazakhstan.

Agricultural Standouts

WHEAT

Wheat production is a large-scale enterprise that began in the 1950s in an effort to showcase Soviet agricultural prowess. More than 300,000 square kilometers were planted to wheat in the first few years and hundreds of thousands of Russians immigrated to work in the fields. The first harvests exceeded expectations but by the end of a decade the soil had become barren; poor fertilizer use and lack of erosion control led to loss of most of the topsoil. In the 1990s, many state and collective farms were replaced by inefficiently run small farms and cooperatives. Wheat harvests fell nearly as spectacularly as they rose. Yields picked up in 2000 when grain-trading companies took over the management and consolidated these struggling farms and cooperatives, providing much-needed capital and inputs, expertise, and market outlets.

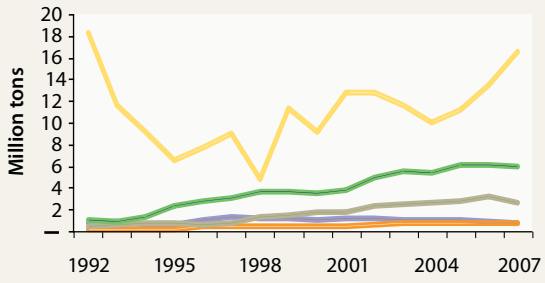
Wheat, primarily grown as winter wheat, is Central Asia's chief grain and now occupies more than 15.8 million hectares in the region. During most of the 20th century, wheat cultivation was concentrated in rainfed areas. However, as grain self-sufficiency became a priority, there have been dramatic increases in the amount of irrigated land sown to grain. The Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan have all increased irrigation areas planted with wheat. Between 1992 and 2005, their wheat production increased by about 40%, 270%, 650%, and 500%, respectively, with both Tajikistan and Turkmenistan more than doubling wheat yields per hectare. Massive increases in the area under wheat in Turkmenistan and Uzbekistan account for much of their spectacular growth in wheat production.

While the goal of its neighbors has been self-sufficiency, Kazakhstan has continued in its role as Central Asia's breadbasket. Spring wheat and winter wheat are grown in Kazakhstan's warm, irrigated southern regions, accounting for a third of the annual wheat crop. The other two-thirds are produced in the country's three rainfed northern oblasts, Akmola, Kostanai, and North Kazakhstan (see image next page). This rich wheat country dates from the Soviet Virgin Land's Campaign, which plowed up and seeded more than 20 million hectares of fragile grassland for wheat production between 1950 and 1960. Wheat production soared, but enormous areas of steppe lands subsequently deteriorated, later requiring millions of hectares of land to be abandoned. Declines in wheat land continued after independence. However, state investment in inputs brought a rebound in 2000, and the wheat production area climbed some 3 million hectares in 5 years.

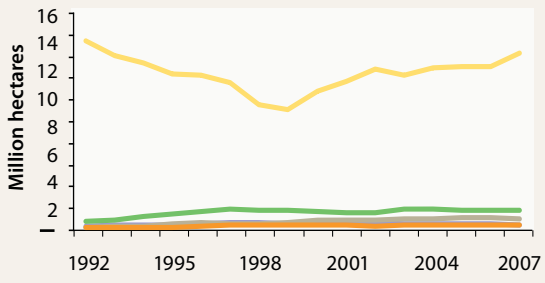
Generally speaking, northern Kazakhstan is considered a risky agricultural zone, receiving very little rainfall and drought in 2 of every 5 years.

Nonetheless, its chernozem and *kashtan* soils are extremely fertile and capable of excellent harvests in years of adequate rain. Moreover, because a hot finish contributes to improved quality, Kazakh wheat tends to be relatively high in protein and quality, and is even better during drought years. Kazakhstan counts wheat among its major exports and, given increasing global demand for the grain, prospects look promising. Moreover, if world grain prices continue to increase, more and more wheat is expected to be planted across the region.

Wheat Production in Central Asia, 1992–2007, million tons



Area Harvested of Wheat in Central Asia, 1992–2007, million hectares



Kazakhstan
Kyrgyz Republic
Tajikistan
Turkmenistan
Uzbekistan

Source: FAOSTAT. 2008. http://faostat.fao.org

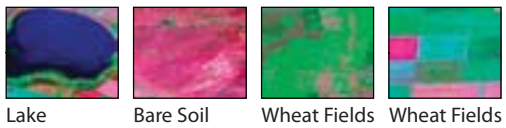
Northern Kazakhstan Wheat Fields

10 5 0 10 Kilometers

1:1,000,000

City

Town



Satellite image: Landsat ETM+ (15m)
Image Acquisition Date: circa 2000 (+/- 3 years)
Projection: Geographic, WGS84
MODIS image: MOD13Q1, Day 257, 2008

Prepared by C. Y JI, 2009.

Upper: Cotton harvest. Cotton plays a major role in the economies of Uzbekistan and Turkmenistan. **Lower:** Tajik villagers collect cotton in Yangiabad, about 140 km from Dushanbe, Tajikistan.

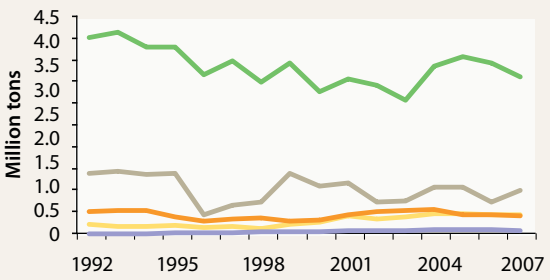
COTTON

Central Asia has the perfect climate for cotton: warm to hot temperatures, low humidity, more sunshine hours, and low risk of rainfall at harvest. Excellent conditions like these helped make Bukhara and Samarkand cotton products popular as far back as the 10th century, fostered the establishment of trade in cotton fiber and cloth to Russia in the 16th century, and encouraged Tsarist expansion to the region to feed Russia's textile mills in the 19th century.

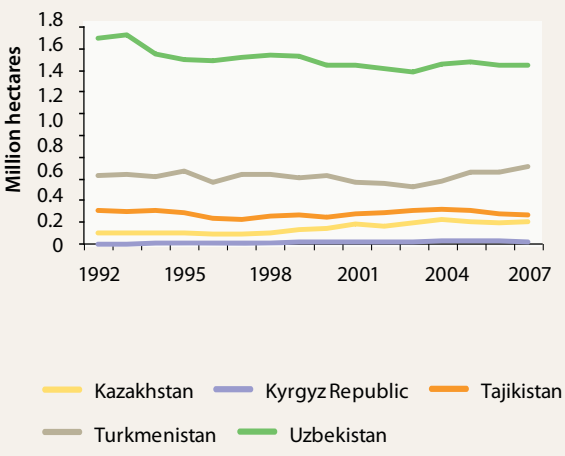
But cotton has proved a double-edged sword. While it has reaped considerable wealth for the region, recent dependence on it—in what many have labeled a virtual monoculture—has had serious consequences. Primary is the environmental degradation caused by the massive irrigation required for growing vast amounts of cotton in Central Asia's parched lands.

Under the Soviets, cotton production expanded geometrically. Production is down somewhat from pre-independence levels. However, it remains a paramount crop that still dominates Tajikistan, Turkmenistan, and Uzbekistan economies. Between 1992 and 2004, cotton lint has been the number one export in each of these countries, and cotton seed, cotton linter, oil of cotton seed, and cotton waste have all ranked among the top exports. The cotton subsector accounted for roughly a fifth of Tajikistan's and Uzbekistan's exports in 2004 and 2005. Production mandates from government are mostly responsible for these high numbers.

Cotton Production in Central Asia, 1992–2007, million tons

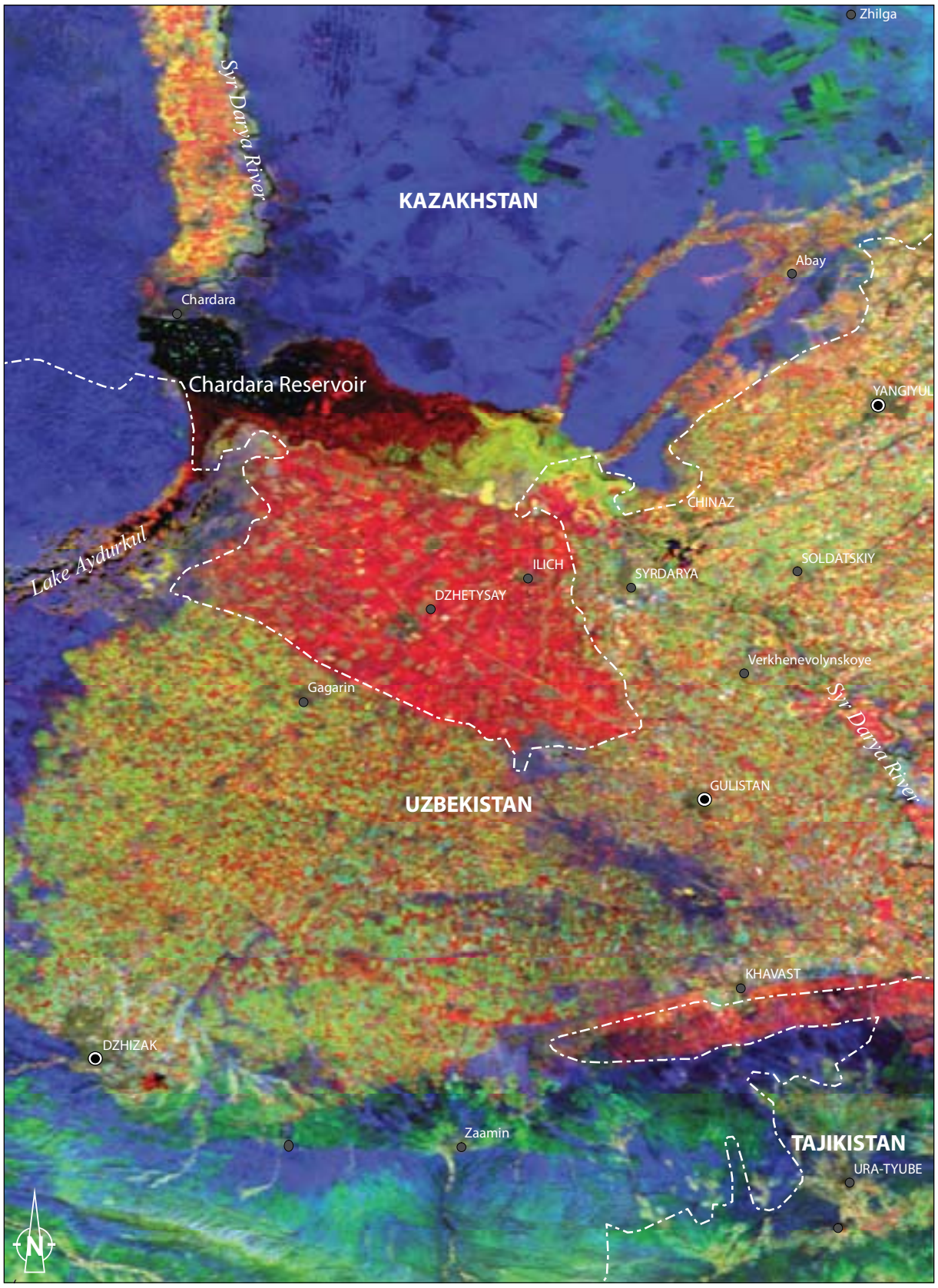


Area Harvested of Cotton in Central Asia, 1992–2007, million hectares



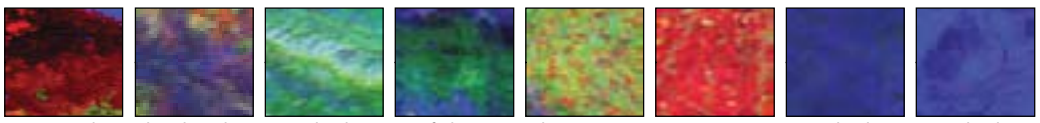
Source: FAO. http://faostat.fao.org (accessed 29 April 2009).

Golodnaya Steppe



10 5 0 10
Kilometers

1:1,000,000



Provincial capital
City
International boundary

Satellite Image: MODIS NDVI Composite (250m)
Image Acquisition Dates: April, May, October, 2008
Projection: Geographic, WGS84

Prepared by C. Y. Ji, 2010

Upper: Cotton ready to be harvested. **Lower**: Cotton loading in Uzbekistan. Image at left shows a cotton-growing area, the Golodnaya Steppe, in Kazakhstan and Uzbekistan, with significant areas of land in Uzbekistan abandoned due to poor drainage causing high salinity.

Upper: Across Central Asia, the cotton industry includes carpet making—here in a carpet factory in Uzbekistan. **Lower:** Cotton factory in the Kyrgyz Republic.

Cotton lint was also the top export for the Kyrgyz Republic, and has stood second only to wheat in Kazakhstan for many years. Both these countries have been diversifying their agriculture in recent years in light of the importance of food security and to some extent have been moving from cotton to grain.

Cotton will continue to play an important role in the region. However, the region has to confront its cotton legacy. Studies have linked cotton monoculture with poverty and, in some cases, repression. However, cotton's role in water and land degradation has caused the most alarm—witness the damage to the Aral Sea and its surroundings.

Golodnaya Steppe, shown in the image on the previous page, is one of the major cotton production bases in Uzbekistan. Much of the area is affected by soil salinity due to disrepair of drainage systems.

The business of cotton, its method of production, and its relative importance to the region's future call for reassessment of the subsector. This will take time. One thing is certain, however: less reliance on cotton and greater agricultural diversification hold strategic, environmental, and socioeconomic benefits for the region.

Fergana Valley

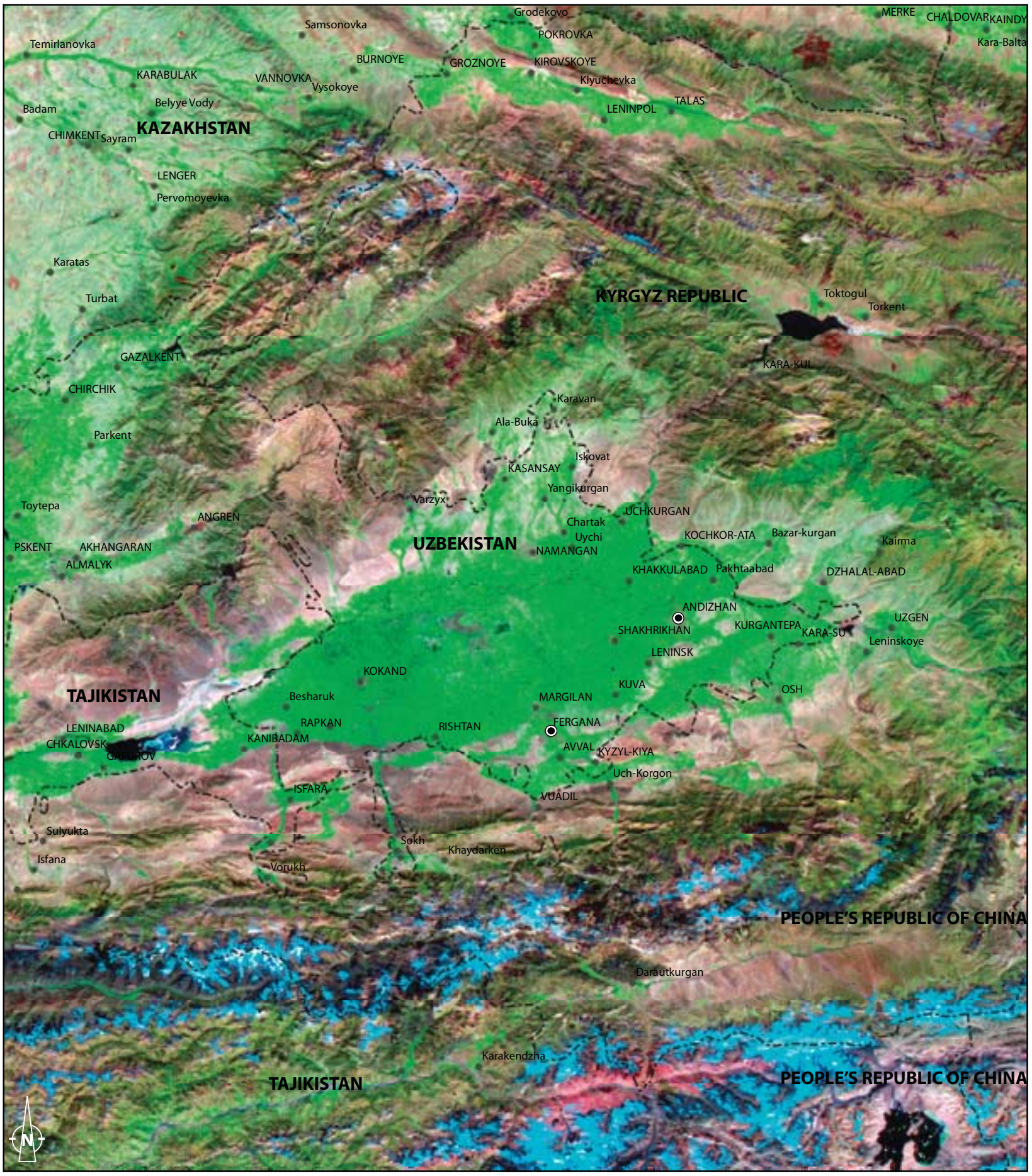
Fergana Valley's rich land and central location (see image, opposite page) have attracted people for millennia. It is as much a center for the region's agriculture as it is for its industry and cultural history. Topographically, it is an enormous depression spanning 22,000 square kilometers between the mountain ranges of the Tien Shan in the north and the Gissar-Alai in the south. Approximately 300 kilometers (km) long and up to 70 km wide, it lies mainly in eastern Uzbekistan and partly in Tajikistan and the Kyrgyz Republic. Comprising only about 1% of Central Asia's land area, it is home to about 18% of the population or about 11 million people, making it one of the region's most densely populated areas. More than a quarter of the populations of Uzbekistan and Tajikistan, and more than half of Kyrgyz Republic's population live in the valley.

Made fertile by the Naryn and Kara Darya rivers, which join in the Fergana to form the Syr Darya, the valley is the backbone of Central Asia's agriculture. It is a major producer of cotton, wheat, fruits, and raw silk. Because of their local demand, many other crops are grown on a smaller scale as well. In the Uzbekistan part, these include carrots, maize, melons, mungbean, and rice, as well as groundnut and vegetables. Rice is double-cropped using drainage water if salinity is not too high. In southern areas, maize and mungbean are also double-cropped. In the Tajik portion of the valley, small-scale farmers also double-crop. Maize and mungbean are grown widely, followed by buckwheat, common bean, groundnut, millet, sesame, soybean, tobacco, and vegetables. When water availability is good, rice is also grown. In addition to annual crops, the area is covered with orchards, vineyards, walnut groves, and mulberry tree plantations (for silk production).

Fergana was exploited by the former Soviet Union for its metal and uranium ores. There are also deposits of oil and natural gas. Other minerals include iron, gold, uranium, mercury, antimony, and ozocerite. These immense natural resources have led to considerable industrialization, mainly through mining and processing industries (oil and gas, chemicals, and textiles).

Unfortunately, increasing population, poor land management, and industrialization have taken a toll on this verdant region. Deforestation and overgrazing, salinization of agricultural soils, pressure on mountain slopes from recent human occupation and agricultural development, as well as land disputes—many of them transboundary—are of increasing concern. Pollution and hazards associated with industry and mining, from both active and past operations, also constitute a threat to both the environment and security. Fifty years of Soviet uranium mining in the adjacent mountains led to accumulation of 174 million tons of toxic and radioactive piles and tailings, deposited in river catchments, river beds, and floodplains. These threaten the valley's future through pollution, especially of water sources, by radioactive and toxic chemicals and the prospect of their movement down the valley in the event of earthquakes, landslides, or erosion.

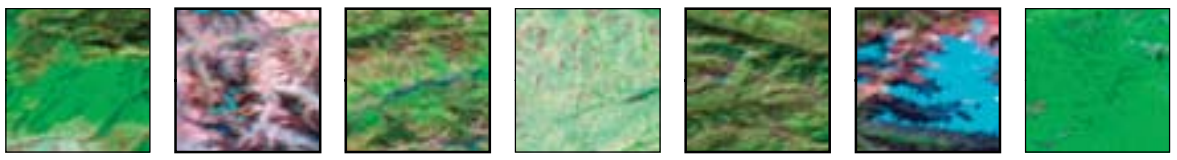
Fergana Valley



25 12.5 0 25 Kilometers

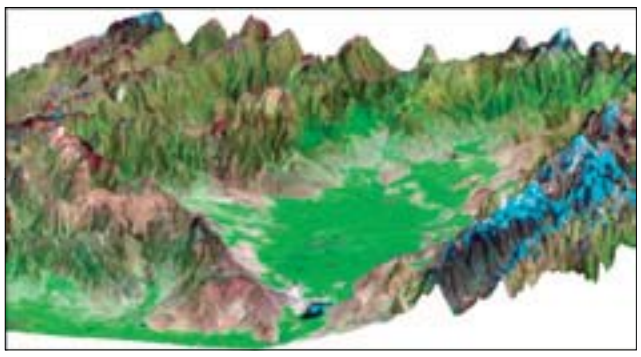
1:1,800,000

- Provincial capital
- City
- International boundary



Satellite image: MODIS (MOD13Q1, 250m)
Image Acquisition Date: Days 257, 2008
Projection: Transverse Mercator

Prepared by C. Y. Ji, 2009.



Right: Three-dimensional image of the Fergana Valley

Upper: A shepherd and his flock in the steppe below the Alatau range, Kazakhstan. **Lower:** Horses graze in the foothills of the Alatau range.

RANGELAND

Central Asia's rangelands are confined to no single topography. They extend over more than 60% of the region, and are abundant everywhere from the deserts of Uzbekistan and Turkmenistan to the mountains and foothills of the Kyrgyz Republic and Tajikistan, and the Kazakhstan great steppe. Specifically, rangeland refers to open, mostly unimproved, land composed of native plant communities that include grasses and shrubs, and may also include seeded managed areas. Generally, it is any land associated with grazing and fodder. However, rangelands are also a source of food, fuel, medicinal plants, and recreation, and provide a significant carbon sink, vital in preventing escape of greenhouse gases.

With more than 185 million hectares of rangeland, Kazakhstan ranks fifth in the world in pasture resources, and first in rangeland per livestock head. Rangeland covers nearly 70% of the country and is found in Kazakhstan's flat steppe zone in the north, the semidesert of the central region, the desert zone of the south and west, and in the southern pasture and desert areas, which can be used year-round. Rangeland also covers roughly 50% or more of the Kyrgyz Republic, Turkmenistan, and Uzbekistan.

The majority of the Kyrgyz Republic's rangeland is found at altitudes of 1,000–3,500 meters, with 25% above 3,500 meters. Land cover varies from

Rangelands of Central Asia, 2007

	Land Area ('000 hectares)	Rangeland (Permanent Meadows and Pastures) ('000 hectares)	Rangeland as % of Land Area
Kazakhstan	269,970	185,098	69
Kyrgyz Republic	19,180	9,375	49
Tajikistan	13,996	3,770	27
Turkmenistan	46,993	30,700	65
Uzbekistan	42,540	22,000	52
Region	**392,679**	**250,943**	**64**

Source: FAOSTAT. 2009. http://faostat.fao.org (updated April 2009).

Upper: Shepherds set up camp in the pastures of the Kazakhstan steppe. **Lower:** Herding sheep across rugged terrain in Jalalabad, Kyrgyz Republic.

semidesert at lower elevations to steppe, mountain steppe, and alpine meadow. Seasonal use patterns generally depend on elevation, with summer pastures found at elevations above 2,500 meters, spring and fall pastures at 1,500–2,500 meters, and winter pastures often below 1,500 meters. Tajikistan's rangeland, like that of the Kyrgyz Republic, is mountainous, with seasonal and year-round pastures.

In Uzbekistan, 80% of rangeland is in the deserts of the Kyzylkum, Ustyurt Plateau, Karshi Steppe and Fergana Valley; rangeland is also found in piedmont areas in the east and in semidesert areas spread sporadically around the country. Most of Uzbekistan's rangeland can be used year-round.

But overgrazing has reduced the productivity of the region's pastures dramatically and is leading to their desertification. In Tajikistan, for example, 90% or more of pasture land is degraded; and in Uzbekistan, 70%.

Top: A breeder from the state stud farm, Uzbekistan, shows the farm's pride—home-bred White Karakul sheep. **Middle:** Horses are also a source of milk for rural families; farmer milks a horse in Sary near Pavlodar, Kazakhstan. **Bottom:** Goats are a source of both meat and milk in many areas of the region.

LIVESTOCK

Livestock remain one of Central Asia's most important agricultural commodities. They represent a principal export of Kazakhstan, the Kyrgyz Republic, and Turkmenistan, and a key source for rural employment, food, and income generation across the region. Long a staple of Central Asian agriculture, traditional forms of nomadic pastoralism were practiced in some parts of the region until the 1930s, when Soviet mass collectivization abruptly forced the last pastoralists to move to big agricultural cooperatives and state-run farms.

Central Asia's livestock sector flourished under collectivization. Soviet infrastructure not only offered animal health services and a ready supply of mechanically harvested fodder but also provided sufficient shepherds and transport to ensure that grazing animals could follow traditional seasonal patterns of migration. Herds and flocks grew enormously, and markets were made available for meat, pelts, and wool within the former Soviet Union, and for pelts to luxury markets abroad.

Regional independence brought an end to this supply and market infrastructure, and the sector quickly declined as state support all but disappeared and large enterprises gave way to smaller units—cooperatives and individual and household farms. Herd and flock sizes began to plunge. Small livestock counts eroded genetic pools and breeding practices. Lack of state support led to declines in animal health and ended the transport of animals to fertile, remote rangelands, causing farmers to overgraze close to home, resulting in land degradation near villages and underutilization of land elsewhere. Together, this has reduced farm quality and income, and led to increasing levels of poverty in rural areas, with livestock, in many cases, being sold off and land being sowed with subsistence crops instead of fodder.

Still, the livestock sector is anything but fading. This is important because it is not only vital to the rural economy but it also significantly contributes to the region by providing employment, a source of nutrition, and much-needed foreign exchange. Primary livestock include sheep, cattle, goats, pigs, and horses. Top 10 livestock export products since 2000 have variously included cattle hides, pig meat, wool, and skim cow milk in Kazakhstan; cattle hides, fine animal hair, wool, cow milk, cheese, and ice cream in the Kyrgyz Republic; and wool and cattle hides in Turkmenistan. Uzbekistan and Turkmenistan are important breeders of Karakul sheep, famous for the production of Astrakhan pelts. Along with Tajikistan, these countries also produce significant quantities of cattle meat and fresh milk from sheep and goats.

Today, the sector is dominated by private ownership, although the institutions created to replace the pastoral collectives remain weak. Progress varied in the countries. In the Kyrgyz Republic, agrarian reform has progressed quite rapidly, with most collective farms restructured as cooperatives or peasant enterprise associations. In Kazakhstan where agriculture is less significant in

the overall economy, reform in the livestock sector has been slower.

For the sector to grow, these fledgling private institutions—as well as the traditional herding groups and herders' organizations that are taking on greater roles—need continued support; for example, through technologies to increase fodder production and preservation in the lowlands, improve grazing management, and use feed resources more efficiently. Reintroduction of high-yielding forage crops offers some promising solutions.

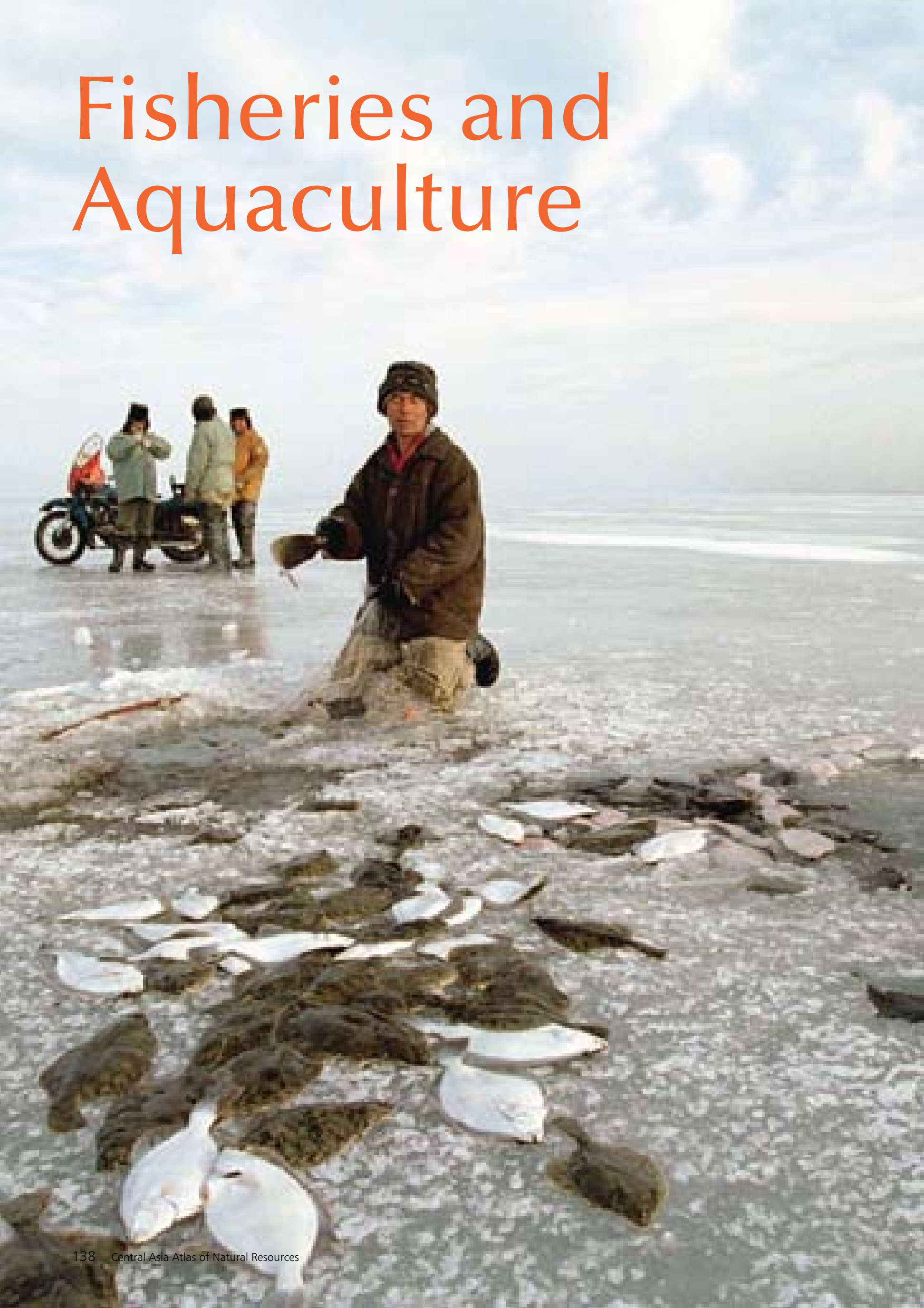
Central Asia's Major Livestock Products, 2007, kilograms
Top 5 Products in Each Country are Shown in Bold Type

	Kazakhstan	Kyrgyz Republic	Tajikistan	Turkmenistan	Uzbekistan
Camel milk	—	26	—	—	260
Camel meat	—	—	—	—	610
Cattle meat	**383,800**	**92,000**	**26,900**	**102,000**	**586,300**
Chicken meat	52,000	5,500	700	12,600	24,900
Cow milk, whole, fresh	**5,006,700**	**1,192,000**	**529,000**	**1,332,800**	**5,121,000**
Goat meat	10,500	7,300	—	6,400	—
Goat milk, whole, fresh	15,500	8,500	**54,600**	—	36,300
Hen eggs, in shell	**147,700**	**20,830**	**6,180**	**33,900**	**37,500**
Horse meat	58,000	20,500	—	—	2,000
Natural honey	—	1,400	200	—	2,200
Other bird eggs, in shell	1,700	110	—	255	3,200
Pig meat	**218,000**	18,900	—	210	19,200
Rabbit meat	2,000	200	—	—	200
Sheep meat	**114,000**	**39,500**	**29,400** [a]	**90,200**	**88,900**
Sheep milk, whole, fresh	51,000	**40,000**	—	—	**500,000**
Silk-worm cocoons, reelable	—	150	—	—	18,000
Wool, greasy	34,172	10,600	3,700	**20,200**	22,600

— = data not available.
[a] Sheep and goat meat.
Source: FAOSTAT, 2009. http://faostat.fao.org

Top: Herd of goats in Tes Tur, Kyrgyz Republic. **Middle:** Sheep in the green valley near Karakol, Altyn Arashan, Kyrgyz Republic. **Bottom:** Kyrgyz traveler with his donkey and cart near the shore of Lake Issyk-Kul.

Fisheries and Aquaculture



A fisher removing flounder from a net pulled from a hole in the ice in the northern section of the now divided Aral Sea. The northern Aral Sea is rebounding and catches are increasing year by year. **Upper right:** Mixed harvest from the northern Aral Sea, where catches have been growing in diversity and quantity since the Aral Sea was divided by a dike in Kazakhstan in 2005. **Lower right:** The herbivorous grass carp *(Ctenopharyngodon idella)*, successfully introduced into Central Asian rivers, is a commercial species with ecological benefits; it also helps to keep waterways clear by eating aquatic weeds.

Central Asia's major source of fish is the Caspian Sea. During the Soviet period, more than half a million tons of fish were harvested from the sea each year by the five countries surrounding it, the main species being sturgeons, beluga, and sterlet; sprat and herring; zander or pike-perch; common carp; bream; catfish; and the Caspian roach. Other commercially important species are the shads: blackback shad, dolginka shad, and Caspian shad; and the asp (a carp).

Catches of most of these fish have fallen dramatically since the beginning of the 1960s, as large reservoirs and canals were constructed on rivers flowing into the Caspian basin for irrigation, especially of cotton farms. These prevented many anadromous species, especially the sturgeons, from completing their life cycle throughout most of their range. Pollution from agricultural and industrial effluent and from oil production on and around the sea has also degraded many fish habitats.

The Aral Sea was also a source of fish. However, its reduction in size accompanied by increased salinity and pollution reduced catches there to almost zero. Other sources of fish production are natural fisheries in all freshwater bodies and aquaculture, or fish farming, in lakes, ponds, and reservoirs.

At present, fish production is at a low ebb, with regional production at 50,000–60,000 tons, plus a significant but unknown illegal catch. Between 1989 and 2006, fisheries and aquaculture harvests in Kazakhstan, Turkmenistan, and Uzbekistan fell by 60%–72%, while in the Kyrgyz Republic and Tajikistan they fell even more dramatically, by 98% and 94%, respectively.

Fish consumption now is only a tenth of that in the 1980s. At that time in the Kyrgyz Republic, for example, Thursday was "fish day," when all restaurants served fish dishes. After independence, as fish became scarcer and more expensive, this tradition vanished. Consumption there is now less than 1 kilogram per person per year, and less than half a kilogram in Uzbekistan. Kazakhstan's (mainly Caspian) fisheries provide its population with about 8 kilograms per person per year on average.

The main reasons for declining production are overfishing; poor management; large decreases in investment in research, production facilities, and maintenance of fleets and hatcheries; and pollution of water bodies. Some details follow.

The fisheries sector in Kazakhstan was very important during the Soviet period, with production exceeding 80,000 tons per year, 90% of which came from the Caspian Sea. In 2006, total production was about 35,000 tons, almost all from the Caspian. Exports remain significant. Aquaculture during the Soviet period contributed 8,800 tons of fish per year but has virtually

Top left: Fresh fish for sale in a street in Almaty, Kazakhstan. **Top middle:** People fishing at a trout farm in Turgen Gorge near Almaty. **Top right:** Fish being prepared for canning at a factory in Turkmenbashi on the Caspian Sea, Turkmenistan. **Middle:** Dried fish for sale at a roadside store near Naryn, Kyrgyz Republic. **Bottom:** The asp *(Aspius aspius)* is a fish-eating carp, found in most of Asia and eastern Europe; it grows to 9 kilograms and is a game fish as well as a commercial species in Central Asia.

disappeared. In 2003, a Fish Farming Committee was established to revive the industry. Hatcheries for carp and sturgeon are being set up and long-term land leases made available to encourage private investment.

A new development is boosting Kazakhstan's fisheries. The waters of the northern Aral Sea have been rising since Kazakhstan separated it from the larger southern part by a dike in 2005, and fish catches have been booming. The annual harvest increased from 52 tons in 2004 to 1,490 tons in 2008. And with plans in hand for other dikes and canals, catches could multiply again.

Fish production in the Kyrgyz Republic was mainly in Lake Issyk–Kul, with annual harvests approaching 1,500 tons. Production began to fall. In the 1970s and 1980s, 70% of the annual harvest of 1,400 tons came from pond culture on state-run farms. After independence, the farms were privatized and production declined. Kyrgyz Republic's 1,900 lakes and 30,000 rivers longer than 10 kilometers produce very little at present, but could produce significant quantities—given cost–benefit studies and enforced regulations, especially on illegal fishing. However, the opening of reservoirs for hydropower interferes with fish reproduction and habitats, and stocking will be needed to increase catches.

Tajikistan's fish production from its extensive rivers and reservoirs is quite low. Reservoirs have been stocked with a variety of species, including snow trout, Amudarya trout, Tibet char, Tajik char, Turkestan bullhead, Amudarya goby, and topminnows, among others. The Kayrakkhum Reservoir, for example, currently provides 150 tons of fish per year.

Turkmenistan's entire western border faces the Caspian Sea. Yet, the only fishery of any significance now is that for the small Black Sea

Central Asia Fish Production, 1996 and 2006, tons

	1996			2006		
	Capture	Aquaculture	Total	Capture	Aquaculture	Total
Kazakhstan	44,273	1,682	45,955	35,148	528	35,676
Kyrgyz Republic	160	185	345	7	20	27
Tajikistan	40	93	133	184	26	210
Turkmenistan	9,014	307	9,321	15,000	16	15,016
Uzbekistan	1,494	5,006	6,500	3,400	3,800	7,200

Sources: *FAO Yearbook of Fishery and Aquaculture Statistics.* 2006.
FAO Fisheries and Aquaculture - Global Statistical Collections. www.fao.org/fishery/statistics/en

Central Asia Fish Trade, 1996 and 2006, $ '000

	Trade1996		Trade 2006	
	Imports	Exports	Imports	Exports
Kazakhstan	16,881	19,017	33,738	50,589
Kyrgyz Republic	1,435	–	3,949	18
Tajikistan	114	–	954	–
Turkmenistan	223	293	617	27
Uzbekistan	1,553	534	1,213	444

Sources: *FAO Yearbook of Fishery and Aquaculture Statistics.* 2006. FAO Fisheries and Aquaculture - Global Statistical Collections. www.fao.org/fishery/statistics/en

sprat, about 15,000 tons annually. Its erstwhile lucrative sturgeon fishery for caviar has dwindled to almost nothing as the sturgeon species have become almost extinct. The country's harvest from lakes and reservoirs is very low, less than 500 tons per year, yet there is potential to produce six times that amount. Harvests are now increasing with the successful introduction of algae-eating silver and grass carps from the People's Republic of China into the Amu Darya River Basin. An added benefit is that these carps keep the canals clear of aquatic weeds and prevent damage from water eutrophication.

Before the 1960s, the Aral Sea provided 25,000 tons or 60% of Uzbekistan's annual fish catch but by the early 1980s, the Aral Sea catch declined to zero. Total fish production in 2006 was only 7,200 tons, around half from 800,000 hectares of lakes and reservoirs and the remainder from aquaculture. The lakes and reservoirs could provide three times this amount, while the 10,000 hectares of aquaculture ponds could produce 20,000 tons annually. The subsector was privatized in 2003 and more than half a million hectares have been leased out for aquaculture. Commercially important species include common carp, pike-perch, common bream, catfish, asp, goldfish, silver carp, grass carp, snakehead, and pike.

Beluga Sturgeon

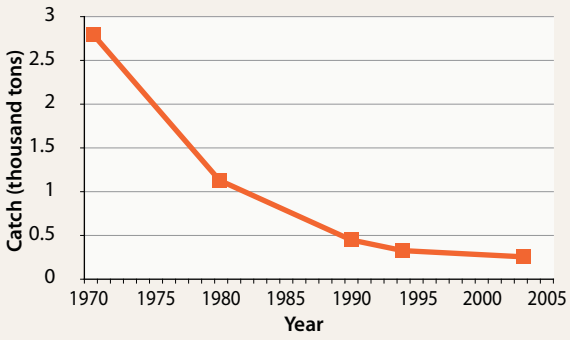
Caviar, one of the world's most exotic and expensive foods, is the eggs or roe, of sturgeons. The slightly saline Caspian Sea is the favorite haunt of sturgeons. Six species live there and in the many rivers that flow into it from the surrounding countries—Azerbaijan, Iran, Kazakhstan, the Russian Federation, and Turkmenistan. The Beluga sturgeon (*Huso huso*) yields the most expensive caviar of all, selling at two to three times the price of other sturgeon caviar. And it is an impressive fish to say the least, growing to 6 meters or more and weighing up to 2 tons, making it far bigger than most sharks. After reaching maturity at around 2 meters long and 13 years of age, mature female Belugas head into the freshwater rivers annually to spawn.

The Caspian Sea accounts for 80%–90% of all sturgeons caught. The catch of Belugas fell from nearly 3,000 tons in 1970 to about 300 tons in 2003. The reasons are a microcosm of many similar problems faced by inland fisheries everywhere. First, many rivers have become blocked with hydropower dams since the 1950s, and said to have affected by now 90% of the spawning grounds. Second, heavy fishing even of small sturgeon that had not yet spawned meant there were insufficient numbers of young fish replacing those caught. Third, the Soviets built hatcheries but most of these fell into disrepair after independence of the Russian republics. Fourth, there is no Caspian-wide management of the fisheries. They are managed by the individual countries. Finally, restrictions on catch have led to much illegal fishing, and no wonder. Recent prices of Beluga caviar were about $3,000 for a 0.25 kilogram (kg) pack, translating into a retail value of up to $360,000 from a single moderate (250 kg) size fish. Fifth, the Caspian rises and falls in a cyclic pattern over decades. It reached its lowest level in recent times in 1977, meaning less food—small fish, crustaceans, and worms—for the sturgeon. By 1995, the sea had risen substantially, flooding lands by then contaminated with agricultural residues like pesticides, oil, and metals from mining wastes.

Since 1998, official international trade has been regulated by the Convention on International Trade in Endangered Species (CITES) so that all caviar has to have an export permit and be from a legal fishery. Regulations under CITES closed the trade from the Caspian and other areas in 2006 but allowed it to re-open in 2007. Meanwhile, the sturgeon populations show no signs of recovery and could eventually become extinct.

Upper: In the past decade, fishers have rarely seen mid-sized Beluga sturgeon like the one pictured here, captured from the Volga River in the Russian Federation. **Lower:** A Beluga sturgeon from Kazakhstan's Ural River undergoes a nonlethal method of egg extraction.

Beluga Sturgeon Catch



Source: Larissa J. Graham and Brian R. Murphy. 2007. The Decline of the Beluga Sturgeon: A Case Study about Fisheries Management. *Journal of Natural Resources and Life Sciences Education.* 36: 66–75.

Peoples and Cultural Traditions

Above: Kazakh horseman with his eagle; the traditional sport of hunting with eagles is still practiced today. **Upper right:** Portrait of a young girl in Nakhur, Turkmenistan. Villagers claim ancestry from Alexander the Great's army. **Lower right:** Kyrgyz men riding a minibus along the Pamir Highway.

The peoples of Central Asia today derive from a multitude of tribes and races, and from processes of assimilation, coercion, conquest, and migration. Some understanding of this complexity can be found in historical events.

Rich and Turbulent Past

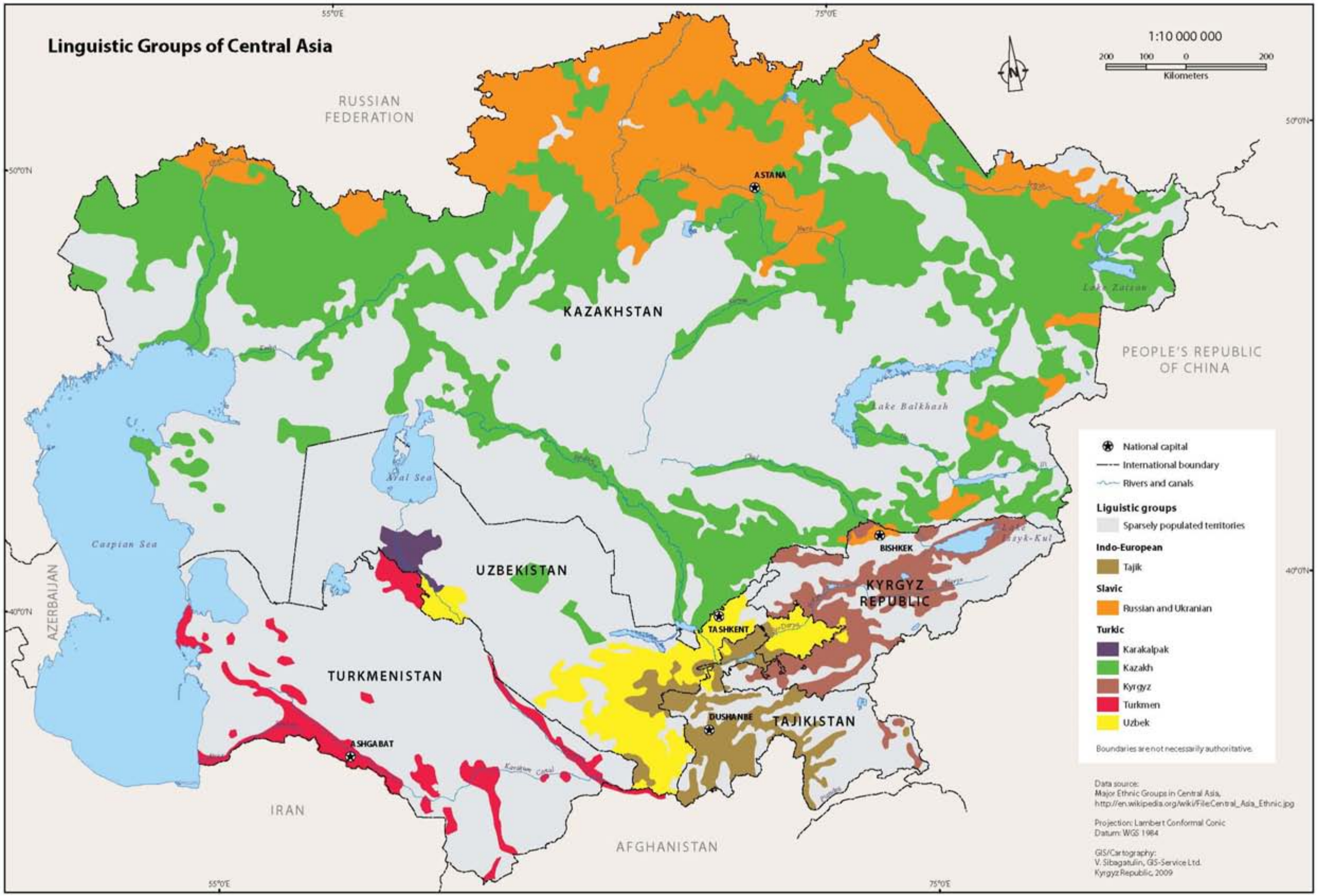
The area now called Central Asia was occupied in past millennia by Persian or Iranian tribes—mainly Persian-speaking nomads and settlers in the steppes, piedmonts, and mountains, and around rivers and oases in the more arid and desert areas. They developed irrigation for agriculture perhaps 5,000–6,000 years ago and large populations developed around the irrigated areas. The area of the present Uzbekistan is said to be one of the cradles of human civilization, containing some of the world's oldest sedentary populations and cities. Domestication of horses for transport in about 4,000 BC is attributed to these people.

Empires rose and fell. The Archaemenid Persian Empire, perhaps the largest empire of ancient times, covered the region from 550 BC to 330 BC. A Greek dynasty under Alexander the Great then held sway for more than a century until a nomadic tribe from the Central Asian steppe, the Parni, seized control and began the Parthian Empire, which assimilated Archaemenid and Greek culture and lasted until the 3rd century AD, when the Romans finally conquered the Parthians and took their almost incredible wealth to Rome.

Across the southwestern parts of the region, the Sassanid Persian Empire then arose. It replaced Greek cultural influence and restored Iranian traditions until Muslim Arab invasions swept across the region in the latter half of the 7th century. Arabic tribes and culture dominated much of the region over the next 3–4 centuries, establishing Islam as the main religion, and bringing what is described as a golden age of art, culture, and knowledge.

In the east of the region, Greek influence was replaced by that of the Kushan Empire that brought Indian influence and by the Chinese Han dynasty. The Persian language and culture persisted through the period of Arab control and by the 12th century, Persian (Farsi) had become the main written language.

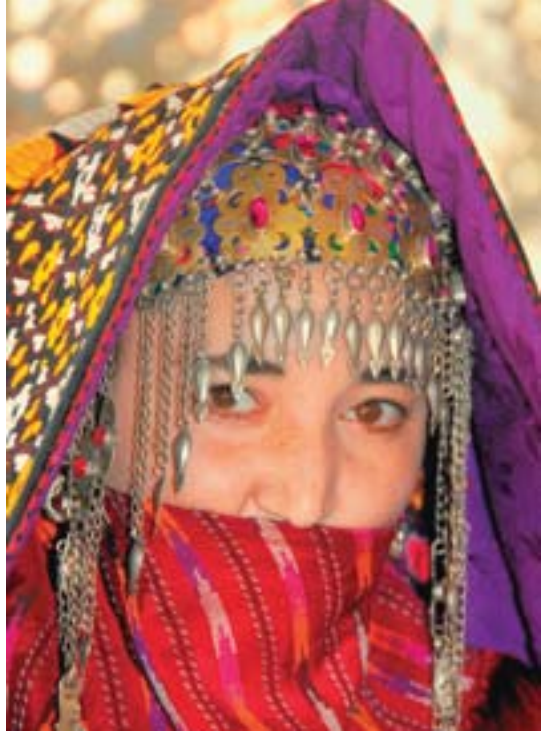
Linguistic Groups of Central Asia



Data source:
Major Ethnic Groups in Central Asia,
http://en.wikipedia.org/wiki/File:Central_Asia_Ethnic.jpg

Projection: Lambert Conformal Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd.
Kyrgyz Republic, 2009



Meanwhile, Turkic tribes, derived from Oghuz tribes from Mongolia in the east, became prominent in the region by the 6th century. One Islamic tribal group, under its leader Seljuk, came to power in the 11th century, occupying most of the region and spreading south into what is now Turkmenistan (and into Iran) and giving rise to the former name of the area: Turkestan, or Land of the Turks (which then also included the present-day Xinjiang Uyghur Autonomous Region).

Turkmen came to be identified with these Oghuz, especially those who adopted Islam; later the term Turkmen replaced Oghuz altogether. The Turkmen gradually removed the Persian influence across Central Asia and Turkish people—the Oghuz Turks (or Turkmen), Uzbeks, Kazakhs, Khazars, and Kyrgyz—still dominate the region today.

Early in the 13th century, the Mongol tidal wave of Genghis Khan swept through the region, on the one hand destructive but on the other bringing security of trade along the Silk Road. Europeans, Marco Polo, among them, began to venture across Asia.

The Mongols were conquered by Uzbek tribes at the beginning of the 16th century. Over the next 4 centuries, the region was splintered into many khanates and emirates accompanied by almost incessant struggles for power. Uzbek rule was weakened, while the wealth of the region as a whole declined as ocean transport began to replace the Silk Road.

The rise of the British Empire in the west and of the Russian Empire to the north replaced Turkic and Mongol influence as the British and Russians vied for control over the region through the 19th century in a 100-year "Great Game." The Russian revolution of 1917 changed the dynamics of this conflict, when Russia annexed most of the region. The countries now known as Central Asia were formed in the 1920s as republics of the former Soviet Union.

The division of the region into five republics by the Soviets in the 1920s broadly followed ethnic and

Clockwise from top: Young woman in Tastubek, Kazakhstan; Turkmen Bride, Ashgabat, Turkmenistan; Young boy from Saty near Pavlodar, Kazakhstan; Ethnic Kyrgyz family, as denoted by the man's hat, in their yurt in the Aksu Valley, Gorno Badakshan, Tajikistan.

Map of Central and East Asia, in Smith's *New General Atlas*, London, 1816, showing most of the terrain covered by the Silk Road; most of the present Central Asia was known as Independent Tartary (left side of the map).

Silk Road to Hydrocarbon Highway

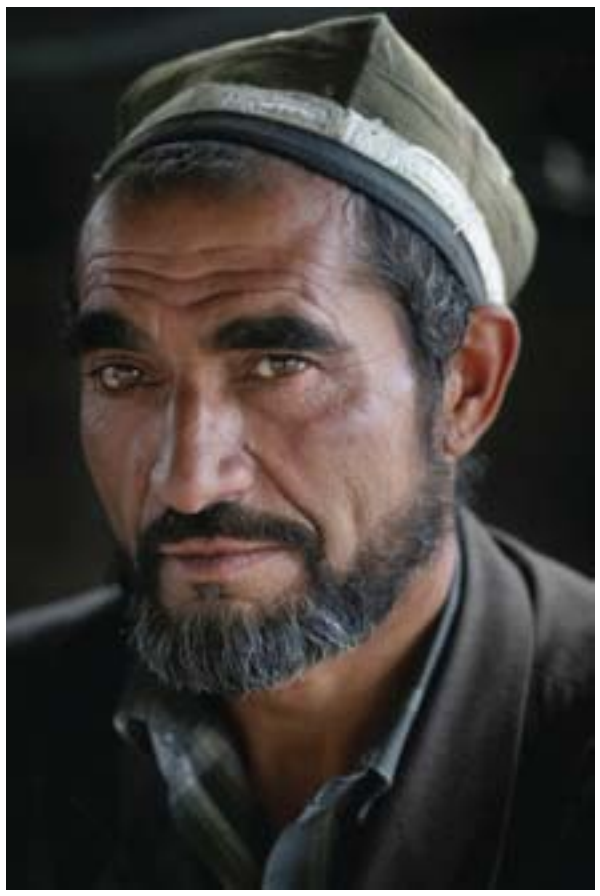
As early as the 2nd century BC, Chinese silk was well known and prized in Rome. It traveled there along a 7,000-kilometer route by horse and camel that passed through the lofty Pamir or Tien Shan ranges and across Central Asia. Magnificent cities arose at major stopover points (caravanserais), including Merv in what is now Turkmenistan and Bukhara and Samarkand in Uzbekistan. From these cities, the route went either along the Kazakhstan steppe around the northern side of the Caspian Sea or through the deserts and south of the Caspian into Persia (Iran).

Many other wares were traded along the routes, including spices and perfumes, medicines, jewels, and silverware—and slaves. Philosophies, religions, languages, scientific discoveries, technologies, and diseases also passed from east to west and west to east. Goods were bought and sold by traders along the way going in either direction and also to and from South Asia.

Armies used the routes. Those of Genghis Khan and successors, while brutal, made the way safer for travelers like Marco Polo, whose stories in the 13th century led to a flourishing of trade that finally came to an end in the 17th century as sea routes became more popular and profound economic and political changes overtook the Asian countries.

Collectively, the many routes are called the Silk Road, ironically a name that only dates from the 19th century. Now oil and gas pipelines crisscross the deserts and steppes where the caravans passed, taking a new product, energy, to distant countries.

The oldest of the three fortresses at Ayaz Qala, once a caranavserai, built around the 4th century BC in the Ellikqala region of present-day Karakalpakstan in Uzbekistan.



linguistic groups, but not entirely. For example, the division of the population of Fergana Valley among three republics—the Kyrgyz Republic, Tajikistan, and Uzbekistan—turned some ethnic communities into minority groups in a different country. Independence brought increased ethnic tensions as the countries began to exert their new nationalism.

Tribes and Languages

Within the major ethnic groupings are various clans or tribes. For instance, the Kazakhs belong to one of three clans or tribes—the Lesser Horde in the west, Middle Horde in the north and east, and Great Horde in the south. Their language is a subgroup of northeastern Turkic languages, heavily influenced by both Tatar and Mongol.

The Kyrgyz belong to one of three groups of clans: left wing, right wing, or "neither." They all share a common Turkic language. Prior to independence, Turkmen lived in many separate tribal and territorial groups, virtually independent from each other and speaking different dialects. Tribal affiliation has remained an important social factor up to the present. Major Turkmen tribes include the Tekke, Ersari, Yomud, Goklen, Salor, and Sarik.

The Tajiks have Persian roots and their Persian language has several geographically based dialects. Written Persian dates from the 5th century BC and the "modern" version, Farsi, was first written in the 9th century AD. The language was renamed Tajik when the former Soviet republics were created. In one part of the country, Badakhshan, however, people speak several Pamir languages that have no script and are still not written.

Traditionally, the Turkic languages were only spoken. Histories and legends were passed on orally through elders appointed to the task and, in some groups, through poets who traveled with wealthy families. Kazakh was not written until the 1860s and Kyrgyz in 1919. Turkmen scholars and

Clockwise from left: Elderly Kyrgyz shepherd outside his yurt on an alpine plateau; Girls in traditional dress displaying some of the famous Turkmenistan carpets; Sunrise at the Tila-Kari Medressa (Muslim school) in Registran, Samarkand, Uzbekistan; Portrait of a Tajik man in traditional hat; Uzbek shuttle trader and daughter embroidering ceremonial clothes.

Upper: Buzakashi players. **Lower:** A magnificent Akhal-Teke horse with rider.

poets began to use a written language, Chaghatai, in the 18th century.

Cultural Icons

Central Asia has a unique blend of cultural icons. Foremost among them is the horse, first domesticated in the region some 6 millennia ago. Horses extended the reach of travelers and warriors alike and accelerated the spread of cultures and religions. Horses were a major factor in the success of the Mongol hordes in their invasions.

Modern horse breeds range from the stocky Przewalski's horse from the steppe, the last surviving subspecies of wild horses, to the Akhal Teke breed, which has a special place in the culture of Turkmenistan. These are tall, slim horses of a golden color, furthest among the Central Asian breeds from the Przewalski's horse and are the ancestral breed of western racehorses. Other ethnic groups also take pride in their horses. Horses are said to be the wings of the Kyrgyz people. The Tajiks have their *lokai* breed and the Uzbeks the *karabair* breed, both horses of great endurance.

Horses are an essential ingredient of recreational activities in most of the region, in such games as horseback fighting, in which riders grapple to topple each other from their horses; horse racing over distances up to 100 kilometers; wrestling among horse riders for a goat carcass (buzakashi), a lively event depicting the chasing and beating of a wolf that has attacked a livestock herd; and chase-the-girl, a wedding ritual involving the groom chasing and catching the bride—both on horseback.

Bactrian, or two-humped, camels were domesticated around the same time as the horse; these camels were used for transport and, by the 2nd millennium BC, in towing wheeled vehicles for farmers. The camel became for the sedentary groups what the horse was for the nomadic tribes. Horses were often associated with war, camels with trade: horses gave Genghis Khan's hordes advantage in battle; camels made possible the caravans that plied the Silk Road.

Falconry, using birds (mostly falcons and hawks, although the Kyrgyz also used golden eagles) to catch prey for humans, is a proud tradition with roots in the 1st or 2nd millennium BC. It was held in esteem as a noble sport across the region and beyond and is now popular worldwide. The Saker falcon is a favorite bird for falconry, a popularity, however, that has led to rapid decline of Central Asian Saker populations.

Ethnic groups throughout the region have one thing in common, the yurt, their compact, circular houses with dome roofs, made of a wooden frame covered in felt from the hides of sheep or other livestock. Of course, different tribes have different touches and motifs. All have the advantage of being quickly erected and dismantled for travel, as the nomadic communities move their herds from pasture to pasture.

Nomadic groups have traditionally crafted carpets for their yurts. The best-known carpets are those from Turkmenistan and Uzbekistan, such as the "red rugs," woven by nomadic tribes, principally Tekke Turkmen, who extract a wide variety of red and red-brown dyes from the madder plant for their carpets.

Women are skilled in exuberant and colorful embroidery and each ethnic group has its own distinctive patterns. Embroidery extends beyond garments to decorative motifs on animals, especially horses.

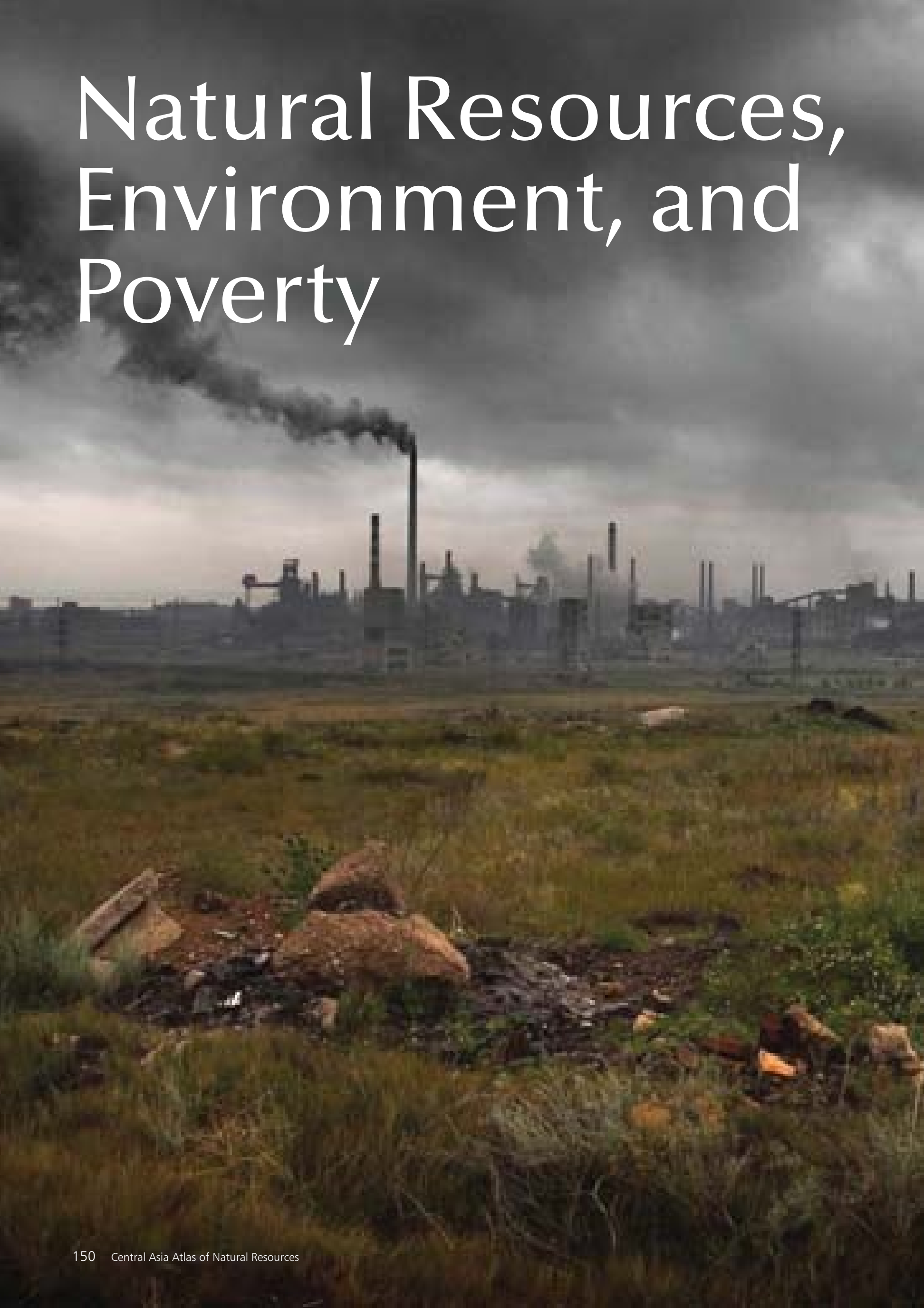
The New Nomads

Formerly nomads who moved with their livestock across a relatively borderless expanse of deserts, steppes, and mountains, Central Asians found themselves bottled up by the Soviets. Nomadic pastoralism was still the main way of life in the region in the early 20th century and it virtually came to an end when the Soviets created their republics. Some ethnic groups found themselves on the wrong side of new borders that separated them from erstwhile neighbors. And this situation lasted more than 60 years.

The breakup of the Soviet Union also ended travel restrictions and unlocked borders in at least some of the Central Asian countries. There were sudden, large initial migration flows to ethnic or cultural homelands, some of it voluntary and some forced due to ethnic tension or conflict. In more recent years, the motivation has been to seek better-paid jobs. Market opportunities in Kazakhstan—which lost at least 15% of its population during the early transition period—have made it now the largest receiving country in the region. Emigration from some of the region's countries is spurred by degradation of pastureland at home. Pastoral nomads have become economic nomads.

Upper: Woman in colorful clothes, with her camel and its calf at Damla Oasis in the Karakum Desert, Turkmenistan. **Lower:** New Nomads: Tajik migrant workers on their way to a construction site in Moscow, Russia.

Natural Resources, Environment, and Poverty



The price of economic growth in Central Asia, perhaps more than anywhere else in Asia, has been paid by the environment. Particularly during the Soviet period, when massive agricultural and industrial enterprises, together with gigantic infrastructure that straddled the region, were put in place, environmental concerns were considered to be less important than development goals. These enterprises were nearly all based on exploitation of natural resources—oil and gas beneath deserts, sea, and steppes; cotton and wheat agriculture on converted steppe and desert land; mining for many metals in all terrains; and underpinning everything, diversion of precious water from the region's sparse rivers.

The first inklings of the enormity of these environmental costs were seen when the Aral Sea in the west began to shrink in the 1960s. The consequences for the environment stretched all the way across the region to the mountains in the east. And from those mountains and along the plains came pollution from agriculture, drilling, and mining whose effects were felt in turn as far as the westernmost parts of the region.

Virtually every aspect of natural resource development in the region has resulted in enormous and sometimes irreparable environmental damage. "Unsustainable" describes the present state of regional economic development.

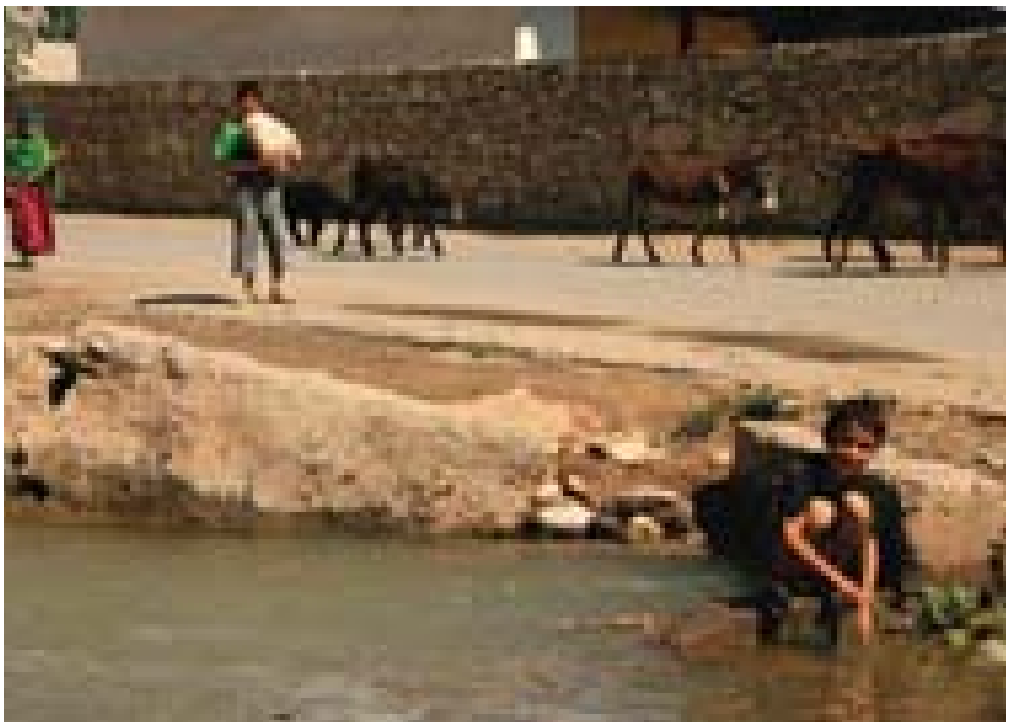
Overstretched Water Resources

Water scarcity has been Central Asia's fundamental concern for millennia; its mismanagement is now equally fundamental. The use of water—for energy and especially for irrigation—is greater than the capacity of the water resources to satisfy both human and ecosystem needs, making current water-use practices unsustainable. Use of excessive water from Soviet times until today has caused both reparable and irreparable damage, affecting the quality of the region's air, soil, and biodiversity, and of the water itself. Water misuse has reduced productivity of natural land areas, rivers, and reservoirs. It has transformed topography and climate. And in the face of expected negative effects on water sources from climate change, continued mismanagement and misuse of water will result in far greater consequences.

DIVERSION OF WATER RESOURCES

Water diversion in the region's main water sources, the Amu Darya and Syr Darya basins, primarily results from the regulation of rivers by reservoirs to store water for irrigation and power generation. Under Soviet authority, water was allocated between the countries of the region by quota. This water-use quota system remains to a degree. However, without a "central authority,"

Industrial complex in Shymkent, the "City of Grass," Kazakhstan. Upper left: Camels graze where fish used to swim—the dried Aral Sea. **Lower right:** Dump site in the former Aralsk harbor in the Aral Sea.



Upper: A hydropower station in Tajikistan. **Lower:** A boy in need of water fills out a bottle from the river near Kurgan Teppa in Tajikistan.

differences in country priorities make coordination of rational water allocation between upstream and downstream users difficult.

Between 1960 and 2000, farmland grew enormously in the Amu Darya and Syr Darya basins. To service this land, vast irrigation and drainage networks were built. By the 1980s, overall water consumption had begun to exceed available river water resources. The difference has been made up by using return water from drainage such that in the Amu Darya and Syr Darya basins, 100%–110% and 130%–150%, respectively, of available water resources are used.

Poor construction in Soviet days and lack of maintenance have led to infrastructure deterioration. A history of inappropriate management led to high water application, which reduced farmland quality by raising water tables and increasing salinization. Reduced crop production creates a vicious cycle because the labor-intensive practice of using large amounts of water to flush out salt only serves to increase the damage. Over the years, poor irrigation practices have caused millions of hectares of land to be taken out of production, and according to some reports, have resulted in direct crop losses across the region of $1.7 billion annually. Moreover, as farm revenues decline, less money becomes available for irrigation infrastructure maintenance.

REDUCTION OF FRESHWATER SUPPLIES

A significant portion of available water resources comes from irrigation drainage waters and industrial and domestic wastewater. Some return flow water is used repeatedly for irrigation. More than half of irrigation water is discharged into rivers and a third into natural depressions. Irrigated waters contain high levels of salt, pesticides, fertilizers, and other minerals and toxic substances, which pollute surface water and groundwater, reducing clean water supplies and creating water shortages.

Mineralization has affected lakes, rivers, and reservoirs; in some cases, killing biota and rendering water unfit for fishing. Poor quality and

lack of freshwater have hindered industries that need water to operate as well. This is especially true in the Aral Sea area, where businesses have been forced to close down, causing unemployment and migration away from the area. Because water quality and quantity affect the spread of disease, freshwater shortages have also contributed to health risks.

Land Degradation

No hard and fast definitions for land degradation exist. Put simply, it is reduction in the capacity of soil to support life, and is caused by damage to the physical, chemical, or biological properties of soil, which contributes to an unsustainable ecosystem. Land degradation in Central Asia is severe. Years of heavy exploitation have brought untold damage to the region's fragile lands. Most common forms of degradation are caused by improper irrigation practices, overgrazing, overcultivation, and pollution.

Degradation manifests itself in salinization, waterlogging, water and wind erosion, soil compaction, depletion, and the process of desertification, which in turn add to a degradation cycle. While reliable estimates of the economic costs of land degradation are not available, they are estimated to be in the billions of dollars. Dependence of the poor on the productivity of natural resources makes people living on the margin especially vulnerable to land degradation.

Top: Land degradation by livestock overgrazing is a major problem in the region. **Middle:** Livestock drinking from a well in a remote pasture area of Kazakhstan, showing the overgrazing effect near such watering areas. **Bottom:** Grass bunds have been widely planted to promote sand dune stabilization.

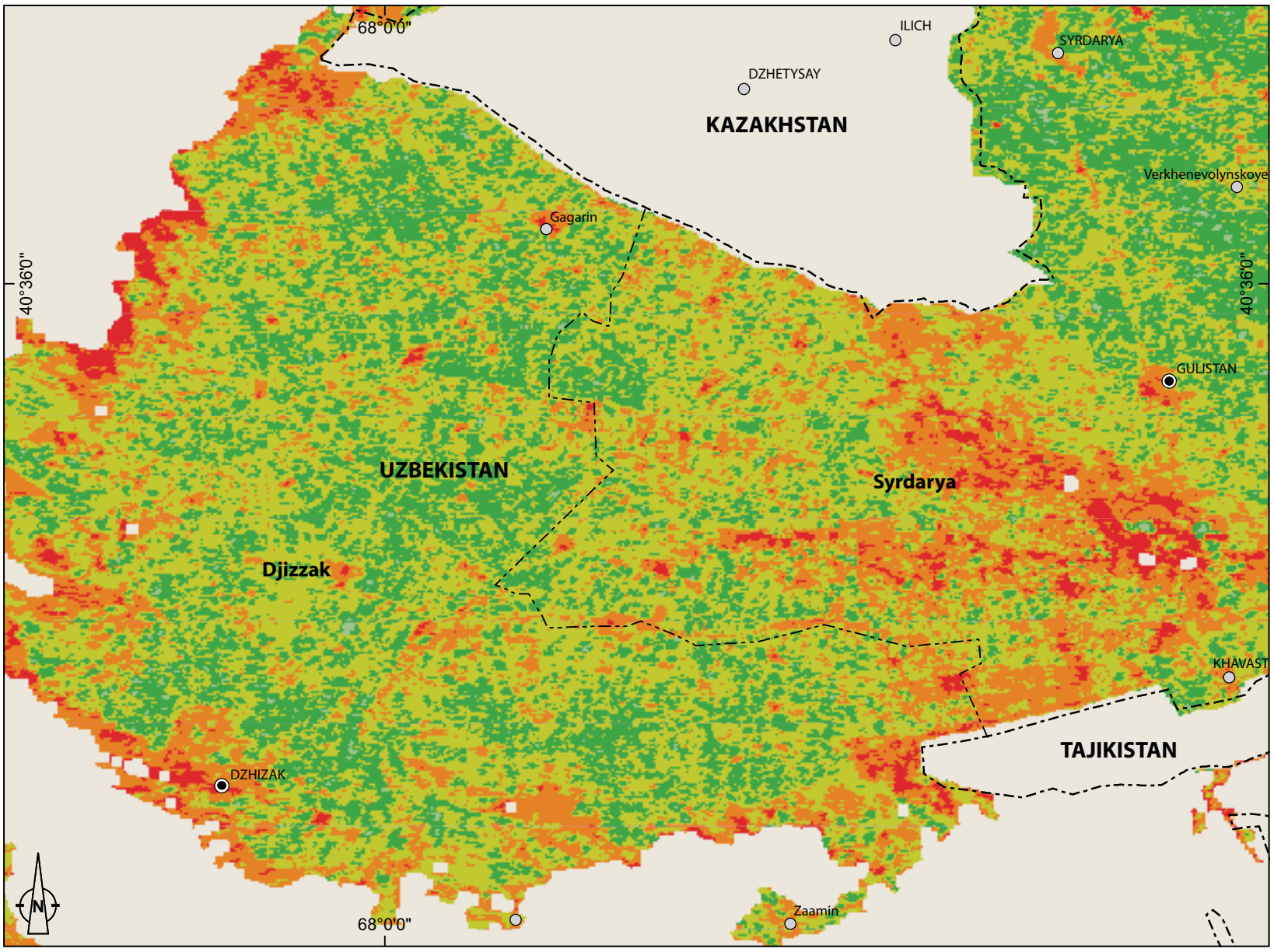
Upper and lower: Abandoned lands due to secondary salination of soil in irrigated areas of the Syr Darya River basin.

SALINIZATION

Vast stretches of land in the Amu Darya and Syr Darya basins and in the region of the Aral Sea are either spoiled or badly degraded because the soil has become salty or waterlogged. The level of salts in both rivers has steadily increased as salt-carrying drainage water has been discharged into the rivers. More than one-half of Central Asia's irrigated land is estimated to be salinized and/or waterlogged. Land that is moderately to heavily damaged by salt reaches up to 35% of irrigated land in Tajikistan and 80% in Turkmenistan. The Kyrgyz Republic, too, suffers from a high degree of salinization. The causes are many and include shoddy construction and poor maintenance of irrigation infrastructure, as well as poor water management.

Uzbekistan has the most extensive irrigated areas in the region. About 10% of the land is intensively cultivated and irrigated. Nearly 60% of the land potentially suitable for irrigation is subject to natural salinization and about half the croplands suffer from secondary salinization. Annually, 20,000 hectares are abandoned due to high soil salinization and waterlogging. The map next page shows the salinity level of the Golodnaya Steppe based on the 2008 annual maximum Normalized Difference Vegetation Index as a surrogate to the Maximum Attainable Yield model.

Soil Salinity Mapping - Golodnaya Steppe



7 3.5 0 7 Kilometers

1:650,000

- Provincial capital
- City
- Oblast boundary
- International boundary

Dataset used: Annual Maximum NDVI of MODIS (MOD13Q1), 2008
Projection: Geographic, WGS84

Prepared by C. Y. Ji, 2009

Salinity Indicator

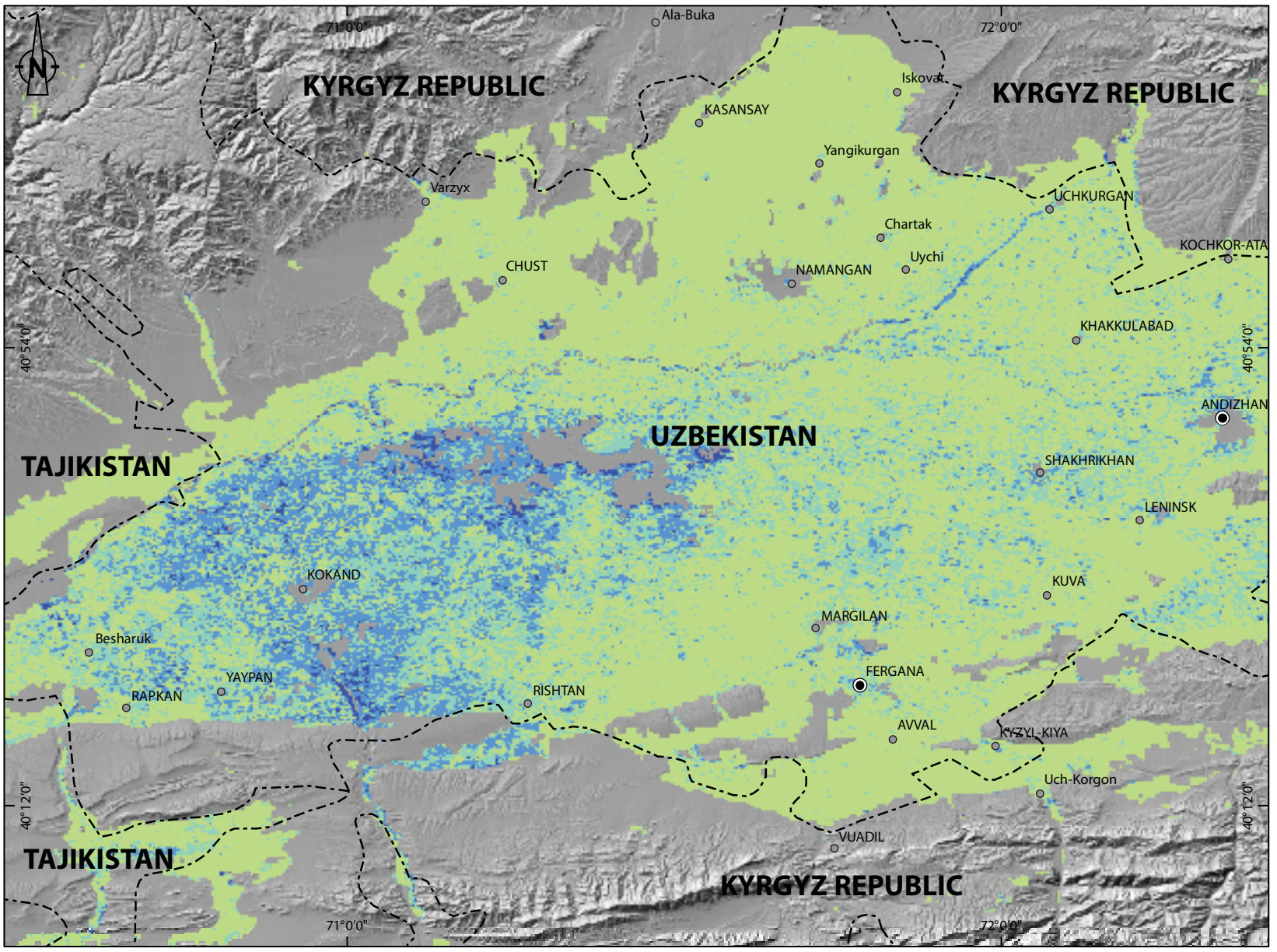
- Very high
- High
- Moderate
- Slight
- None

Salinization Causes and Effects

Primary or natural salinization occurs where soil is rich in soluble salts or there is a shallow saline groundwater table and inadequate rain to remove (leach) soluble salts from the soil. Secondary, usually human-caused, salinization occurs when irrigation is applied without adequate drainage for salts, causing them to stay in the soil when water evaporates. These salts accumulate over time and destroy soil fertility. In a natural state, salt-tolerant plants evolve. When natural flora are removed and irrigated crops introduced, an artificial equilibrium is created that must be maintained or salinization results.

Other causes of salinization include waterlogging, improper cropping patterns and rotations, and chemical contamination from heavy use of mineral fertilizer. Because salt inhibits a plant's ability to absorb nutrients, salinization renders soil infertile. Salinized land is less productive and often abandoned. In the worst case, soil becomes so salty that nothing can grow.

Mapping Waterlogging of Irrigated Areas - Fergana Valley



10 5 0 10 Kilometers

1:1,000,000

Provincial cap ital

City

International boundary

Dataset: MODIS (MOD13Q1, 250m)
Image Acquisition Date: Day193, 2008
Projection: Geographic, WGS84

Waterlogging Index

- None
- Slight
- Moderate
- Heavy

The image above, made in July 2008, used MODIS data to create a simple waterlogging index using the near infrared (Band 2) and a middle infrared (Band 7) based on 16-day composite data.

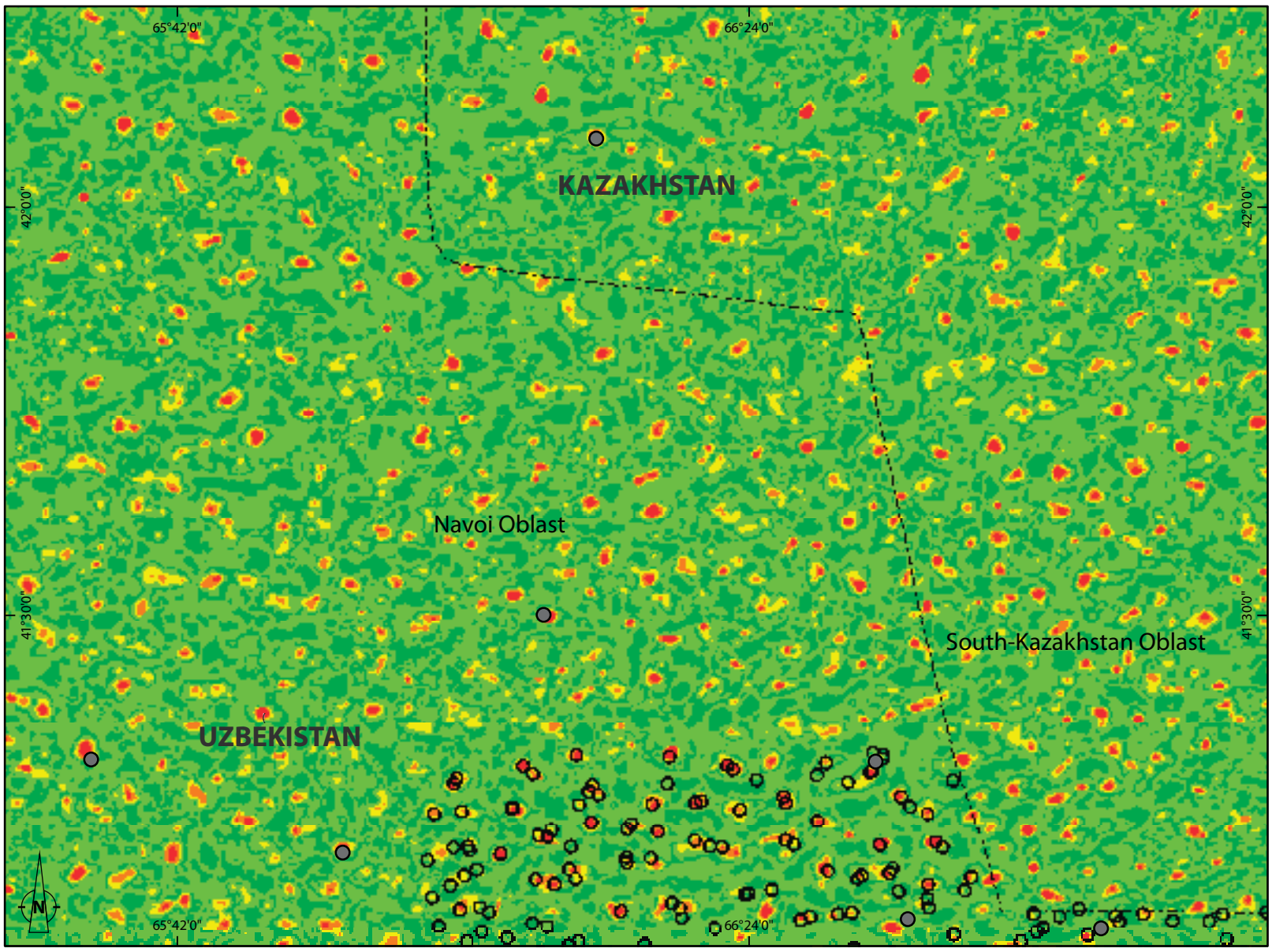
Prepared by C. Y. Ji, 2009

■ Waterlogging caption needed.

WATERLOGGING

When drainage is not adequate or there is too much irrigation, waterlogging may occur—excess water raises water tables, bringing salt and other toxic substances to the surface. In Uzbekistan, the groundwater table is less than 2 meters below the surface in about one-third of irrigated lands. The area of waterlogged lands varies from 40% in the Fergana Valley, as shown in the image here, to 80% in downstream Amu Darya.

Mapping Grazing Gradients - Navoi Oblast, Uzbekistan and South-Kazakhstan Oblast, Kasakhstan



8 4 0 8 Kilometers

1:800,000

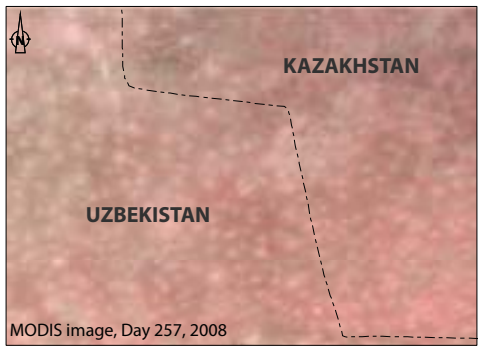
Town
Well location
International boundary

Dataset used: Annual Maximum NDVI of MODIS (MOD13Q1), 2008
Projection: Geographic, WGS84

Prepared by C. Y. JI, 2009

Grazing Gradients

1
2
3
4
5



MODIS image, Day 257, 2008

Grazing gradients are based on local statistical measures of Normalized Difference Vegetation Index (NDVI). Gradients 1 and 2 are areas considered not degraded, while gradients 3, 4, and 5 are slightly, moderately, and severely degraded areas, respectively. This MODIS image acquired on day 257, 2008, shows degraded pastureland as bright, circular-shaped areas (loss of vegetation).

OVERGRAZING

Overgrazing by livestock on pastures with poor fodder capacity is a primary cause of rangeland degradation. Overgrazing causes native perennial grasses to be consumed and trampled (compacted). Overgrazing also destroys native lichen and algae, which are important for fixing nitrogen and holding water. Their loss further depletes the land, reducing its ability to replenish itself and remain stable. Erosion often follows, increasing the chances of desertification.

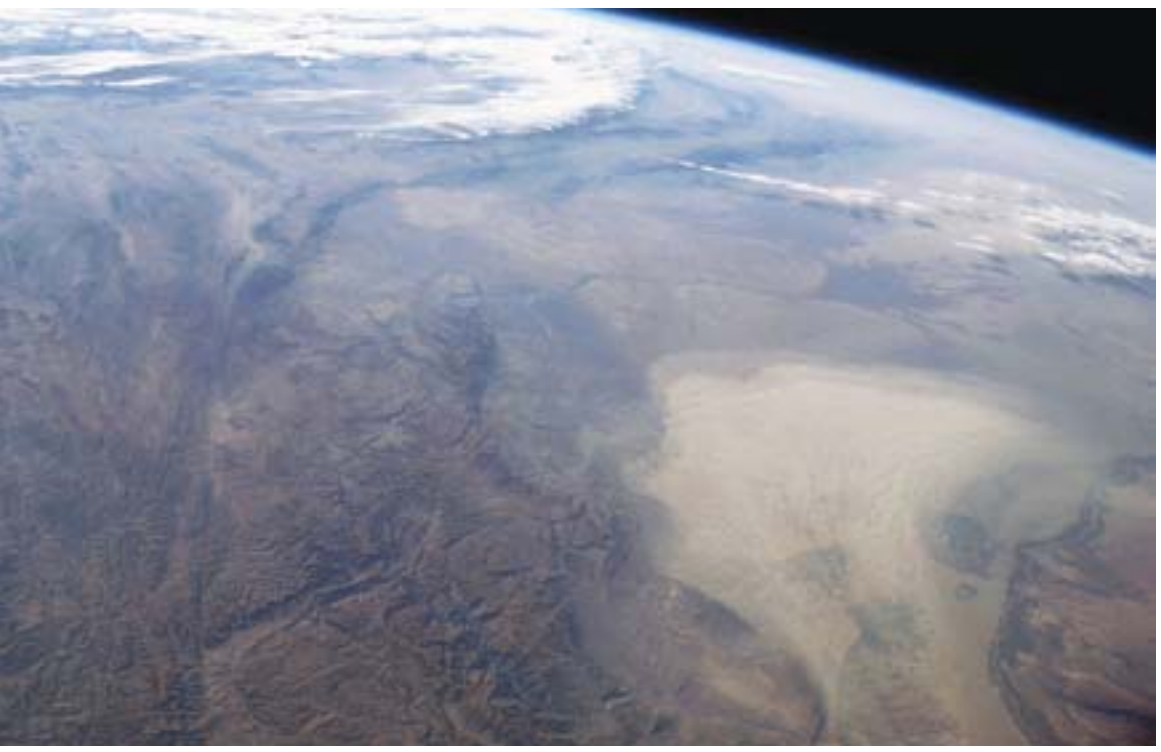
As this remote-sensing image shows in Navoi Oblast, Uzbekistan, and part of South Kazakhstan Oblast, Kazakhstan, degradation is most profound close to populated areas, such as towns and villages and watering holes, where many small-scale herders do not have the resources to transport animals to more distant pastures. In Uzbekistan alone, 7.3 million hectares of pastureland have been affected.

Overgrazing leads to degraded pasture lands; in Naryn, Issyk-Kul.

Sandstorms

Vast sandy and *solonchak* deserts, both natural and human caused, combine with Central Asia's windy climate to make wind-blown dust, salt, and sand frequent and debilitating problems. As moisture evaporates, upper soil layers become loose, making them prone to wind damage. Summer winds, which are particularly strong, often create dust storms that carry away huge amounts of soil. Karakum and Kyzlkum dust storms last an average of 20–40 days a year, blanketing fields in sand and dust, and lowering crop yields. In highly salinized areas, dust salt is also spread. Mineralization of the Aral Sea has made things worse. Salt, chemicals, and other pollutants blow from the dry sea bed to form white dust storms and sandstorms that influence the climate, degrade the landscape, and affect the economy of the area as well as people's health.

A youth protects his brother's eyes from wind-blown sand in the Karakum Desert in Turkmenistan. Sand and dust storms are health hazards in arid and semi-arid areas.



A huge dust storm in Turkmenistan seen from the International Space Station. Winds blowing down the Amu Darya River Valley whipped up the storm, which appears as the light brown mass extending toward the center of the photo from the lower right.

WIND AND WATER EROSION

Wind blows away small particles of soil, which lowers the land and denudes it of nutrients. Blown particles can abrade plant tissues, allowing pathogens to enter them. Wind erosion not only reduces agricultural yields but can also lead to irreparable land damage. Potential for wind erosion in Central Asia is probably greatest in pastureland and arid and semi-arid steppes. Reports from the 1990s stated that wind erosion affected as much as 45 million hectares of Kazakhstan's plowed land and rangeland. In Tajikistan, wind erosion affects almost one-quarter of its agricultural land. Turkmenistan's and Uzbekistan's vast deserts are especially susceptible to wind erosion once land is disturbed.

Water erosion is responsible for washing away millions of tons of soil material each year from the region's irrigated and rainfed land, especially on mountain slopes and piedmont plains.

SOIL DEPLETION

Although overcropping (or overplanting) and monocropping—repeatedly planting a single crop—are different, they have the same negative result: reduced land fertility. Overcultivation exhausts soils, decreasing the activity of biological organisms, which slows down the accumulation of nutritive elements and decreases crop productivity. Inadequate crop rotation in Central Asia's cotton- and grain-growing areas has forced vast tracts of land to be taken out of cultivation. In some cases, millions of tons of soil have been imported to replenish lost nutrients, but this is a costly and wasteful process, and of little use unless followed by sound crop rotation.

DESERTIFICATION

Desertification does not mean extension of the desert, but degradation of soil leading to conditions characteristic of deserts. It is a process that often begins in times of severe drought, when land

Desertification, as defined by the Food and Agriculture Organization (FAO) of the United Nations, is "the sum of the geological, climatic, biological and human factors which lead to the degradation of the physical, chemical and biological potential of lands in arid and semi-arid zones, and endanger biodiversity and the survival of human communities."

cannot adequately balance human pressures and overuse pushes the land to the brink. In humid climes, desertification is gradual. In arid Central Asia, when factors go especially wrong, it can engulf land at an accelerated pace. Drought and desertification affect all countries in Central Asia, as much as 66% of the land area of Kazakhstan, 97% of Tajikistan, and 80% of Turkmenistan and Uzbekistan. Moreover, nearly 90% of Kyrgyz Republic's agricultural land is said to be degraded and exposed to desertification.

Industrial, Transport, and Urban Pollution

Oil, gas, and mineral extraction all come with negative ecological by-products. Oil extraction practices in Kazakhstan and Turkmenistan are contaminating the Caspian Sea and inland areas. Gas exploration, gas flaring, and aging gas infrastructure in Kazakhstan, Turkmenistan, and Uzbekistan result in escaped methane, a highly potent greenhouse gas. Extraction of minerals causes land upheaval and pollution from tailings throughout the region. And mining of the uranium ore has its own set of disturbing consequences.

Manufacturing is also taking its toll. Large segments of Central Asia's manufacturing base are resource intensive, making them anything but environment-friendly. Increasing quantities of untreated solid and liquid industrial waste are released. The motor transport sector is significantly affecting the environment as well, the result of aging fleets, substandard maintenance, and low-quality motor oil.

As its industry and population grow, Central Asia's air quality becomes an increasing concern. Chief sources of air pollutants are coal burning, inefficient power plants, industry, and transport. A cocktail of ammonia, benzene, carbon dioxide, chlorine, dust, formaldehyde, hydrogen fluoride, hydrogen sulfide, lead, nitric oxide, ozone, phenol, sulfur dioxide, and other toxic compounds is causing widespread respiratory tract and circulatory and digestive system diseases. In Almaty, Kazakhstan, and in Bishkek, Kyrgyz Republic, respiratory diseases are said to affect more than 40% of the inhabitants. In Kazakhstan, these diseases cost the country on average $56 per person each year, equivalent to $60 per ton of emissions into the air.

While toxic compounds affect the health of the population directly, emissions of certain gases, especially carbon dioxide and methane, have a more insidious effect—by contributing to global climate change.

Upper: View of one of the main streets of Oskemen, Kazakhstan, flanked by a towering industrial complex. **Lower:** Termitau, Kazakhstan, one of the world's largest steel factories, built in Soviet days.

The Fedchenko glacier in Tajikistan, the largest glacier in Central Asia, is said to be shrinking due to climate change.

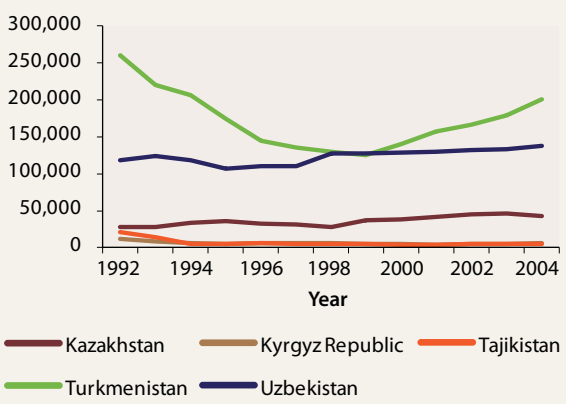
Climate Change

Climate change, in the form of higher temperatures, changing rainfall patterns, and more violent weather, is beginning to affect Central Asia, adding a new dimension to the young countries' struggle toward sustainable development. While the primary cause of climate change—increasing amounts of greenhouse gases in the atmosphere—is a global problem, the region is by no means blameless.

GREENHOUSE GASES

Central Asia generates large amounts of greenhouse gases, mainly carbon dioxide but significant methane emissions as well, the energy sector being the largest emitter. Kazakhstan is the 30th largest carbon dioxide emitter in the world. Its emissions slowed in the 1990s but began to increase again in the 2000s as the country's economy has improved and are expected to more than double over the next decade.

Carbon Dioxide Emissions in Central Asia, thousand metric tons



Source: Carbon Dioxide Information Analysis Center as cited by UN Millennium Development Goals. http://mdgs.un.org

Greenhouse Gas Emissions in Central Asia, Gg $C0_2$ equivalent

	1990	Latest available year per country
Kazakhstan (2004)		
Carbon dioxide (CO_2)	236,929.2	168,804.1
Methane (CH_4)	1,224,650.9	640,105.0
Nitrous oxide (N_2O)	8,323,559.8	3,387,423.9
Non-CO_2	9,548,210.7	4,027,528.9
Total GHG	9,785,139.9	4,196,333.0
Kyrgyz Republic (2000)		
Carbon dioxide (CO_2)	29,100.7	11,697.5
Methane (CH_4)	5,869.9	3,078.2
Nitrous oxide (N_2O)	1,149.8	275.9
Non-CO_2	7,019.7	3,354.1
Total GHG	36,120.4	15,051.6
Tajikistan (2008)		
Carbon dioxide (CO_2)	19,294.5	22,000.0
Methane (CH_4)	3,234.0	1,890.0
Nitrous oxide (N_2O)	1,147.0	1,200.0
Non-CO_2	4,381.0	1,900.0
Total GHG	23,675.5	4,284.4
Turkmenistan(1994)		
Carbon dioxide (CO_2)	—	31,859.1
Methane (CH_4)	—	20,325.2
Nitrous oxide (N_2O)	—	125.3
Non-CO_2	—	20,450.5
Total GHG	—	52,309.5
Uzbekistan (1994)		
Carbon dioxide (CO_2)	114,559.0	102,157.0
Methane (CH_4)	37,737.0	41,811.0
Nitrous oxide (N_2O)	10,850.0	9,920.0
Non-CO_2	48,587.0	51,731.0
Total GHG	163,146.0	153,888.0

— = data not available, Gg = giga (billion) grams, GHG = greenhouse gas.
Note: Figures exclude Land Use Change and Forestry.
Sources: UNFCCC. GHG Emission Profiles. http://unfccc.int/ghg_data/ghg_data_unfccc/ghg_profiles/items/3954.php
Republic of Tajikistan. 2008. *Statistical Annual Yearbook*. www.stat.tj

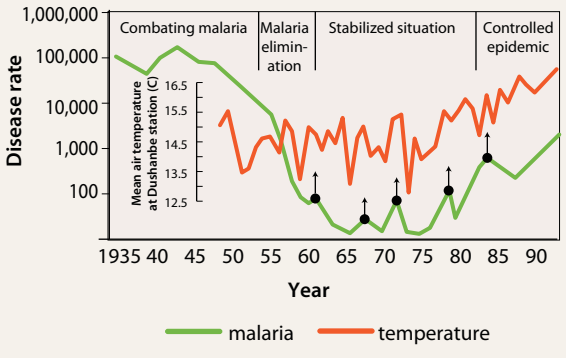
The Kyrgyz Republic's emissions also fell in the 1990s. The country lost the subsidies on oil and gas that it enjoyed in the Soviet period and turned to clean hydropower. Nevertheless, its greenhouse gas emissions were expected to grow 25% in the first decade of the 2000s. Tajikistan produces few greenhouse gases, relying largely on hydropower for its energy needs and with a relatively small industry sector. Offsetting this advantage to some extent, however, is carbon dioxide emissions through deforestation.

Turkmenistan is a moderate greenhouse gas producer but its emissions are expected to increase, mainly as a result of the planned increases in oil and gas production activities. Uzbekistan is the world's most carbon-intensive economy, with greenhouse gas emissions comparable to those of its much larger neighbor Kazakhstan. More than a quarter (27%) of these gases is methane, generated by mining, transport of natural gas, production of oil and coal, and from agriculture—rice cultivation and intestinal fermentation in ruminant livestock.

EFFECTS OF CLIMATE CHANGE

Climate change will most likely bring higher temperatures to the region, which will result in major environmental, economic, and social disruptions. Glaciers are shrinking—those in the Tien Shan, Gissaro-Alai, Pamirs, and Dzhungarskiy and Zailiyskiy Alatau have been decreasing by about 1% each year in recent decades. This means that water availability in the major rivers, Syr Darya and Amu Darya, which depend on annual glacier melt to some degree, may decline by up to 30%–40% in the future. Increasing frequency of drought and lower grain productivity are also very likely to occur. For example, in Kazakhstan, according to the Kazakhstan Scientific Research Institute of Environment and Climate, the winter wheat crop may fall by more than a quarter. Harvests from natural forage lands may decline by 30%–90% and this, along with the direct effect of increased hot weather on animals, would seriously affect livestock production.

Malaria Incidence and Climatic Factors in Tajikistan



Source: Kayumov A. and A. Lizenko as cited by Tajikistan 2002. *State of the Environment Report.*

Public health will be affected directly by more extreme weather across the region, such as deaths from heat waves, mudslides, and floods. Mudslide occurrences in Kazakhstan are predicted to increase by a factor of 10 if temperatures rise 2–3°C; social and economic centers in lowland areas could become environmental disaster zones. Cardiopulmonary diseases will increase and insect-borne infections will extend their range. For example, in Tajikistan, malaria is on the increase as average air temperatures have slowly been rising over recent decades.

Most analyses agree that it is already too late to stop global warming over the medium to long term even if greenhouse gas emissions could be drastically reduced now. Thus, while it is most important to reduce these emissions, adaptation measures to lower or prevent the worst-predicted impacts of climate change are also vitally needed.

For the Central Asian countries, especially those dominated by deserts—Kazakhstan, Turkmenistan, and Uzbekistan—adaptation to climate change will need many changes. In agriculture, it will mean strengthening existing ways of combating drought and desertification, using crops that need less water or have a growing season more suited to the changing conditions, using advanced methods of fertilization and pest control, and managing pasturelands better to prevent overgrazing and to rehabilitate degraded pastureland.

For water resources, adaptation measures needed include minimizing water losses in irrigation and transport canals, more efficient irrigated farming, transferring water-using businesses away from low-water areas, improving sanitary and industrial practices near open-water and groundwater sources, and better protection of watersheds from degradation and contamination.

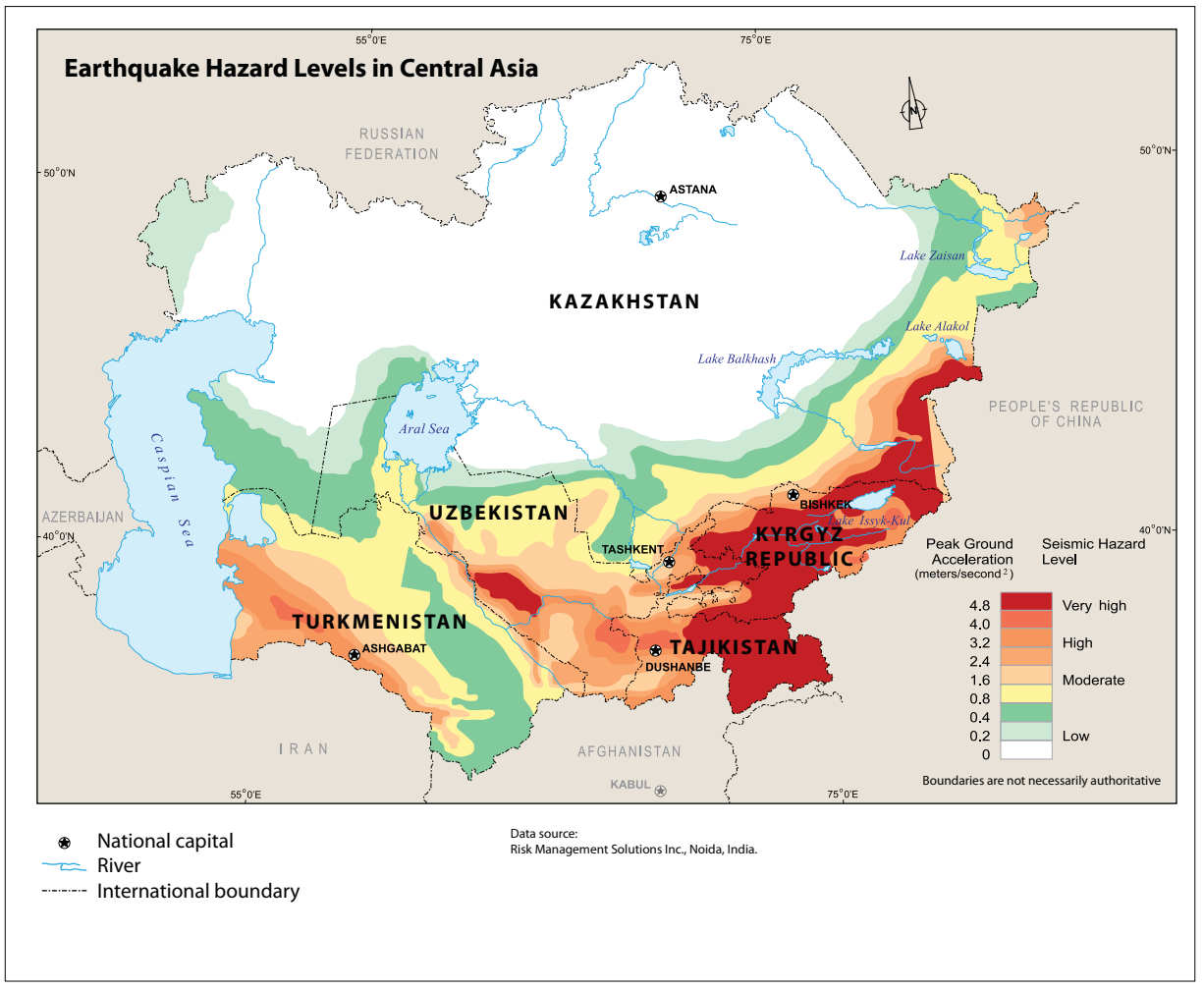
In all these adaptation efforts, cooperation across the region will clearly be to the advantage of all countries: with so many common problems, new solutions will not have to be invented in each country. However, the present standoff with regard to cooperation in water use—a key factor in the survival of the countries themselves—presently impedes their prospect of a sustainable future.

Natural Disasters

Disasters, both natural and human-made, are constant and growing threat to lives, livelihoods, and socioeconomic development across Central Asia. Worst affected by natural disasters in terms of economic vulnerability is Tajikistan, where loss potential is as much as 70% of gross domestic product. Tajikistan each year experiences 50,000 landslides; 5,000 tremors and earthquakes; and hundreds of avalanches and debris flows. In the Kyrgyz Republic, over 1,210 natural disasters were registered during 1992–1999. Both in the Kyrgyz Republic and in Kazakhstan, direct damage from disasters is said to cost on average of about

Top: Kumkol oil field, Kazakhstan. The region's energy sector is the largest emitter of greenhouse gases. **Middle:** *Takir* or *takyr* (a shallow submerged area with heavy clay soil. When it dries out, a crust with fissures due to filamentous algae forms on the surface) in the desert of Turkmenistan. **Bottom:** Abandoned irrigated land near southwest shore of Lake Issyk-Kul, Tong District, Issyk-Kul Oblast, Kyrgyz Republic.

Upper and lower: Landslides in a piedmont area of the Kyrgyz Republic.



$20 million annually, and indirect damage may be up to 10 times that amount. And the frequency and impact of disasters have been rising dramatically worldwide since the early 20th century—more than 800% since the 1960s.

The major risks in all countries are earthquakes, except in Tajikistan where floods are the main hazard. Flooding is the second most important hazard in the other countries, except Turkmenistan, which is more prone to drought.

The most catastrophic natural disasters are earthquakes that have leveled even major cities in the region, sometimes more than once—Almaty, then capital of Kazakhstan, was leveled three times in the late 1800s and early 1900s; Ashgabat, capital of Turkmenistan, was destroyed in 1948; and Tashkent, capital of Uzbekistan, was badly damaged in 1966—and those killed, injured, or otherwise affected have numbered in the hundreds of thousands. The main reason is that the southern part of the region lies in one of the world's most active seismic belts. Nearly all of Tajikistan and the Kyrgyz Republic are under severe earthquake threat, about half of Uzbekistan, and a third of Kazakhstan.

Human-made disasters, like the demise of much of the Aral Sea, overuse of water resources, and land degradation, have cost the region countless billions of dollars over the past century. And further threats abound. Many huge, aging, reservoirs in Central Asia pose threats of major flooding, in some cases across borders. For example, if Lake Sarez—itself formed by a major earthquake—were to burst, it would affect millions of people in Afghanistan, Tajikistan, Turkmenistan, and Uzbekistan.

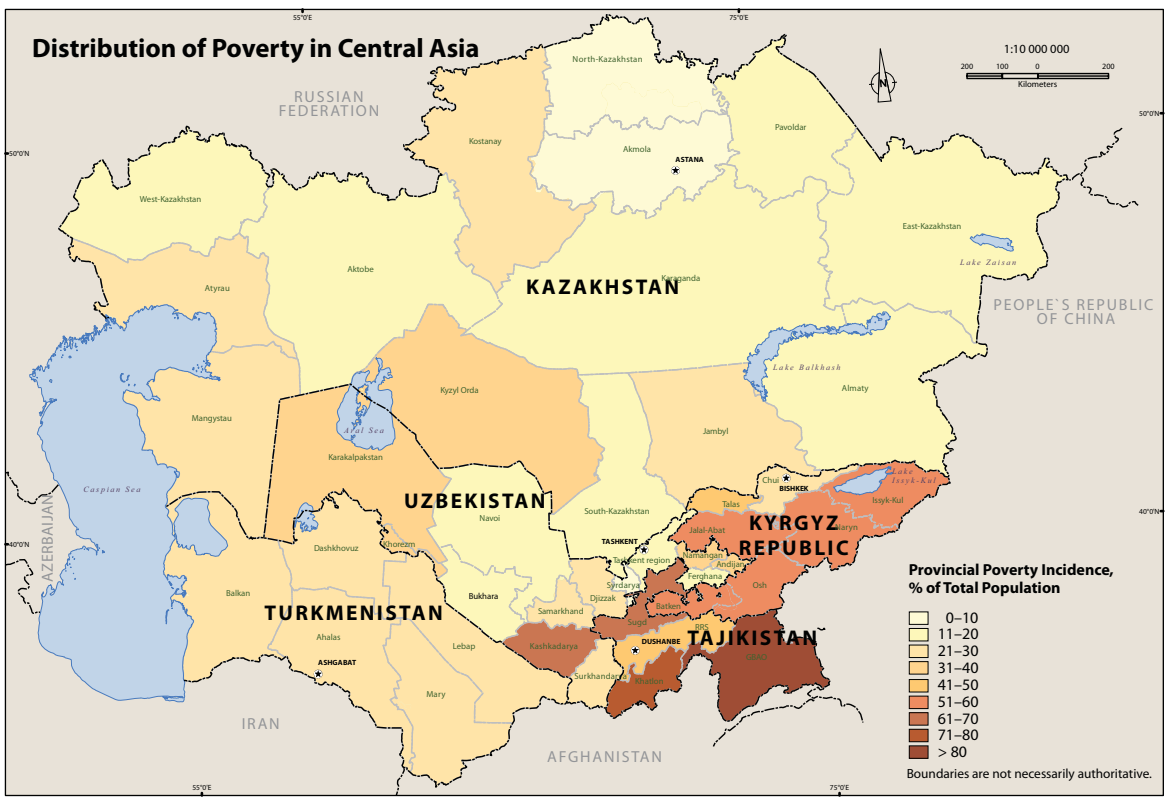
Another threat is the result of past decades of uranium processing, waste dumping, and pesticide storage, which have left a legacy of huge dump sites that are increasingly hazardous to the environment and human life. For example, along most of the length of the Syr Darya, people are at risk from radioactive wastes in the tailing dumps of uranium mines near waterways in upstream Kyrgyz Republic and Tajikistan.

The countries are working together on ways to minimize disaster impact because natural and human-made disasters not only affect all the countries but can also cross borders with serious implications for the economy in one or more countries that can reverberate throughout the region.

Poverty and Environment

Unsustainable natural resource development and natural and human-made disasters have exacted a massive toll on the region's environment. But who pays this toll? Undoubtedly, nearly all of the region's populations are suffering in varying degrees from the effects of air and water pollution from industry, agriculture, and toxic dust blown from abandoned agricultural land and from the environs of the Aral Sea.

But it is the rural populations—in farms and fisheries, mines, oil and gas installations, and rangelands—that are closest to and most affected by degraded or damaged environments. And these people are mainly the poor. More than 60% of Central Asia's poor are in the countryside; in the Kyrgyz Republic and Tajikistan, more than three-quarters of the poor live in rural areas.



Note:
The property levels in the map above are based on data from international organizations and while not identical with national poverty data, reflect the same pattern.

Data sources:
ADB. Key Indicators for Asia and the Pacific 2008.
www.adb.org/statistics; World Bank. Dimensions of Poverty in Kazakhstan. Volume II: Profile of Living Standards in Kazakhstan in 2002. 9 November 2004; World Bank. Kyrgyz Republic Poverty Assessment 2007, Volume I: Growth Employment and Poverty. October 19, 2007; World Bank. Republic of Tajikistan Poverty Assessment Update. 6 January 2005; World Bank. Uzbekistan Living Standards Assessment. Policies to Improve Living Standards. Vol. II: Full report. May 2003.

Projection: Equidistant Conic
Datum: WGS 1984

GIS/Cartography:
V. Sibagatulin, GIS-Service Ltd.
Kyrgyz Republic, 2009

A comparison of the maps on distribution of poverty and earthquake risk in the region illustrates the poverty–environment connection: the highest poverty rates are in the mountainous environments, where natural hazards, particularly earthquakes, are greatest.

The environmental perspective on poverty has come to the fore in recent years. Many people are materially poor because of the physical environment in which they live. There are dryland poor in marginal and desert areas, flood-affected wetland poor in areas of frequent inundation, upland poor in remote upland or mountainous areas, coastal poor along shorelines, and slum poor with high exposure to urban pollutants. Asia-wide, they account for 53% of all extreme poverty. While there is still optimism that overall poverty in its income and social dimensions will decrease in the future, environmental poverty will most likely persist and the proportion of environmentally poor will increase. By 2020, up to 70% of Asia's extremely poor may be the result of their degraded environment.

Health indicators show the human price of degraded environments. For example, infant and child mortality rates increased in Kazakhstan, Turkmenistan, and Uzbekistan between 1980 and 2001 while life expectancy fell in Kazakhstan. A glaring example is the severe recent health situation—compared to that in the 1960s—of those, mainly poor, living near the drying Aral Sea where the severely degraded environment results in 10% of children dying in their first year, 15% increase in deaths from chronic gastritis and kidney disease, doubling of the heart disease rate, ten-fold increase in cancer, 15–fold increase in kidney disease, and 21–fold increase in deaths from tuberculosis. There has been much emigration from the area but the poor cannot afford to move and many presently suffer the consequences.

Region-wide, poverty soared when the republics gained their independence because of the collapse or major restructuring of the large-scale collective and state farms that dominated socioeconomic life in rural Central Asia during the Soviet period. These farms provided agriculture and food products as well as social services such as schools, health services, and housing. Since independence, public utilities (piped water, heating, sanitation) and services (schools, health care, kindergartens, etc.) in rural areas have declined in both numbers and quality, worsening living conditions there. The rural poor mostly lack property rights to land or their houses and so cannot easily borrow money or start their own businesses. All these negative impacts of the transition to market economies have driven the rural poor further into the vicious environment–poverty circle.

Poverty reduction only became the main objective of development efforts by donor agencies in the late 1990s. And even then, environment considerations were often left behind. Nowadays, it is recognized that environmental poverty and environmental degradation can and should be addressed together. Many international, regional, and local efforts are planned or are under way to remediate pollution and restore the region's environment as described in the next chapter.

Hidden Hunger

A natural resource missing from soils in most of the region is an essential micronutrient—iodine. When such micronutrients—vitamins and various minerals—are unavailable in the diet, even if it has enough calories, both physical and mental impairment can result. This "hidden hunger" is prevalent in Central Asia, causing economic losses equivalent to about 1% of annual gross domestic product.

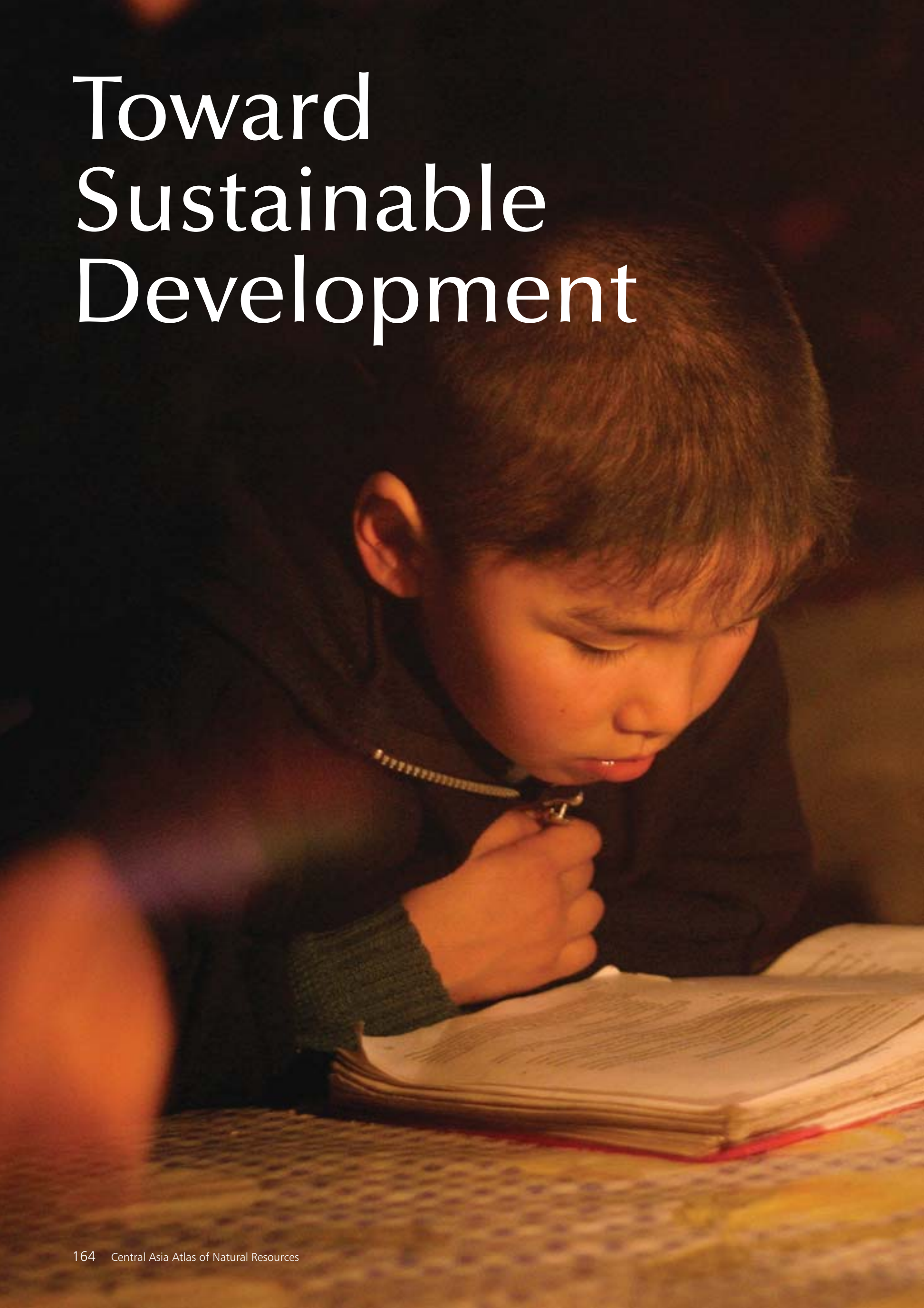
Major micronutrient disorders in the region are not only iodine deficiency disorders (IDD) but also iron deficiency anemia (IDA); and folic acid, vitamin A, and zinc deficiencies. Except for vitamin A deficiency, fortifying staple foods with micronutrients is well known to provide the ideal solution, yet a complex one in practice.

Most salt was fortified with iodine in the former Soviet Union, but by the mid-1990s, goiter, a symptom of IDD, had risen to more than 50% in adults in areas of Kazakhstan and was up to 86% in Tajikistan. Iron deficiency, which tends to be prevalent in wheat-eating populations, such as those in Central Asia because essential micronutrients are lost during wheat milling, had never been addressed.

During 2001–2007, the Asian Development Bank, in partnership with the United Nations Children's Fund (UNICEF), led a regional initiative to help the countries of Central Asia (and Mongolia) fortify all salt with iodine and wheat flour with iron folic acid and zinc. The result to date for iodine deficiency has been to almost halve the numbers of unprotected children in the region. Recovery from iron and folic acid deficiency in women and children has exceeded expectations but is still at a pilot stage. In both cases, however, a solid foundation for eradicating these public health problems has been made and the governments are continuing the effort.

Upper: Locally produced fortified flour makes its debut in the Kyrgyz Republic. Lower: The healthy food logo for fortified foods was widely adopted.

Toward Sustainable Development



Healing Environmental Wounds

The major environmental problems facing the countries of Central Asia are shared ones. Many are legacies from the Soviet period, others from a common wish for rapid development. The region's uneven distribution and consumption of natural resources, and energy and water interdependency mean that success in overcoming these problems will take coordinated efforts among nations of the region and with the global community. Sustainable development must be achieved in a way that remediates the worst legacies of the past, and builds on the region's numerous strengths.

Each country has affirmed its commitment to sustainable development in various regional and international accords and declarations. Countries of the region signed the Rio Declaration (1992) for sustainable development and agreed to develop national sustainable development strategies. Cooperation among the countries has been evident in the 1995 Nukus Declaration of States of Central Asia and International Organizations on Problems of Sustainable Development of the Aral Sea Basin and the 1997 Almaty Declaration of Presidents of Central Asian States calling for, among other things, a comprehensive program of environmental security, including addressing the Aral Sea problem. Further expressions of cooperation in environmental matters were in the Tashkent Declaration for the United Nations Special Program for the Economies of Central Asia (1998) and Ashkhabat Declaration of presidents of Central Asian States (1999).

Central Asia's International Commitments on the Environment

All the Central Asian countries have acceded to global conventions related to the environment, including

- United Nations Framework Convention on Climate Change
- Convention on Biological Diversity
- Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer
- United Nations Convention to Combat Desertification
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
- Convention on Migratory Species of Wild Animals
- Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters.

Source: IFAS, ISDC, SIC, UNEP. 2007. *Sub-Regional Integrated Environmental Assessment: Central Asia*. p. 58.

REGIONAL ACTION

After independence, the countries began making environmental concerns an integral part of their socioeconomic development plans by creating environmental ministries. Recognizing the need for regional cooperation, heads of state established the Interstate Council for the Aral Sea in 1993. This led to the creation of the International Fund for Saving the Aral Sea, which established two commissions: the Interstate Sustainable Development Commission (ISDC) and Interstate Coordinating Water Commission (ICWC). The Aral Sea fund is financed by the countries with further support from the United Nations Development Programme and the Global Environment Facility.

ISDC coordinates and oversees regional cooperation on environmental protection and sustainable development. The Scientific Information Center that operates under its auspices develops and coordinates regional and environmental strategies and provides information and expertise. It is one of several organizations and initiatives in the region that foster nature protection and rational development. Beginning in the early 2000s, under the coordination of ISDC, state environment ministries developed a Regional Environment Action Plan, which has important regional ecological priorities, namely, air pollution, water pollution, land degradation, waste management, and mountain ecosystem degradation.

Young boy doing his homework by candlelight in Tastubek, Kazakhstan, a thriving fishing port until the Aral Sea retreated; now almost deserted. Upper right: The Nurek Reservoir on the Vakhsh River, Tajikistan. The 300-meter high dam is said to be the world's tallest. Wise water management is crucial for sustainable development in Central Asia.

Upper: Roads around Osh, a busy city in the Kyrgyz Republic, are being upgraded with assistance from the Asian Development Bank and the People's Republic of China. **Lower:** Foreign investment is helping this modern glass factory in the Kyrgyz Republic.

The ICWC was established in 1992 as a means for cooperation on transboundary water issues after the collapse of the Soviet Union. Some of the main issues are demographic growth, different national priorities and policies on joint use and exchange of water and energy, uncoordinated infrastructure building, lack of information exchange and conflict-resolution mechanisms, and uncertainties related to climate change.

The Regional Environmental Centre for Central Asia started in 2001, with headquarters in Almaty, Kazakhstan, and country offices in all the five countries. It aims to promote cooperation among all concerned parties across the many sectors involved in addressing local, national, and regional environmental problems in Central Asia by creating opportunities to attract to the region advanced knowledge and best international practices and technologies in the field of environmental management and s ustainable development. The center also aims to increase civil society's role in environmental protection and sustainable development.

The center has undertaken such activities as Ili-Balkhash Basin integrated water management, training in sustainable development, analysis of climate change issues, support for civil society initiatives, and environmental action plan implementation.

A new and large regional program is the Central Asian Countries Initiative for Land Management (CACILM). CACILM is a 10-year partnership between the five countries of Central Asia and the international donor community, led by the Asian Development Bank, to combat land degradation and improve rural livelihoods. CACILM, which began in 2006, aims to restore, maintain, and increase the productivity of the region's land for the economic and social well-being of those who depend on it, while preserving the land's ecological functions and integrity. Through CACILM, national working groups in each country have developed frameworks to describe land degradation issues, analyze the natural and human causes, and design solutions. Joint activities have included training; sustainable management of forest, pasture, and agricultural lands; integrated management of natural resources; protected area management; and environmental rehabilitation in the region of the former Aral Sea.

The disaster emergency policies of the five countries include a regional mechanism based on an agreement made at independence, based on the Soviet State Commission on Emergencies and an Interstate Council for Emergency Situations Regarding Natural and Man-Made Disasters (covering also six other countries). Countries in the region also cooperate through regional, subregional, and bilateral agreements, such as between Kazakhstan, the Kyrgyz Republic, and Uzbekistan on joint collaboration for the rehabilitation of tailing sites that have trans-boundary impact.

Most recently, the Central Asia Regional Economic Cooperation Program is undertaking a Disaster Risk Management Initiative in Central Asia and the Caucasus, focusing on (i) coordination of disaster mitigation, preparedness, and response; (ii) insurance for and financing of losses, reconstruction, and recovery; and (iii) hydro-meteorological forecasting, data sharing, and early warning.

NATIONAL ACTION

Countries of the region have completed national environmental action plans that have identified problems areas—such as water deficits, land degradation, and environmental pollution—and actions to address them. Legislation, codes, and guidelines to help manage, regulate, and monitor activities affecting the environment have also been put in place. They address such areas as industrial development and agricultural practices, waste treatment and disposal, standards for air and water quality, and deforestation. They also provide prohibitions against specific practices harmful to the environment, such as gas flaring and deforestation as well as sanctions and punishments for violators.

Many environmental laws, including those in response to climate change and commitments under the United Nations Framework Convention on Climate Change, are now in place but they are often inconsistent, weak, and not always enforced. In addition, the intersectoral nature of sustainable development issues requires involvement of several ministries and agencies. Experience to date has shown the need for stronger coordination among the different offices and ministries in terms of policies, initiatives, functions, and authorities. There is also a need for stronger accountability systems and for programs to help build the expertise of development managers.

CIVIL SOCIETY

Civil society, mostly through nongovernment organizations (NGOs), is playing a major role in bringing awareness of and education on environmental matters to the region. Some 400 environmental NGOs are in Central Asia, half of them in Kazakhstan.

Many of these NGOs are organized into "ecoforum NGO" groups and have coordinating councils working in specific areas. All the countries cater to these groups through their laws on environment protection, which assign rights to public organizations to receive timely and complete information about the state of environment, results of deliberations of government environment agencies, and information on intended developments. In the different countries, NGOs publish material through various media; take part in environment projects; hold workshops, conferences, and training courses; and lobby government for environmental reforms.

INTERNATIONAL ORGANIZATIONS

Assistance from international environmental organizations has been shown to be both welcome and beneficial to the countries, such as the trading ban on endangered sturgeon by the Convention on International Trade in Endangered Species, classification of endangered flora and fauna by the International Union for the Conservation of Nature, designation of protected wetlands under the RAMSAR Convention Bureau, assignment of World Heritage Sites by UNESCO, and development of Econet by WWF.

So far, implementing the various conventions, regional and national plans, and protected areas has been slow, while more than a decade of projects to rehabilitate the Aral Sea has failed to make an impact—indications that the countries have yet to appreciate fully the extent of environmental damage and the fragility of the ecosystems in which their socioeconomic development is taking place.

Upper: Bilateral assistance from Turkey helped this textile factory in Turkmenbashi, Turkmenistan to produce cotton goods for export to the United States and Europe; it employs more than 3,000 women. **Lower:** Community action: women help each other making building material from clay.

Upper: Irrigated agriculture in Uzbekistan. Region-wide, crop productivity and water-use efficiency need improving to ensure food security. **Lower:** Men cultivating cotton seedlings in a farm in Kalinino, Karategin, Tajikistan, under the Farm Privatization Project.

Developing a Sustainable Future

Central Asia's economic strengths are in its natural resources: energy (oil, gas, and hydropower), minerals, and agriculture. Their further development should be pursued in a way that benefits all the countries' populations equitably. And if development is to be sustainable, environmental concerns cannot be neglected. The Millennium Development Goals provide excellent indicators of progress toward sustainable development. Population growth and urbanization are key factors in this regard. Improved living standards can lead to declining population growth rates, lessening pressure on the supporting environment.

ENERGY AND MINERALS

Within the region, the sharply uneven distribution of energy resources of each country means that each has something the others need. For example, Kazakhstan has ample supplies of oil and coal; the Kyrgyz Republic and Tajikistan have huge potentials for hydropower energy; and Uzbekistan's gas has natural markets in Kazakhstan, the Kyrgyz Republic, and Tajikistan. Further, Central Asia's abundant energy resources and its position between two of the world's largest markets for energy—Europe to the west and the rest of Asia to the south and east—place it as a potentially important regional market for trading, transport, and sales of energy.

As with its energy resources, Central Asia's mineral deposits are spread unevenly across the region. Many are in geographically isolated places, such as mountain areas, making transport access difficult. Some large mines in the region operate on a world scale. And though extraction is extensive and mining—along with metallurgy—has a long heritage, great exploration and production potential remains. Much investment, however, is needed to modernize processing plants and to maintain and develop infrastructure. To encourage investors, some countries have updated mining laws. Progress also continues in the area of privatization, with an increasing number of joint ventures taking place with foreign partners. Added to these energy and mineral assets is the large scope for development of solar and wind power for both domestic and export energy markets.

To ensure sustainable development and protect against effects of global climate change, the countries would benefit from focusing on energy efficiency, reducing pollution from hydrocarbon production and mineral extraction, and clean energy, for example, through retrofits for greenhouse gas mitigation, elimination of gas flaring, and development of renewable energy sources, particularly thermal solar and wind power. Energy diversification would help buffer the present economic reliance on one or a few resources and make the nations less susceptible to global price fluctuations.

AGRICULTURE

Further development of irrigated agriculture will require attention not only to land and water resources but also to labor and production infrastructure. The increasing privatization of farms has had some negative effects: for example, farms are smaller than during the Soviet period and existing large machinery and other infrastructure are less useful, while crop rotation systems have changed.

Steps that need to be taken include increasing crop productivity and irrigation water-use efficiency, improved management of livestock breeding, attention to environmental concerns,

Left: Road construction in Kalinino, Karategin, Tajikistan. **Right:** An old woman begging for money in the Chorzu Bazaar market in Tashkent, Uzbekistan

and cooperation among the five countries on the rational use of land and water resources. Water remains the key factor. The leaders of the five countries were still unable to resolve their disputes on water allocation, which has been one of the region's most intractable problems since independence, when Soviet period water-sharing agreements came to an end.

However, individual countries are taking action. For example, Uzbekistan is upgrading and rehabilitating irrigation and drainage systems in two major agricultural areas—the Zarafshan River Basin and Fergana Valley—under a 2009 $100 million loan from the Asian Development Bank.

Regional Economic Cooperation

Helping the Central Asian countries benefit from their individual resource strengths is their membership in the eight-country Central Asia Regional Economic Cooperation (CAREC) Program initiated in 1997 (the other three countries are Afghanistan, Azerbaijan, and the People's Republic of China [focusing on Xinjiang Uygur Autonomous Region]).

CAREC's goal is to improve living standards and to reduce poverty in countries through more efficient and effective regional economic cooperation. To date, CAREC has focused on financing infrastructure projects and improving the region's policy environment in the priority areas of transport, energy, trade policy, and trade facilitation. In 2006–2008 alone, the program attracted $2.3 billion from multilateral institutions for investment in 42 projects. CAREC's main thrusts in the energy sector are to improve and expand power generation, and to foster energy trade within and beyond the region.

Achieving Millennium Development Goals

The Millennium Development Goals (MDGs) are a set of eight goals to which almost all nations, including those of Central Asia, committed themselves following the Millennium Summit of the United Nations in 2000. The goals have a base year of 1990 and are to be attained by 2015. They have been universally accepted as indicators of progress toward sustainable development.

In the Soviet period, Central Asian countries had relatively high achievements in the areas now covered by the MDGs. These were reversed by economic collapse following the disintegration of the former Soviet Union. When the countries localized their MDGs in national MDG and poverty reduction strategies, they found there was a need to redefine the goals. The 1990 baseline, for example, is unsuitable for the region. In 1990, their social and infrastructure development indicators were higher than in other countries with comparable incomes. Progress toward the MDGs in the region is thus often based on the year of lowest gross domestic product (GDP), which was 1995 in Kazakhstan, the Kyrgyz Republic, and Uzbekistan, and 1997 in Tajikistan and Turkmenistan. Also, the income poverty line of $1.00 per day (revised by the World Bank to $1.25 in 2008) is too low and $2.15 per day or applying national poverty lines is more suitable. Central Asians face higher costs than do people in other, mainly tropical, developing regions because of the need for good shelter and winter clothing; more calories are needed while food is more expensive.

In the following, the countries' progress in MDGs related to natural resources and the environment—poverty and hunger, health, and environmental sustainability—is described.

Poor woman starting a fire in the stove in her home in the village of Tokhtamysh in the Aksu Valley, Tajikistan.

Poverty in Central Asia

	Soviet period (1989–1990)		2003	
	GNP per capita (1990)* ($)	Poverty rate (1989)** (% of population)	GNP per capita (2003)* ($)	Poverty rate (2003) *** (% of population)
Kazakhstan	2,600	16	1,780	21
Kyrgyz Republic	1,570	33	340	70
Tajikistan	1,130	51	210	74
Turkmenistan	1,690	35	1,120	44
Uzbekistan	1,340	44	420	47

* GNP per capita, Atlas method (current US dollars).
** Individuals in households with gross per capita monthly income of less than 75 rubles.
*** Percent of population with expenditures below $ 2.15 (purchasing power parity) per day.
GNP = gross national product.

Sources: Pomfret, R. and K. Anderson. 2001. Economic Development Strategies in Central Asia since 1991. *Asian Studies Review* 25 (2). pp. 185–200; World Bank. 2005. *Growth, Poverty and Inequality. Eastern and the Former Soviet Union.* Washington, DC; World Bank. 2005. *World Development Indicators 2005.* Washington, DC.

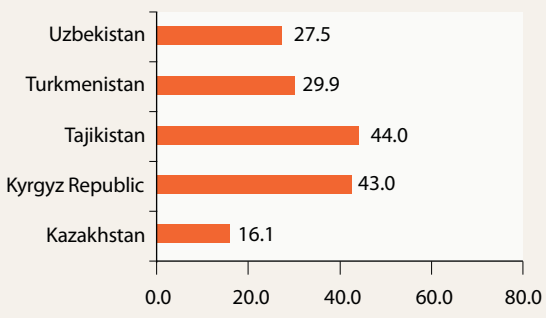
POVERTY AND HUNGER

MDG Goal 1—to eradicate extreme poverty and hunger—targets halving the poverty rate and the proportion of people who suffer from hunger.

Following independence—and the end of subsidies from Moscow—the new Central Asian countries suffered sharp drops in real output during the first half of the 1990s, and poverty, based on national poverty lines, began to soar. In Kazakhstan, the poverty rate increased from 16% of the population in 1989 to a peak of 43% in 1998; in the Kyrgyz Republic, it rose from 33% in 1989 to peak at 64% in 1999; and in Tajikistan, from 35% to an astounding 83% in 1999.

Poverty rates in the countries have fallen since, with the lowest in Kazakhstan, which has always been the most prosperous country in the region. Nevertheless, average per capita income remains lower than in the Soviet period. The most recent national poverty data (see bar graph) compared with the situation in years of lowest gross domestic product, suggest that Kazakhstan has now achieved the poverty MDG while the other countries are likely to achieve the goal in time.

Proportion of Population in Poverty, Based on National Poverty Lines (%)



Source: Bauer, A. et al. 2008. The World Bank's New Poverty Data: Implications for the Asian Development Bank. Manila. *ADB Sustainable Development Working Paper Series No. 2.* Manila.
Note: Based on national poverty reduction strategies. Figures in graph are latest available year per country: Kazakhstan (2004), Kyrgyz Republic (2005), Tajikistan (2003), Turkmenistan (1998), and Uzbekistan (2007).

A Kyrgyz boy carries a sack of plastics, paper, and other materials for recycling to the Dordoi market.

However, a 2005 study that gathered comparative cost-of-living data worldwide showed that national poverty estimates have seriously underestimated poverty incidence in recent years. The Central Asian countries used poverty lines of $1.7–$3.2/day—well above the old $1/day international standard—to calculate national poverty lines. Using the new (2005) purchasing power parity (PPP) estimates and a $2/day poverty line, all the countries except Kazakhstan have shown increased "moderate" poverty levels (see table below).

Proportion of Population in Poverty, Based on International Poverty Lines (%)

	Poverty line = $1.25/day	Poverty line = $2.00/day
Kazakhstan	1.2	10.4
Kyrgyz Republic	21.8	51.9
Tajikistan	21.5	50.9
Turkmenistan	11.7	31.5
Uzbekistan	38.8	69.7

Note: Figures based on purchasing power parity in 2005.
Source: Bauer et al. 2008. Based on the World Bank PovCalNet (accessed October 2008).

The $1/day international standard was also revised to $1.25 in light of the 2005 PPP data and when applied to Central Asia shows that extreme poverty affects a significant proportion of the populations, except in Kazakhstan, which has almost eradicated extreme poverty, while Turkmenistan also appears likely to achieve the poverty MDG on time, based on this standard.

The future looks brighter. The International Monetary Fund (IMF) projected that gross domestic product (GDP) in the hydrocarbon-exporting countries (Kazakhstan, Turkmenistan, and Uzbekistan) would grow at 8.1% per year during 2002–2015. This is associated with investments of about 30% of GDP made possible by oil and gas sales. Progress in poverty reduction is forecast to be relatively impressive with a decrease of more than 50% in the poverty rate during the same period. GDP in the other countries would grow at about half that rate with poverty reduction of about 35%. These projections were made before the global economic crisis of 2008–2009, which in Central Asia mainly affected countries that depend on remittances from workers who emigrate to find good-paying jobs. Poverty may increase in the Kyrgyz Republic, Tajikistan, and Uzbekistan because a slowdown in infrastructure development in wealthier countries has reduced the availability of such jobs. Nevertheless, the energy assets of these countries, in a world of growing energy demand, should buffer their economies to some extent.

A good indicator of trends in eliminating hunger is the proportion of malnourished children under 5 years of age. Kazakhstan has achieved the goal of halving child hunger and the Kyrgyz Republic is expected to be an early achiever. There are no comparative data for the other countries but Tajikistan (17%) and Turkmenistan (11%) stand out with more than one child in 10 suffering from hunger.

On a population-wide basis, hunger increased between the early 1990s and early 2000s in Kazakhstan, Tajikistan, and Uzbekis tan. The situation was worrying in Uzbekistan with just over a quarter of the population in hunger, and most alarming in Tajikistan, where more than 60% of the population was undernourished.

Poverty and hunger reduction will not be done by economic growth unless it embraces all strata of the population. Employment generation is a key

Above left: Child mortality has dropped markedly throughout the region since independence, but deaths of women during pregnancy and childbirth have increased in recent years. **Above right:** Tajikistan mother and baby daughter.

element especially in rural areas; unemployment and underemployment are very high, and wages in the public sector and agriculture are mostly very low.

And because much of the poverty is related to degraded environments, equal attention has to be paid to restoring or rehabilitating them through, for example, reduction of air, land, and water pollution; more sustainable agriculture; and implementing the network of protected areas (Econet)—all in ways that benefit both the environment and the poor.

HEALTH

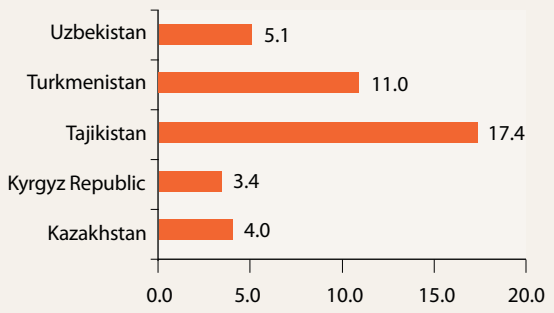
The health-related Millennium Development Goals (MDGs) are goal 4, to reduce under-5 child mortality by two-thirds; goal 5, to improve maternal health; and goal 6, to combat HIV/AIDS, malaria, and other diseases.

There was a general lowering of health care standards after independence of the countries as they struggled to allocate reduced budgets. Facilities have deteriorated, patients have had to pay more, and there is a chronic lack of qualified staff in health care centers.

Nevertheless, all countries have made solid gains in reducing child mortality since independence. Turkmenistan has achieved this goal, and the other countries are set to achieve the goal ahead of 2015.

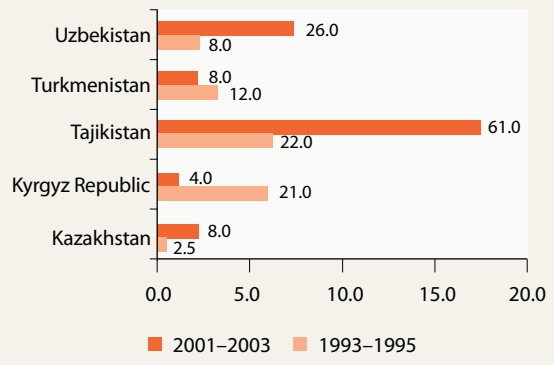
However, maternal health in terms of women's deaths at childbirth regressed markedly during 2000–2005 in the Kyrgyz Republic, Tajikistan, and Turkmenistan. Uzbekistan remained steady. Kazakhstan was the only achiever; maternal mortality there fell by a third.

Prevalence of Underweight Children Under 5 Years of Age (%)



Source: United Nations Millennium Development Goals Indicators. Available: http://mdgs.un.org/unsd/mdg/Data.aspx

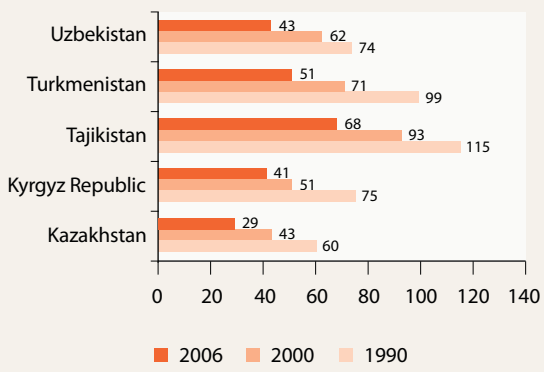
Proportion of Population Below Minimum Level of Dietary Energy Consumption, 1993–1995, 2001–2003, (%)



Note: Kazakhstan's figure for 1993–1995 is less than 2.5.
Source: United Nations Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx

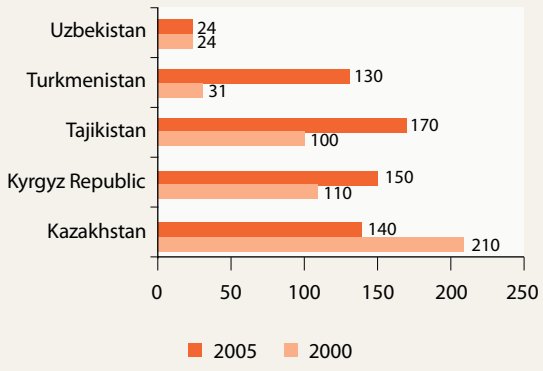
On combating diseases, data are available for the percentage of gross domestic product (GDP) spent on health per country as a proxy for health status. The 2004 allocations for health varied between 1.0% and 3.3%, still low compared to

Children Under-5 Mortality Rate Per 1,000 Live Births, 1990, 2000, 2006



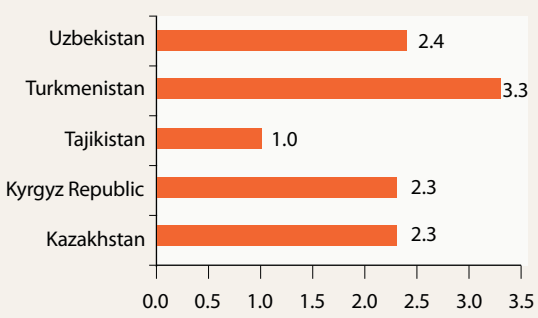
Source: United Nations Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx

Maternal Mortality Ratio Per 100,000 Live Births, 2000, 2005



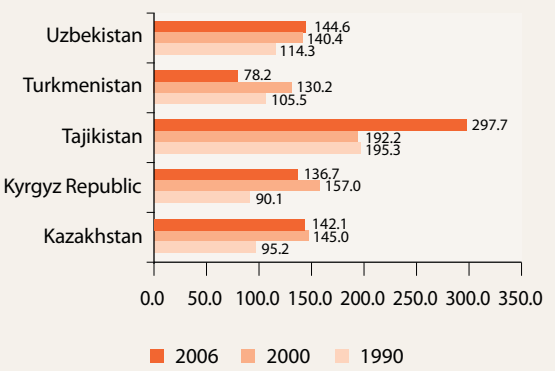
Source: United Nations Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx
Key Indicators for Asia and the Pacific 2008, ADB. www.adb.org/statistics

Government Expenditure for Health, % of gross domestic product



Source: United Nations Development Programme. 2007. *Human Development Report 2007/2008.*

Tuberculosis Prevalence Rate Per 100,000 Population



Source: United Nations Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx

Top: Mother and daughter in the village of Tanat, eastern Kazakhstan, just outside a former nuclear test site where rates of cancer remain relatively high. **Middle:** HIV/AIDS testing in a laboratory, Kyrgyz Republic. **Bottom:** Staff of a nongovernment organization distributing contraceptives to sex workers in Termitau, Kazakhstan, in a campaign against HIV/AIDS.

many Western countries, where health budgets are around 6%–8% of GDP.

Tuberculosis prevalence has risen by 30%–50% since independence, except in Tajikistan where it has doubled. These are the highest disease increases since independence and result from deterioration of the treatment system and availability of drugs as well as a decline in availability of central heating.

A camel stands in front of a chemical plant that was producing an abundance of carbon soot into the atmosphere on the Cheleken peninsula, Turkmenistan, adjacent to the Caspian Sea. (Photo taken in 1997). Such plants have been major producers of greenhouse and toxic gases in the region.

Estimates on the prevalence of HIV/AIDS vary widely, and policy makers have very little evidence of the status of the disease. However, from the data available the numbers are evidently on the rise. There is an urgent need for better estimates of the numbers infected and for better-organized responses in the health system.

ENVIRONMENTAL SUSTAINABILITY

Considering that 20% of the burden of diseases in developing countries can be attributed to insufficient and unsafe water, poor sanitation, carriers like mosquitoes, indoor and outdoor air pollution, and other environmental conditions, dealing with environmental causes of death and disease is highly cost-effective and yields other lifestyle benefits.

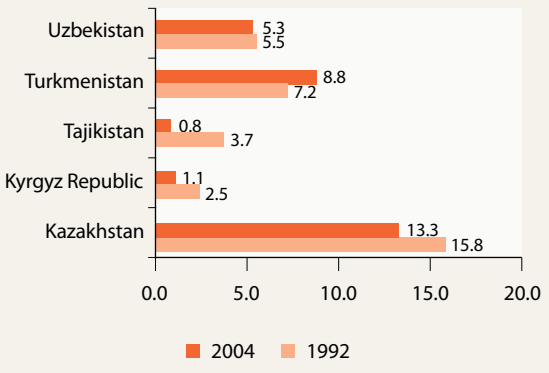
Millennium Development Goal 7, to ensure environmental sustainability, focuses on three areas: integrating principles of sustainable development into national policies and programs and reversing environmental damage, halving the proportion of people without access to safe drinking water, and making significant improvement in the lives of those living in the slums.

An indicator often used to measure sustainable development is emission levels of the greenhouse gas carbon dioxide. The post-independence economic downturn has had a positive effect in reducing carbon dioxide production and in improving air quality because many heavy industries of the Soviet period were not economically viable under the new conditions. Between 1992 and 2004, emissions per capita decreased somewhat in all the countries except Turkmenistan. Nevertheless carbon dioxide production per capita is still significant. Kazakhstan has one of the highest emissions per capita in the world. And with economic recovery, emissions are beginning to increase, although more from households and vehicles than from industry.

One encouraging sign is that consumption of all ozone-depleting substances (which include chlorofluorocarbons [CFCs], bromofluorocarbons [halons], methyl chloroform, carbon tetrachloride, methyl bromide, and hydrochlorofluorocarbons [HCFCs]) has decreased by orders of magnitude in all the countries, except Uzbekistan, which began with a small emission base.

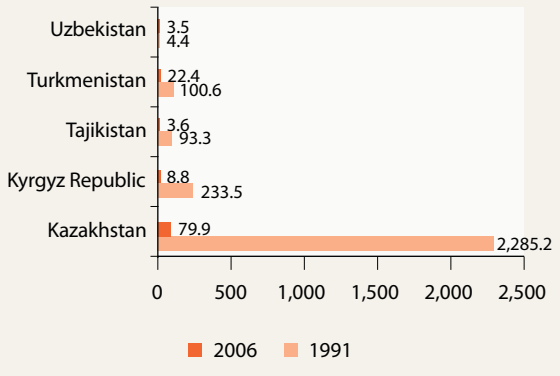
Other indicators of Millennium Development Goals on sustainable development are not so applicable to Central Asia. They include the proportion of land under forest, which is not a major consideration given the initial small area of forests; and proportion of protected areas for biodiversity conservation. Biodiversity is well maintained in deserts and other less accessible areas; thus, the areas designated as protected areas may have little bearing on overall biodiversity status in the region. Better indicators of sustainable environmental development in the region might be effectiveness of management of pastureland and irrigated agricultural land.

Carbon Dioxide Emissions (CO_2), 1992 and 2004
Metric tons of CO_2 per capita



Source: Carbon Dioxide Information Analysis Center (CDIAC), as cited by United Nations Millennium Development Goals Indicators.

Consumption of All Ozone-Depleting Substances, ODP metric tons



ODP = ozone-depleting substance.
Note: Data for Uzbekistan is for 2005 instead of 2006.
Source: United Nations Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx

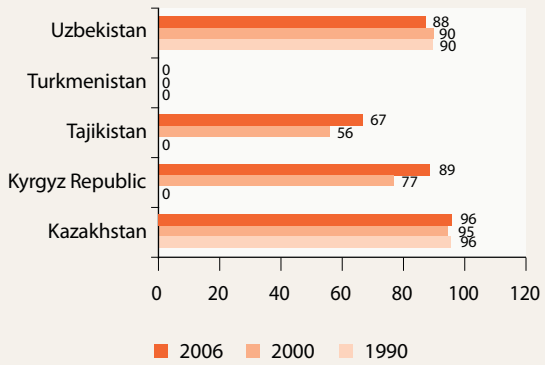
Access to safe water is usually measured as access to "improved sources" of drinking water. Quality of drinking water is of increasing concern in the region. After many years of intensive farming in arid areas and neglect of drinking water systems, the quality of water from improved sources mostly does not meet drinking water standards. So far, official figures show limited improvement over the last 2 decades but this is a goal the countries are unlikely to achieve without major cooperative water management measures, which could take many more years. Access to improved water sources is more likely in urban than rural areas in all countries, and by a wide margin in Tajikistan.

Improvement in the well-being of those living in the slums is indicated by their increasing access to sanitation facilities—as well as access to safe water. Such access has been a major problem in Central Asia, although slums per se are almost nonexistent because of the need for solid shelter against the cold. The overall sanitation situation looks impressive—more than 90% of people having access to improved sanitation facilities. But the remainder are mainly the poor for whom there are no data.

Even the limited progress to date in attaining the Millennium Development Goals of some countries may be negated by the effects of climate change, if not countered with efficient ways of adapting to new climatic conditions, as discussed in the previous chapter.

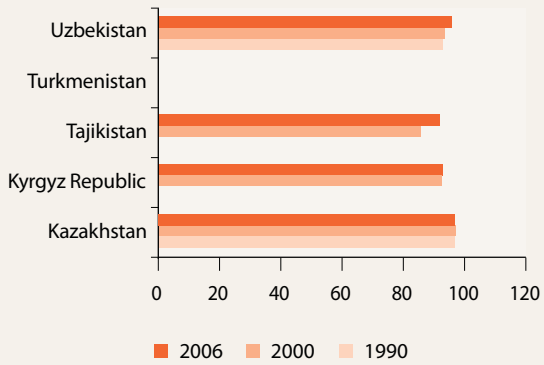
Upper: Young girl with her donkey transporting water near Sangtuda, south of Dushanbe, Tajikistan. **Lower:** Young boys collecting water from communal pumps in Abraly, near Semey Polygon, Kazakhstan.

Proportion of Population Using An Improved Drinking Water Source, 1990, 2000, 2006



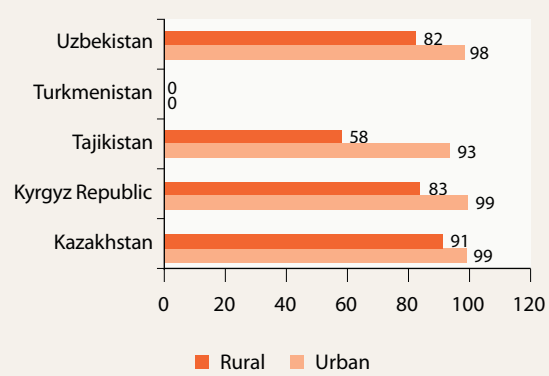
Note: No data for Turkmenistan for all years; no data for the Kyrgyz Republic and Tajikistan for 1990.
Source: United Nations Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx

Proportion of Population Using An Improved Sanitation Facility, 1990, 2000, 2006



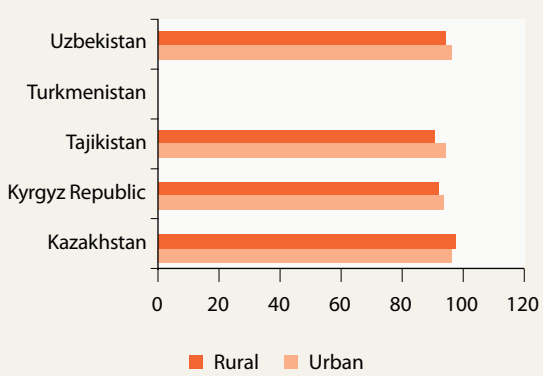
Note: No data for Turkmenistan for all years; no data for the Kyrgyz Republic and Tajikistan for 1990.
Source: United Nations Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx

Proportion of Population Using An Improved Water Source, 2006



Note: No data for Turkmenistan.
Source: United Nations Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx

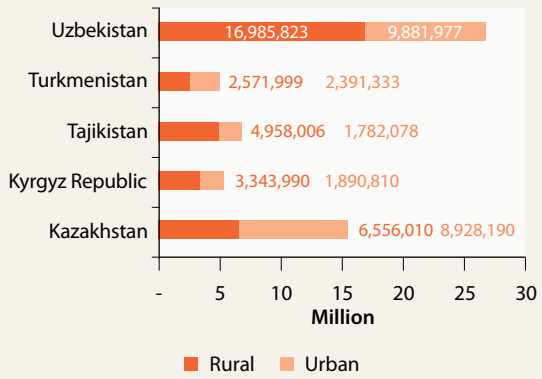
Proportion of Population Using An Improved Sanitation Facility, 2006



Note: No data for Turkmenistan.
Source: United Nations Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx

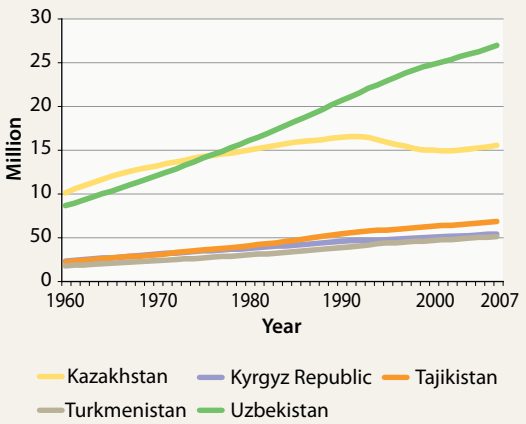
Upper: Crowded housing in Turkmenabat, Turkmenistan. Cities and towns in the region will take up an increasing proportion of the population in future years. Lower: Father and sons outside their farm house, south of Dushanbe, Tajikistan. Rural poverty drives many Tajiks to seek work in cities and in other countries.

Population of Central Asia, 2007



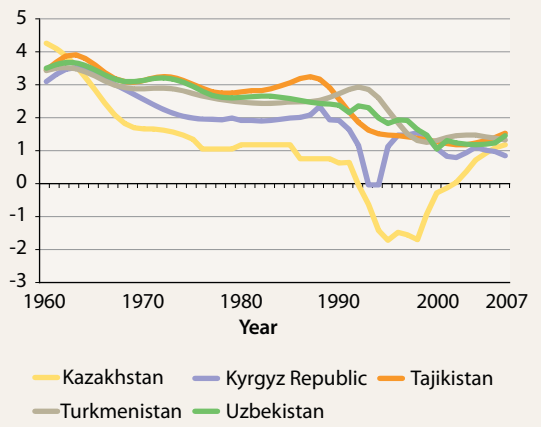
Source: World Bank. World Development Indicators Online.

Population of Central Asia, 1960–2007



Source: World Bank. World Development Indicators Online. Various years.

Central Asia Population Growth, Annual %, 1960–2007



Source: World Bank. World Development Indicators Online. Various years.

Urbanization Projection to 2020

	Urban share of population, 2000 (%)	Urban share of population, 2020 (%)
Kazakhstan	56	60
Kyrgyz Republic	34	39
Tajikistan	28	26
Turkmenistan	45	53
Uzbekistan	37	39

Source: Hugo, Graeme. 2003. Urbanisation in Asia: An Overview. Paper prepared for the Conference on African Migration in Comparative Perspective, Johannesburg, South Africa, pp. 4–7. http://pum.princeton.edu/pumconference/papers/2-Hugo.pdf

Population and Urbanization

FLUCTUATING POPULATIONS

In 2007, Central Asia was home to about 61.6 million people: Uzbekistan was the most populous (27.0 million); Kazakhstan was next, with 15.4 million, but given its vast size, it is one of the least densely populated countries in the world. The three other countries had markedly smaller and similar population sizes—Tajikistan with 7.1 million, Turkmenistan with 6.9 million, and the Kyrgyz Republic the smallest, with 5.2 million.

The population sizes of the now Central Asian countries can only be traced back 1 century with any confidence. The region has seesawed in its population growth rate in the wake of civil and international wars and policies of tsarist Russian and then Soviet rulers. The countries' populations swelled during the Soviet period, due to immigration, particularly in Kazakhstan. At independence, this trend reversed, with many Russian-speaking people leaving the region. For the region as a whole though, there was at the same time an inflow of forced migrants from neighboring areas of civil and economic unrest. Other factors affecting regional population size include more recent migration associated with agriculture expansion in some countries, national migration policies, and health status of the populations.

The result of these phenomena has been a general decline in the rate of population growth since the 1960s. Growth rates fell precipitously after independence in some countries, especially Kazakhstan and the Kyrgyz Republic. Kazakhstan's population declined for several years in the 1990s as a result of large-scale emigration, mainly of Russians; in both countries, falling life expectancy was another major factor. Other countries held back their transition to market economies to avoid disruption to their populations, but life expectancies gradually declined also in Turkmenistan and Uzbekistan. A long civil war tragically lowered the growth rate in Tajikistan.

The latest growth data suggest that the countries are now back on a path of gradually declining population growth rates.

This is fortunate because, although the region's total population is tiny compared with that of Europe, which is about the same physical size—in 2008, Europe contained some 500 million people; Central Asia's total was only about 62 million—Central Asia's communities are concentrated in small areas where water is available, and that is a small fraction of the region's land area. The region-wide environmental problems now faced there suggest that even the present population cannot be sustained. One commentator observed: "The region needs a revolution in its agricultural system or a sudden drop in its birth rate, or both, to avoid a crisis of enormous proportions—but neither task will be easy."

Central Asian countries are among the least urbanized nations in Asia. However, urbanization has accelerated since independence, in part because previously, people often could not move freely from place to place. Cities in Kazakhstan and Uzbekistan are growing faster than the national population growth rate. For example, the population of Kazakhstan's urban areas increased 500% over the past 8 years.

Indications are that net population increase in the region during this century will be absorbed in urban centers. Such increases pose large problems for city planners.

TOWARD SUSTAINABLE URBAN AREAS

As urban populations grow, housing becomes a problem, especially in Central Asia where before independence the state provided housing. This role has decreased but the private sector cannot match present demand.

Housing is but one of many issues where demand exceeds supply. Water has become a major issue in the region's cities and towns. Supplies from aquifers and reservoirs are on the whole contaminated and unsafe for drinking. Piped water is unsafe in many places also because the piping systems need repair and lack sanitary protection. Residents often have to boil water or buy water trucked in from safe sources. Solid waste management is an equally severe urban problem. Few garbage dumps meet environmental compliance standards. Only a minority of urban areas has adequate solid waste collection and disposal; the situation is similar with sewage collection systems and sewage treatment plants.

These deficiencies have their health consequences. Health disorders and diseases are fairly similar across the region, the most prevalent being tuberculosis, viral hepatitis, and cardiovascular and liver diseases.

Greening Kazakhstan and Turkmenistan Capitals

In 1998, shortly after Astana, shown on the right, became Kazakhstan's new capital, city greening activities were introduced. By 2005, 25,000 hectares were made green areas by Zhasyl Aimak, the state enterprise tasked with the assignment. Managed by the municipal government, the ring of green around Astana, designed to serve as a windbreak, will feature parks, numerous plant species, and trees, such as maple, poplar, cherry, and birch. The goal is to have 75,000 hectares planted by 2015.

Turkmenistan's capital Ashgabat (lower photo) has also undergone transformation. Between 1998 and 2004, more than 30 million seedlings were planted in 25,000 hectares as part of the Greenbelt Program, which planted more than 50 million seedlings in all. Administration is handled by Gok Gushak (joint-stock forestry company), which provides a yearly forestry plan, monitors afforestation progress, and sells seedlings. Work is performed in collaboration with the Ministry of Nature Protection.

Many "good practices" toward sustainable cities and towns can now be applied to Central Asia; practices that can embrace change and seek to improve residents' living standards and welfare, while managing and minimizing the associated problems. The major difficulties are overcoming the inertia of existing systems—many still carryovers from the Soviet period—and avoiding conflict with respected values, traditions, culture, beliefs, and institutions.

Central Asian cities and other settlements have two advantages over those in most other places. First, Soviet period planning emphasized the greening of urban areas. Across the region's cities are parks and gardens, and treelined roads. Greenbelts around cities and elsewhere were constructed to reduce pollution from industries, protect water reserves, and provide recreational areas. But lack of heating fuel, such as gas, has driven the poor in some cities to cut down trees for heating houses. These greenbelts need to be maintained—both to continue their present roles and to provide income for the poor through managed harvesting of both wood and other products, such as fruits.

The relatively low rate of urbanization to date is Central Asia's other advantage in pursuing a course toward sustainable cities and towns. The region can learn from the mistakes and the good practices of other more urbanized countries and apply the lessons before problems become overpowering.

Information Resources

Statistical Tables

Demographic and Economic Indicators

DEMOGRAPHIC DATA, 2007 - LATEST AVAILABLE YEAR (Units In Thousands)

Source: http://ddp-ext.worldbank.org/ext/DDPQQ/showReport.do?method=showReport as of 9 June 2009

Kazakhstan—Demographic data

Indicator	1990	1995	2000	2005	2007
Population, total	16,348.00	15,815.63	14,883.60	15,147.00	15,484.20
Birth rate, crude (per 1,000 people)	0.02	0.02	0.01	0.02	0.02
Death rate, crude (per 1,000 people)	0.01	0.01	0.01	0.01	0.01
Population density (people per square kilometer)	0.01	0.01	0.01	0.01	0.01
Rural population	7,144.08	6,974.69	6,504.13	6,498.06	6,556.01
Rural population (% of total population)	0.04	0.04	0.04	0.04	0.04
Urban population	9,203.92	8,840.94	8,379.47	8,648.94	8,928.19
Urban population (% of total)	0.06	0.06	0.06	0.06	0.06

Kyrgyz Republic—Demographic data

Indicator	1990	1995	2000	2005	2007
Population, total	4,423.00	4,589.90	4,915.30	5,143.50	5,234.80
Birth rate, crude (per 1,000 people)	0.03	0.03	0.02	0.02	0.02
Death rate, crude (per 1,000 people)	0.01	0.01	0.01	0.01	0.01
Population density (people per square kilometer)	0.02	0.02	0.03	0.03	0.03
Rural population	2,751.11	2,923.77	3,175.28	3,302.13	3,343.99
Rural population (% of total population)	0.06	0.06	0.06	0.06	0.06
Urban population	1,671.89	1,666.13	1,740.02	1,841.37	1,890.81
Urban population (% of total)	0.04	0.04	0.04	0.04	0.04

Tajikistan—Demographic data

Indicator	1990	1995	2000	2005	2007
Population, total	5,303.15	5,772.39	6,172.84	6,550.21	6,740.08
Birth rate, crude (per 1,000 people)	0.04	0.03	0.03	0.03	0.03
Death rate, crude (per 1,000 people)	0.01	0.01	0.01	0.01	0.01
Population density (people per square kilometer)	0.04	0.04	0.04	0.05	0.05
Rural population	3,622.05	4,104.17	4,537.03	4,820.96	4,958.01
Rural population (% of total population)	0.07	0.07	0.07	0.07	0.07
Urban population	1,681.10	1,668.22	1,635.80	1,729.26	1,782.08
Urban population (% of total)	0.03	0.03	0.03	0.03	0.03

Turkmenistan—Demographic data

Indicator	1990	1995	2000	2005	2007
Population, total	3,668.00	4,192.98	4,502.14	4,833.27	4,963.33
Birth rate, crude (per 1,000 people)	0.03	0.03	0.02	0.02	0.02
Death rate, crude (per 1,000 people)	0.01	0.01	0.01	0.01	0.01
Population density (people per square kilometer)	0.01	0.01	0.01	0.01	0.01
Rural population	2,013.73	2,293.56	2,440.16	2,547.13	2,572.00
Rural population (% of total population)	0.05	0.05	0.05	0.05	0.05
Urban population	1,654.27	1,899.42	2,061.98	2,286.13	2,391.33
Urban population (% of total)	0.05	0.05	0.05	0.05	0.05

Uzbekistan—Demographic data

Indicator	1990	1995	2000	2005	2007
Population, total	20,510.00	22,785.00	24,650.00	26,167.37	26,867.80
Birth rate, crude (per 1,000 people)	0.03	0.03	0.02	0.02	0.02
Death rate, crude (per 1,000 people)	0.01	0.01	0.01	0.01	0.01
Population density (people per square kilometer)	0.05	0.05	0.06	0.06	0.06
Rural population	12,285.49	14,035.56	15,455.55	16,563.94	16,985.82
Rural population (% of total population)	0.06	0.06	0.06	0.06	0.06
Urban population	8,224.51	8,749.44	9,194.45	9,603.42	9,881.98
Urban population (% of total)	0.04	0.04	0.04	0.04	0.04

Kazakhstan Economic Indicators, 1990–2007 (units in thousands)					
Indicator	**1990**	**1995**	**2000**	**2005**	**2007**
Agriculture, value added (% of GDP)	–	0.01	0.01	0.01	0.01
Changes in net reserves (BoP, current US$)	–	-298,694.73	-570,077.37	1,824,106.62	2,414,703.36
Current account balance (% of GDP)	–	-0.00	0.00	-0.00	-0.01
Current account balance (BoP, current US$)	–	-213,100.00	366,309.48	-1,055,840.93	-7,333,401.32
Expense (% of GDP)	–	–	0.01	0.02	0.01
Expense (current LCU)	–	–	356,747,659.00		
Exports of goods and services (% of GDP)	–	0.04	0.06	0.05	0.05
External debt stocks (% of GNI)	–	0.0	0.1	0.1	0.1
External debt stocks, total (DOD, current US$)	–	3,750,246.00	12,432,603.00	43,378,214.00	96,133,405.00
Foreign direct investment, net (BoP, current US$)	–	963,900.00	1,278,161.53	2,117,077.81	6,945,072.81
Foreign direct investment, net inflows (% of GDP)	–	0.00	0.01	0.00	0.01
Foreign direct investment, net outflows (% of GDP)	–	0.00	0.00	-0.00	0.00
GDP (current US$)	26,932,729.9	20,374,306.8	18,291,990.5	57,123,672.1	104,853,479.4
GDP growth (annual %)	–	-0.01	0.01	0.01	0.01
GDP per capita (current US$)	1.6	1.3	1.2	3.8	6.8
GDP per capita growth (annual %)	–	-0.0	0.0	0.0	0.0
GDP per capita, PPP (current international $)	5.1	3.7	4.8	8.7	10.9
GDP, PPP (current international $)	83,680,464.5	57,984,390.1	71,189,884.4	131,765,489.7	168,204,093.6
GNI (current US$)	26,932,729.9	20,191,285.2	17,149,675.5	51,757,264.9	92,709,126.1
GNI per capita, Atlas method (current US$)	–	1.3	1.3	2.9	5.0
GNI per capita, PPP (current international $)	5.1	3.6	4.5	7.9	9.6
GNI, Atlas method (current US$)	–	20,190,398.5	18,864,269.3	44,604,518.4	77,723,476.0
GNI, PPP (current international $)	83,680,464.5	57,463,522.7	66,744,147.8	119,386,954.3	148,722,330.2
Goods exports (BoP, current US$)	–	5,440,000.00	9,288,112.70	28,300,591.25	48,351,135.15
Goods imports (BoP, current US$)	–	5,325,900.00	7,119,733.77	17,978,784.49	33,260,182.52
Grants and other revenue (% of revenue)	–	–	0.02	0.02	0.03
Grants and other revenue (current LCU)	–	–	85,915,178.00	411,987,195.97	635,537,254.70
Imports of goods and services (% of GDP)	–	0.04	0.05	0.04	0.04
Industry, value added (% of GDP)	–	0.03	0.04	0.04	0.04
Merchandise exports (current US$)	–	5,250,000.00	8,812,000.00	27,849,000.00	47,755,343.59
Merchandise imports (current US$)	–	3,807,000.00	5,040,000.00	17,352,500.00	32,756,356.06
Merchandise trade (% of GDP)	–	0.04	0.08	0.08	0.08
Net capital account (BoP, current US$)	–	-380,600.00	-290,533.22	14,005.78	-37,566.22
Net income (BoP, current US$)	–	-145,500.00	-1,254,053.64	-5,696,919.75	-12,193,007.40
Net trade in goods (BoP, current US$)	–	114,100.00	2,168,378.93	10,321,806.76	15,090,952.63
Present value of external debt (current US$)	–	–	–	–	94,262,700.17
Revenue, excluding grants (% of GDP)	–	–	0.01	0.02	0.02
Revenue, excluding grants (current LCU)	–	–	294,456,000.00	1,617,977,310.66	2,043,761,739.20
Rural population growth (annual %)	0.00	-0.00	-0.00	0.00	0.00
Service exports (BoP, current US$)	–	535,100.00	1,053,004.04	2,228,439.09	3,554,992.01
Service imports (BoP, current US$)	–	775,800.00	1,850,028.12	7,495,712.03	11,626,805.00
Services, etc., value added (% of GDP)	–	0.06	0.05	0.05	0.05
Total reserves (% of total external debt)	–	0.04	0.02	0.02	0.02
Total reserves (includes gold, current US$)	–	1,659,893.91	2,098,969.80	7,069,707.38	17,641,023.63
Total reserves in months of imports	–	0.00	0.00	0.00	0.00
Total reserves minus gold (current US$)	–	1,135,516.19	1,594,117.42	6,084,195.42	15,776,758.29
Trade in services (% of GDP)	–	0.01	0.02	0.02	0.01

— = data not available, BoP = balance of payments, DOD = disbursed and outstanding debt, GDP = gross domestic product, GNI = gross national income, LCU = local currency unit, PPP = purchasing power parity, US = United States.
Source: http://ddp-ext.worldbank.org/ext/DDPQQ/showReport.do?method=showReport

Kyrgyz Republic Economic Indicators, 1990–2007 (units in thousands)					
Indicator	**1990**	**1995**	**2000**	**2005**	**2007**
Agriculture, value added (% of GDP)	0.03	0.04	0.04	0.03	0.03
Changes in net reserves (BoP, current US$)	–	46,373.69	11,823.34	-93,011.55	-327,426.06
Current account balance (% of GDP)	–	-0.01	-0.01	-0.00	-0.01
Current account balance (BoP, current US$)	–	-234,717.00	-76,084.94	-35,413.60	-228,325.24
Expense (% of GDP)	–	0.03	0.02	–	0.02
Expense (current LCU)	–	4,127,800.00	10,328,200.00	–	25,666,353.80
Exports of goods and services (% of GDP)	0.03	0.03	0.04	0.04	0.04
External debt stocks (% of GNI)	–	0.0	0.1	0.1	0.1
External debt stocks, total (DOD, current US$)	–	609,470.00	1,827,411.00	2,027,290.00	2,401,111.00
Foreign direct investment, net (BoP, current US$)	–	96,090.00	-6,860.12	42,565.33	208,102.44
Foreign direct investment, net inflows (% of GDP)	–	0.01	-0.00	0.00	0.01
Foreign direct investment, net outflows (% of GDP)	–	–	0.00	–	-0.00
GDP (current US$)	2,673,999.9	1,661,018.5	1,369,691.9	2,459,876.1	3,744,624.9
GDP growth (annual %)	0.01	-0.01	0.01	-0.00	0.01
GDP per capita (current US$)	0.6	0.4	0.3	0.5	0.7
GDP per capita growth (annual %)	0.0	-0.0	0.0	-0.0	0.0
GDP per capita, PPP (current international $)	1.8	1.0	1.3	1.7	2.0
GDP, PPP (current international $)	7,999,426.3	4,577,119.8	6,529,589.9	8,886,594.7	10,498,748.4
GNI (current US$)	2,673,999.9	1,625,596.3	1,287,697.8	2,371,676.2	3,692,245.5
GNI per capita, Atlas method (current US$)	–	0.4	0.3	0.4	0.6
GNI per capita, PPP (current international $)	1.8	1.0	1.2	1.7	2.0
GNI, Atlas method (current US$)	–	1,625,964.0	1,375,439.1	2,298,290.4	3,199,399.2
GNI, PPP (current international $)	7,999,426.3	4,479,510.0	6,138,708.0	8,567,961.4	10,351,893.6
Goods exports (BoP, current US$)	–	408,930.00	510,921.78	686,837.03	1,336,976.00
Goods imports (BoP, current US$)	–	530,950.00	506,216.12	1,105,543.20	2,635,469.81
Grants and other revenue (% of revenue)	–	0.01	0.02	–	0.03
Grants and other revenue (current LCU)	–	313,400.00	2,189,200.00	–	9,404,046.20
Imports of goods and services (% of GDP)	0.05	0.04	0.05	0.06	0.09
Industry, value added (% of GDP)	0.04	0.02	0.03	0.02	0.02
Merchandise exports (current US$)	–	409,000.00	505,000.00	672,014.00	1,135,000.00
Merchandise imports (current US$)	–	522,000.00	554,000.00	1,102,160.00	2,416,987.00
Merchandise trade (% of GDP)	–	0.06	0.08	0.07	0.09
Net capital account (BoP, current US$)	–	-29,043.00	-11,378.42	-20,548.90	-74,857.08
Net income (BoP, current US$)	–	-35,420.00	-82,014.99	-85,177.35	-52,379.25
Net trade in goods (BoP, current US$)	–	-122,020.00	4,705.66	-418,706.17	-1,298,493.81
Present value of external debt (current US$)	–	–	–	–	1,275,133.52
Revenue, excluding grants (% of GDP)	–	0.02	0.01	–	0.02
Revenue, excluding grants (current LCU)	–	2,690,600.00	9,256,500.00	–	29,405,787.40
Service exports (BoP, current US$)	–	39,152.00	62,038.34	259,416.41	684,251.92
Service imports (BoP, current US$)	–	195,113.00	148,175.57	291,253.93	582,194.80
Services, etc., value added (% of GDP)	0.03	0.04	0.03	0.05	0.05
Total reserves (% of total external debt)	–	0.02	0.01	0.03	0.05
Total reserves (includes gold, current US$)	–	133,633.01	261,849.46	612,352.84	1,176,500.81
Total reserves in months of imports	–	0.00	0.00	0.00	0.00
Total reserves minus gold (current US$)	–	80,957.66	239,045.43	569,727.67	1,107,224.53
Trade in services (% of GDP)	–	0.01	0.02	0.02	0.03

— = data not available, BoP = , DOD = , GDP = gross domestic product, GNI = gross national income, LCU = , PPP = purchasing power parity, US = United States.
Source: http://ddp-ext.worldbank.org/ext/DDPQQ/showReport.do?method=showReport

Tajikistan Economic Indicators, 1990–2007 (units in thousands)					
Indicator	**1990**	**1995**	**2000**	**2005**	**2007**
Agriculture, value added (% of GDP)	0.03	0.04	0.03	0.02	0.02
Changes in net reserves (BoP, current US$)	–	–	–	-10,177.01	11,523.94
Current account balance (% of GDP)	–	–	–	-0.00	-0.01
Current account balance (BoP, current US$)	–	–	–	-18,859.70	-495,062.30
Expense (% of GDP)	–	–	0.01	–	–
Expense (current LCU)	–	–	160,005.00	–	–
Exports of goods and services (% of GDP)	0.03	0.07	0.10	0.03	0.02
External debt stocks (% of GNI)	–	0.1	0.1	0.0	0.0
External debt stocks, total (DOD, current US$)	–	633,564.00	1,033,707.00	1,065,476.00	1,227,890.00
Foreign direct investment, net (BoP, current US$)	–	–	–	54,479.30	359,967.40
Foreign direct investment, net inflows (% of GDP)	–	0.00	0.00	0.00	0.01
Foreign direct investment, net outflows (% of GDP)	–	–	–	0	0
GDP (current US$)	2,629,394.9	1,231,523.1	860,550.3	2,312,319.5	3,712,331.3
GDP growth (annual %)	-0.00	-0.01	0.01	0.01	0.01
GDP per capita (current US$)	0.5	0.2	0.1	0.4	0.6
GDP per capita growth (annual %)	-0.0	-0.0	0.0	0.0	0.0
GDP per capita, PPP (current international $)	2.2	0.9	0.9	1.5	1.8
GDP, PPP (current international $)	11,730,546.4	5,032,521.9	5,474,772.0	9,681,676.7	11,816,352.9
GNI (current US$)	2,629,394.9	1,183,000.2	781,056.1	2,237,772.5	3,612,341.0
GNI per capita, Atlas method (current US$)	–	0.2	0.2	0.3	0.5
GNI per capita, PPP (current international $)	2.2	0.8	0.8	1.4	1.7
GNI, Atlas method (current US$)	–	1,182,938.4	1,011,156.5	2,178,089.7	3,103,930.9
GNI, PPP (current international $)	11,730,546.4	4,834,236.9	4,969,034.3	9,369,548.4	11,498,084.7
Goods exports (BoP, current US$)	–	–	–	1,108,092.60	1,556,876.30
Goods imports (BoP, current US$)	–	–	–	1,430,925.90	3,115,005.50
Grants and other revenue (% of revenue)	–	–	0.01	–	–
Grants and other revenue (current LCU)	–	–	14,124.00	–	–
Imports of goods and services (% of GDP)	0.04	0.07	0.10	0.05	0.07
Industry, value added (% of GDP)	0.04	0.04	0.04	0.03	0.03
Merchandise exports (current US$)	–	750,000.00	785,000.00	908,700.00	1,468,200.00
Merchandise imports (current US$)	–	810,000.00	675,000.00	1,330,100.00	2,455,400.00
Merchandise trade (% of GDP)	–	0.13	0.17	0.10	0.11
Net capital account (BoP, current US$)	–	–	–	–	32,838.80
Net income (BoP, current US$)	–	–	–	-40,777.40	-50,742.90
Net trade in goods (BoP, current US$)	–	–	–	-322,833.30	-1,558,129.20
Population density (people per sq. km)	0.04	0.04	0.04	0.05	0.05
Population, total	5,303.15	5,772.39	6,172.84	6,550.21	6,740.08
Present value of external debt (current US$)	–	–	–	–	856,491.34
Revenue, excluding grants (% of GDP)	–	–	0.01	–	–
Revenue, excluding grants (current LCU)	–	–	189,880.00	–	–
Service exports (BoP, current US$)	–	–	–	146,341.80	148,692.10
Service imports (BoP, current US$)	–	–	–	251,518.70	592,078.50
Services, etc., value added (% of GDP)	0.03	0.02	0.03	0.04	0.05
Total reserves (% of total external debt)	–	–	0.01	0.02	–
Total reserves (includes gold, current US$)	–	–	94,280.85	188,914.23	–
Total reserves in months of imports	–	–	–	0.00	–
Total reserves minus gold (current US$)	–	–	92,859.19	168,219.81	–
Trade in services (% of GDP)	–	–	–	0.02	0.02

– = data not available, BoP = , DOD = dispersed and outstanding debt, GDP = gross domestic product, GNI = gross national income, LCU = , PPP = purchasing power parity, US = United States.
Source: http://ddp-ext.worldbank.org/ext/DDPQQ/showReport.do?method=showReport

Turkmenistan Economic Indicators, 1990–2007 (units in thousands)					
Indicator	**1990**	**1995**	**2000**	**2005**	**2007**
Agriculture, value added (% of GDP)	0.03	0.02	0.02	–	–
Changes in net reserves (BoP, current US$)	–	–	–	–	–
Current account balance (% of GDP)	–	–	–	–	–
Current account balance (BoP, current US$)	–	–	–	–	–
Expense (% of GDP)	–	–	–	–	–
Expense (current LCU)	–	–	–	–	–
Exports of goods and services (% of GDP)	–	0.08	0.10	0.07	0.06
External debt stocks (% of GNI)	–	0.0	0.1	0.0	0.0
External debt stocks, total (DOD, current US$)	–	402,247.00	2,518,347.00	1,058,011.00	743,419.00
Foreign direct investment, net (BoP, current US$)	–	–	–	–	–
Foreign direct investment, net inflows (% of GDP)	–	0.01	0.00	0.01	0.01
Foreign direct investment, net outflows (% of GDP)	–	–	–	–	–
GDP (current US$)	3,232,066.8	2,482,228.5	2,904,662.5	8,102,340.1	12,933,396.5
GDP growth (annual %)	0.00	-0.01	0.02	–	–
GDP per capita (current US$)	0.9	0.6	0.6	1.7	2.6
GDP per capita growth (annual %)	-0.0	-0.0	0.0	–	–
GDP per capita, PPP (current international $)	–	–	–	4.7	–
GDP, PPP (current international $)	–	–	–	22,607,202.4	–
GNI (current US$)	3,232,066.8	2,500,628.5	2,727,382.5	7,539,339.8	12,584,396.8
GNI per capita, Atlas method (current US$)	0.9	0.6	0.6	–	–
GNI per capita, PPP (current international $)	–	–	–	4.4	–
GNI, Atlas method (current US$)	3,231,854.1	2,553,445.9	2,907,728.9	–	–
GNI, PPP (current international $)	–	–	–	21,036,314.7	–
Goods exports (BoP, current US$)	–	–	–	–	–
Goods imports (BoP, current US$)	–	–	–	–	–
Grants and other revenue (% of revenue)	–	–	–	–	–
Grants and other revenue (current LCU)	–	–	–	–	–
Imports of goods and services (% of GDP)	–	0.08	0.08	0.05	0.05
Industry, value added (% of GDP)	0.03	0.06	0.04	–	–
Merchandise exports (current US$)	–	1,880,000.00	2,506,000.00	4,939,000.00	8,920,000.00
Merchandise imports (current US$)	–	1,365,000.00	1,786,000.00	3,638,000.00	4,460,000.00
Merchandise trade (% of GDP)	–	0.13	0.15	0.11	0.10
Net capital account (BoP, current US$)	–	–	–	–	–
Net income (BoP, current US$)	–	–	–	–	–
Net trade in goods (BoP, current US$)	–	–	–	–	–
Present value of external debt (current US$)	–	–	–	–	727,298.44
Revenue, excluding grants (% of GDP)	–	–	–	–	–
Revenue, excluding grants (current LCU)	–	–	–	–	–
Service exports (BoP, current US$)	–	–	–	–	–
Service imports (BoP, current US$)	–	–	–	–	–
Services, etc., value added (% of GDP)	0.04	0.02	0.03	–	–
Total reserves (% of total external debt)	–	0.29	–	–	–
Total reserves (includes gold, current US$)	–	1,168,007.40	–	–	–
Total reserves in months of imports	–	–	–	–	–
Total reserves minus gold (current US$)	–	1,168,007.40	–	–	–
Trade in services (% of GDP)	–	–	–	–	–

— = data not available, BoP = , DOD = dispersed and outstanding debt, GDP = gross domestic product, GNI = gross national income, LCU = , PPP = purchasing power parity, US = United States.
Source: http://ddp-ext.worldbank.org/ext/DDPQQ/showReport.do?method=showReport

Uzbekistan Economic Indicators, 1990–2007 (units in thousands)

Indicator	1990	1995	2000	2005	2007
Agriculture, value added (% of GDP)	0.03	0.03	0.03	0.03	0.02
Birth rate, crude (per 1,000 people)	0.03	0.03	0.02	0.02	0.02
Changes in net reserves (BoP, current US$)	–	–	–	–	–
Current account balance (% of GDP)	–	–	–	–	–
Current account balance (BoP, current US$)	–	–	–	–	–
Expense (% of GDP)	–	–	–	–	–
Expense (current LCU)	–	–	–	–	–
Exports of goods and services (% of GDP)	0.03	0.03	0.02	0.04	0.04
External debt stocks (% of GNI)	–	0.0	0.0	0.0	0.0
External debt stocks, total (DOD, current US$)	–	1,799,134.00	4,634,492.00	4,289,936.00	3,875,534.00
Foreign direct investment, net (BoP, current US$)	–	–	–	–	–
Foreign direct investment, net inflows (% of GDP)	–	-0.00	0.00	0.00	0.00
Foreign direct investment, net outflows (% of GDP)	–	–	–	–	–
GDP (current US$)	13,360,608.3	13,350,461.4	13,760,374.8	14,307,510.3	22,308,386.8
GDP growth (annual %)	0.00	-0.00	0.00	0.01	0.01
GDP per capita (current US$)	0.7	0.6	0.6	0.5	0.8
GDP per capita growth (annual %)	-0.0	-0.0	0.0	0.0	0.0
GDP per capita, PPP (current international $)	1.4	1.2	1.4	2.0	2.4
GDP, PPP (current international $)	29,651,259.3	27,139,280.2	35,602,434.7	52,359,265.7	65,143,031.7
GNI (current US$)	–	13,324,461.1	13,541,375.0	14,283,209.7	22,370,385.9
GNI per capita, Atlas method (current US$)	–	0.6	0.6	0.5	0.7
GNI per capita, PPP (current international $)	–	1.2	1.4	2.0	2.4
GNI, Atlas method (current US$)	–	13,323,875.3	15,431,982.1	13,751,400.4	19,722,364.9
GNI, PPP (current international $)	–	27,086,428.1	35,035,811.7	52,270,336.9	65,324,076.9
Goods exports (BoP, current US$)	–	–	–	–	–
Goods imports (BoP, current US$)	–	–	–	–	–
Grants and other revenue (% of revenue)	–	–	–	–	–
Grants and other revenue (current LCU)	–	–	–	–	–
Imports of goods and services (% of GDP)	0.05	0.03	0.02	0.03	0.03
Industry, value added (% of GDP)	0.03	0.03	0.02	0.02	0.03
Merchandise exports (current US$)	–	3,430,000.00	2,817,000.00	4,749,000.00	8,029,400.00
Merchandise imports (current US$)	–	2,750,000.00	2,697,000.00	3,666,000.00	4,848,000.00
Merchandise trade (% of GDP)	–	0.05	0.04	0.06	0.06
Net capital account (BoP, current US$)	–	–	–	–	–
Net income (BoP, current US$)	–	–	–	–	–
Net trade in goods (BoP, current US$)	–	–	–	–	–
Present value of external debt (current US$)	–	–	–	–	3,604,942.58
Revenue, excluding grants (% of GDP)	–	–	–	–	–
Revenue, excluding grants (current LCU)	–	–	–	–	–
Rural population	12,285.49	14,035.56	15,455.55	16,563.94	16,985.82
Rural population (% of total population)	0.06	0.06	0.06	0.06	0.06
Service exports (BoP, current US$)	–	–	–	–	–
Service imports (BoP, current US$)	–	–	–	–	–
Services, etc., value added (% of GDP)	0.03	0.04	0.04	0.05	0.05
Total reserves (% of total external debt)	–	–	–	–	–
Total reserves (includes gold, current US$)	–	–	–	–	–
Total reserves in months of imports	–	–	–	–	–
Total reserves minus gold (current US$)	–	–	–	–	–
Trade in services (% of GDP)	–	–	–	–	–

— = data not available, BoP = , DOD = dispersed and outstanding debt, GDP = gross domestic product, GNI = gross national income, LCU = , PPP = purchasing power parity, US = United States.
Source: http://ddp-ext.worldbank.org/ext/DDPQQ/showReport.do?method=showReport

Mineral Resources

Kazakhstan: Production of Mineral Commodities,[1] (Metric tons unless otherwise specified)

Commodity	2001	2002	2003	2004	2005
METALS					
Aluminum:					
Alumina (thousand metric tons)	1,231	1,386	1,419	1,468	1,505
Bauxite	3,685,100	4,376,600	4,737,100	4,705,600	4,800,000
Arsenic trioxide[e]	1,500	1,500	1,500	1,500	1,500
Bismuth:[e]					
Mine output, Bi content	252	161	150	150	140
Metal, refined	130	130	130	130	120
Cadmium, metal	1,250	1,300	1,351	1,900	2,000
Chromite	2,045,700	2,369,400	2,927,500	3,287,000	3,579,000
Cobalt, mine output, Co content[e]	300	300	300	300	300
Copper:					
Mine output, Cu content[e]	470,100	474,000	485,000	461,000	402,000
Metal:					
Smelter, undifferentiated	433,600	446,200	431,930	445,200	425,000
Refined, primary	425,700	453,000	432,511	445,268	418,833
Gallium[e]	25	20	25	5	7
Gold:					
Mine output, Au content (kilograms)	25,010	22,402	30,000	30,000	18,062
Metal, refined (kilograms)	15,226	10,959	9,906	9,576	9,788
Iron and steel:					
Iron ore, marketable:					
Gross weight	14,140,000	17,675,000	19,300,000	20,300,000	16,469,900
Fe content	8,000,000	10,000,000	10,933,000	11,499,000	9,300,000
Metal:					
Pig iron	3,906,500	4,089,100	4,140,000	4,300,000	3,581,090
Ferroalloys:					
Ferrochromium	761,900	835,800	993,000	1,081,000	1,156,168
Ferrochromiumsilicon	79,800	108,028	98,130	104,800	97,870
Ferromanganese	5,349	2,278	1,931	2,000	2,100
Ferrosilicon	145,800	126,968	127,300	103,580	104,185
Silicomanganese	141,200	164,000	178,920	155,300	170,214
Other[e]	9,000	9,000	9,000	9,000	9,000
Total	1,143,049	1,246,074	1,408,281	1,455,680	1,539,537
Steel:					
Crude	4,691,000	4,868,000	5,066,600	5,371,700	4,452,000
Finished, rolled	3,700,000	3,800,000	3,837,800	4,039,700	3,195,000
Lead:					
Concentrate, Pb content	37,700	46,000	37,500	33,000	44,000
Refined, primary and secondary	158,700	1,622,000	133,200	157,000	131,316
Magnesium, metal, primary[e]	16,000	18,000	14,000	18,000	20,000
Manganese ore, crude ore:					
Gross weight	1,386,500	1,835,000	2,369,000	2,318,000	2,207,700
Mn content[e]	350,000	460,000	580,000	570,000	540,000
Molybdenum, concentrate, Mo content[e]	225	230	230	230	230
Nickel, Ni content of laterite ore	—	—	—	—	193
Rhenium[e] (kilograms)	2,500	2,600	2,600	5,000	8,000
Silicon	NA	NA	83,000	88,000	95,000
Silver, mine output, Ag content (kilograms)	981,900	855,612	804,874	707,443	832,000
Titanium sponge	14,000	14,900	12,500	16,500	19,000
Vanadium, ores, concentrates, slag, Va content[e]	1,000	1,000	1,000	1,000	1,000

continued next page

Kazakhstan: Production of Mineral Commodities,[1] (Metric tons unless otherwise specified) *(continued)*

Commodity	2001	2002	2003	2004	2005
Zinc:					
Mine output, Zn content	344,300	392,000	394,000	361,000	400,000
Smelter, primary and secondary	277,100	286,454	294,566	316,731	356,907
INDUSTRIAL MINERALS					
Asbestos, all grades	271,300	291,100	354,500	346,500	355,000
Barite	72,000	79,000	219,200	310,700	120,000
Boron[e] (thousand metric tons)	30	30	30	30	30
Cement	2,029,200	2,129,400	2,569,700	3,662,000	3,974,800
Clays, kaolin[e]	70,000	70,000	70,000	70,000	70,000
Gypsum	NA	710,700	711,000	800,000	820,000
Phosphate rock:					
Gross weight	97,000	136,500	168,600	229,800	230,000
P_2O_5 content	28,000	39,600	48,900	66,700	52,000
Sulfur, by-product:[e]					
Metallurgy	310,000	260,000	325,000	325,000	325,000
Natural gas and petroleum	1,400,000	1,600,000	1,600,000	1,650,000	1,700,000
Total	1,710,000	1,860,000	1,930,000	1,980,000	2,030,000
MINERAL FUELS AND RELATED MATERIALS					
Coal:	79,000,000	73,731,000	84,906,500	86,875,100	86,385,000
Natural gas (cubic meters)	11,600,000	13,100,000	14,700,000	14,400,000	14,494,000
Petroleum:					
Crude:					
In gravimetric units	39,700,000	42,066,700	45,376,300	50,671,500	55,305,000
In volumetric units[e] (42-gallon barrels)	292,000,000	309,000,000	334,000,000	373,000,000	406,500,000
Refinery products	NA	NA	8,750,000	9,390,000	11,170,000
Uranium:					
U content	2,050	2,800	3,300	3,719	4,357
U_3O_8 content	2,418	3,302	3,892	4,386	5,138

[e]Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. [r]Revised. NA = Not available. — = zero.
[1]Table includes data available through November 2006.
[2]Reported figure.

Tajikistan: Production of Mineral Commodities,[1] (Metric tons unless otherwise specified)

Commodity[2]	2001	2002	2003	2004	2005
METALS					
Aluminum, primary	289,000	307,589	319,360	358,082	379,630
Antimony, Sb content of concentrate[e]	2,500	3,000	1,800	2,000	2,000
Bismuth, mine[e]	5	—	—	—	—
Gold[e] (kilograms)	2,700	2,700	2,700	3,000	3,000
Lead, Pb content of concentrate[e]	800	800	800	800	800
Mercury, Hg content of concentrate[e]	40	20	30	30	30
Silver, Ag content of concentrate (kilograms)	5,000	5,000	5,000	5,000[e]	5,000[e]
INDUSTRIAL MINERALS					
Cement	70,000[r]	100,000[r]	166,300[r]	193,600	253,100
Fluorspar[e]	9,000	9,000	9,000	9,000	9,000
Gypsum	NA[r]	NA[r]	50,100[r]	57,200[r]	8,300[r]
Nitrogen, N content of ammonia	NA[r]	15,300[r]	21,500[r]	44,900[r]	45,000[e]
MINERAL FUELS AND RELATED MATERIALS					
Coal	24,200[r]	35,500[r]	46,500	88,300[r]	94,900
Natural gas (thousand cubic meters)	52,000[r]	33,000[r]	32,800	35,600	29,300
Petroleum, crude	16,100[r]	16,100[r]	17,700	18,900[r]	21,600

[e]Estimated; estimated data are rounded to no more than three significant digits. [r]Revised. — = zero.
[1]Table includes data available through November 2006.
[2]Tajikistan produces a number of other mineral commodities not listed in the table for which information is inadequate to derive estimates.

Turkmenistan: Production of Mineral Commodities[1, 2] (Metric tons unless otherwise specified)

Commodity	2001	2002	2003	2004	2005
INDUSTRIAL MINERALS					
Bentonite[e]	50,000	50,000	50,000	50,000	50,000
Bentonite powder[e]	250	250	250	250	250
Bischofite[e]	100	100	100	100	100
Bromine[e] (kilograms)	150,000	150,000	150,000	150,000	150,000
Cement[e]	450,000	450,000	450,000	450,000	450,000
Epsomite	NA	NA	NA	NA	NA
Ferrous bromide, 51% Br[e]	85	85	85	85	85
Gypsum[e]	100,000	100,000	100,000	100,000	100,000
Iodine[e]	200,000	200,000	200,000	250,000	270,000
Lime[e]	16,000	16,000	16,000	16,000	16,000
Nitrogen, N content of ammonia[e]	75,000	85,000	85,000	85,000	85,000
Salt[e]	215,000	215,000	215,000	215,000	215,000
Sodium sulfate[e]	60,000	60,000	60,000	60,000	60,000
Sulfur[e]	9,000	9,000	9,000	9,000	9,000
MINERAL FUELS AND RELATED MATERIALS					
Natural gas (million cubic meters)	46,300	45,000	59,100	58,570	55,800
Petroleum, crude	7,697,000[r]	8,919,000[r]	9,306,000[r]	10,051,000	9,700,000

NA = Not available.
[e]Estimated; estimated data are rounded to no more than three significant digits. [r]Revised.
[1]Table includes data available through November 2006.
[2]Turkmenistan produces a number of other mineral commodities not listed in the table for which information is inadequate to derive estimates.

Uzbekistan: Production of Mineral Commodities,[1] (Metric tons unless otherwise specified)

Commodity	2001	2002	2003	2004	2005
METALS					
Aluminum, secondary	3,000	3,000	3,000	3,000	3,000
Copper:[e]					
Mine output, Cu content	78,000	80,000	80,000	95,000	100,000
Metal:					
Blister, refinery:					
Primary	80,000	75,000	75,000	105,000[r]	115,000
Secondary	10,000	—	—	—	—
Total	90,000	75,000	75,000	105,000[r]	115,000
Smelter:					
Primary	80,000	75,000	75,000	105,000[r]	115,000
Secondary	10,000	—	—	—	—
Total	90,000	75,000	75,000	105,000[r]	115,000
Gold[e] (kilograms)	87,000	90,000[2]	90,000[r]	93,000	90,000
Molybdenum, mine output, Mo content[e]	500	500	500	500	500
Rhenium[e] (kilograms)	NA	NA	NA	NA	NA
Silver, mine output[e] (kilograms)	80,000	80,000	80,000	80,000	83,000
Steel:					
Crude	460,000	450,000[e]	472,000[e]	607,300[r]	607,253
Rolled	430,000	420,000[e]	446,521	562,200[r]	562,000
Zinc, metal, smelter, primary[e]	35,000	30,000	30,000	30,000	30,000
INDUSTRIAL MINERALS					
Cement	3,926,700[r]	4,062,200[r]	4,804,800[r]	5,067,800[r]	5,068,000
Clays, kaolin[e]	5,500,000	5,500,000	5,500,000	5,500,000	5,500,000
Feldspar[e]	4,300	4,300	4,300	4,300	4,300
Graphite[e]	60	60	60	60	60
Iodine[e] (kilograms)	2,000	2,000	2,000	2,000	2,000
Nitrogen, N content of ammonia[e]	670,000	740,000	815,000[e]	875,300[r]	850,000[e]
Phosphate rock:[e]					
Gross weight	200,000	425,000	430,000	430,000	430,000
P_2O_5 content	47,400	101,000	102,000	102,000	102,000

continued next page

Uzbekistan: Production of Mineral Commodities[1] (Metric tons unless otherwise specified) *(continued)*					
Sulfur:					
By-product:[e]					
Metallurgy	160,000	170,000	170,000	170,000	170,000
Natural gas and petroleum	300,000	350,000	350,000	350,000	350,000
Total	460,000	520,000	520,000	520,000	520,000
Sulfuric acid	NA	841,800	802,400	834,300	740,500
MINERAL FUELS AND RELATED MATERIALS					
Coal	2,800,000	2,735,000	1,909,000	2,700,000	2,700,000
Natural gas (million cubic meters)	56,350	57,670	57,481	59,864[r]	59,686
Petroleum and gas condensate	7,176,000	7,198,000	7,134,000	6,580,000[r]	54,490,000
Petroleum refinery products	NA	5,500,000	5,807,000	NA	NA
Uranium:					
U content	1,962	1,860	1,589[r]	2,016	2,300
U_3O_8 content	2,314	2,193	1,874	2,377	2,712

[e]Estimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. [r]Revised. NA = Not available. — = zero.
[1]Table includes data available through November 2006.
[2]Reported figure.

Energy Resources

Electricity Generation from Coal and Peat, % of total

Country	1990	1995	2000	2005	2006
Kazakhstan	71.1	72.0	70.3	70.3	70.3
Kyrgyz Republic	13.1	4.7 4	4.0	3.6	3.3
Tajikistan	No data available				
Turkmenistan	No data available				
Uzbekistan	7.4	3.5	4.0	4.7	4.7

Electricity Generation from Gas, % of total

Country	1990	1995	2000	2005	2006
Kazakhstan	10.5	8.2	10.7	10.7	11.8
Kyrgyz Republic	23.5	17.4	10.4	9.5	9.6
Tajikistan	9.1	1.2	2.3	2.3	2.3
Turkmenistan	95.2	100	99.9	100	100
Uzbekistan	76.4	72.3	72.3	68.8	69.6

Electricity Generation from Hydro Energy, % of total

Country	1990	1995	2000	2005	2006
Kazakhstan	8.4	12.5	14.7	11.6	10.8
Kyrgyz Republic	63.5	77.8	85.6	86.9	87.2
Tajikistan	90.9	98.8	97.7	97.7	97.7
Turkmenistan	4.8	0.0	0.1	0.0	0.0
Uzbekistan	11.8	13.0	12.5	12.8	12.8

Total Electricity Generation, GWh

Country	1990	1995	2000	2005	2006
Kazakhstan	87,379	66,661	51,324	67,916	71,653
Kyrgyz Republic	15,732	14,285	15,983	16,415	17,082
Tajikistan	18,146	14,768	14,247	17,086	16,924
Turkmenistan	14,610	9,800	9,845	12,820	13,650
Uzbekistan	56,325	47,453	46,840	47,706	49,299

GWh = gigawatt-hour.
Note: Data for individual countries of the former Soviet Union are not available prior to 1990.
Source: Energy Balances of Non-OECD Countries (2008 edition).

Energy Production/Tpes, Self-Sufficiency

Country	1990	1995	2000	2005	2006
Kazakhstan	1.23	1.21	1.89	2.14	2.13
Kyrgyz Republic	0.33	0.51	0.59	0.52	0.53
Tajikistan	0.36	0.41	0.44	0.44	0.41
Turkmenistan	3.81	2.36	3.17	3.7	3.57
Uzbekistan	0.83	1.14	1.09	1.2	1.2

Electricity Consumption, GWh

Country	1990	1995	2000	2005	2006
Kazakhstan	96,535	63,913	47,174	61,674	65,711
Kyrgyz Republic	10,234	9,460	9,360	9,475	10,464
Tajikistan	17,746	13,811	13,437	14,714	14,877
Turkmenistan	8,410	6,574	7,643	9,769	10,403
Uzbekistan	48,880	42,020	43,867	43,421	44,874

Final Consumption of Coal and Peat, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	15.78	11.68	7.32	7.72	5.84
Kyrgyz Republic	2.08	0.13	0.22	0.40	0.37
Tajikistan	0.63	0.02	0.01	0.04	0.05
Turkmenistan	0.3	-	-	-	-
Uzbekistan	1.27	0.33	0.17	0.18	0.18

Final Consumption of Oil, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	15.97	9.00	6.94	8.18	9.01
Kyrgyz Republic	3.04	0.54	0.44	0.62	0.58
Tajikistan	1.95	1.21	0.89	1.44	1.62
Turkmenistan	4.86	2.29	2.67	3.13	3.71
Uzbekistan	7.33	4.79	4.71	3.82	3.56

Mtoe = Million ton of oil equivalent, TPES = total primary energy supply.
Note: Data for individual countries of the former Soviet Union are not available prior to 1990.
Source: Energy Balances of Non-OECD Countries (2008 edition).

Final Consumption of Gas, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	7.77	7.12	5.93	11.86	12.78
Kyrgyz Republic	0.61	0.12	0.16	0.23	0.24
Tajikistan	0.73	0.39	0.36	0.27	0.27
Turkmenistan	6.74	6.22	6.05	6.09	5.82
Uzbekistan	19.68	21.76	26.61	25.48	26.62

Final Consumption of Electricity, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	8.30	4.44	3.03	3.96	4.22
Kyrgyz Republic	0.85	0.79	0.78	0.80	0.89
Tajikistan	1.53	1.19	1.14	1.25	1.26
Turkmenistan	0.72	0.43	0.5	0.64	4 0.68
Uzbekistan	3.69	3.26	3.42	3.38	3.50

Final Consumption of Energy, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	60.52	40.60	28.88	39.74	40.25
Kyrgyz Republic	6.99	1.84	1.85	2.23	2.26
Tajikistan	4.95	2.92	2.48	3.09	3.3
Turkmenistan	12.62	8.94	9.33	10.01	10.37
Uzbekistan	34.95	32.73	37.55	35.44	36.44

Mtoe = Million ton of oil equivalent, TPES = total primary energy supply.
Note: Data for individual countries of the former Soviet Union are not available prior to 1990.
Source: Energy Balances of Non-OECD Countries (2008 edition).

Net Imports of Oil, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	- 5.16	- 8.95	- 26.86	- 51.05	- 54.02
Kyrgyz Republic	2.88	0.52	0.32	0.54	0.52
Tajikistan	1.89	1.18	0.88	1.42	1.61
Turkmenistan	1.41	- 0.90	- 4.09	- 5.47	- 5.04
Uzbekistan	7.30	- 0.45	- 0.40	- 0.32	- 0.30

Total Net Imports of Energy, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	- 16.81	- 11.23	- 38.07	- 64.40	- 69.29
Kyrgyz Republic	5.07	1.26	0.96	1.34	1.33
Tajikistan	3.55	1.94	1.59	1.90	2.14
Turkmenistan	- 55.23	- 18.94	- 31.46	- 44.62	- 44.34
Uzbekistan	7.72	- 4.00	- 4.55	- 9.51	- 9.69

Net Imports of Gas, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	4.92	5.31	- 0.83	- 3.52	- 3.36
Kyrgyz Republic	1.45	0.71	0.55	0.60	0.63
Tajikistan	1.30	0.70	0.60	0.46	0.47
Turkmenistan	- 56.52	- 17.87	- 27.30	- 39.04	- 39.19
Uzbekistan	- 0.52	- 3.42	- 4.25	- 9.18	- 9.38

Note: A negative number shows net exports.
Data for individual countries of the former Soviet Union are not available prior to 1990.
Source: Energy Balances of Non-OECD Countries (2008 edition).

Net Imports of Electricity, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	1.491	0.636	0.260	0.049	0.072
Kyrgyz Republic	- 0.379	- 0.118	- 0.244	- 0.231	- 0.217
Tajikistan	0.103	0.057	0.115	0.022	0.052
Turkmenistan	- 0.427	- 0.174	- 0.069	- 0.108	- 0.115
Uzbekistan	- 0.186	- 0.111	0.110	- 0.007	- 0.007

Primary Supply of Coal and Peat, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	39.953	28.921	23.736	28.188	30.292
Kyrgyz Republic	2.530	0.325	0.487	0.553	0.515
Tajikistan	0.627	0.016	0.012	0.042	0.048
Turkmenistan	0.297	–	–	–	–
Uzbekistan	3.386	1.067	0.884	1.026	1.068

Primary Supply of Oil, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	20.78	11.78	8.64	10.28	11.55
Kyrgyz Republic	3.04	0.54	0.44	0.62	0.59
Tajikistan	2.04	1.21	0.89	1.44	1.63
Turkmenistan	7.45	2.87	3.68	4.37	5.08
Uzbekistan	10.11	6.98	7.33	5.66	5.28

Primary Supply of Gas, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	10.68	10.11	8.85	17.42	18.77
Kyrgyz Republic	1.52	0.74	0.57	0.62	0.64
Tajikistan	1.39	0.73	0.63	0.48	0.49
Turkmenistan	12.25	11.20	10.90	12.26	12.31
Uzbekistan	32.48	34.10	41.55	39.79	41.57

Primary Supply of Combustible Renewables and Waste, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	0.11	0.08	0.07	0.07	0.07
Kyrgyz Republic	0.01	0.00	0.00	0.00	0.00
Tajikistan	No data available				
Turkmenistan	No data available				
Uzbekistan	0.00 0	0.00	0.00	0.00	0.00

Total Primary Energy Supply (TPES), Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	73.65	52.24	42.20	56.69	61.42
Kyrgyz Republic	7.57	2.45	2.44	2.79	2.81
Tajikistan	5.57	3.27	2.85	3.42	3.64
Turkmenistan	19.63	13.90	14.51	16.52	17.27
Uzbekistan	46.37	42.57	50.38	47.00	48.45

Note: In 1971 and 1972, there were some coal bunkers but the amount was negligible. A negative number shows net exports.
Data for individual countries of the former Soviet Union are not available prior to 1990.
Source: Energy Balances of Non-OECD Countries (2008 edition).

Production of Coal and Peat, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	58.01	37.15	34.13	38.07	42.27
Kyrgyz Republic	1.41	0.18	0.16	0.12	0.12
Tajikistan	0.37	0.02	0.01	0.04	0.04
Turkmenistan	No data available				
Uzbekistan	2.26	1.08	0.91	1.05	1.09

Production of Crude Oil and Natural Gas Liquids (NGL), Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	25.93	20.73	35.44	61.75	65.84
Kyrgyz Republic	0.16	0.09	0.08	0.07	0.07
Tajikistan	0.15	0.03	0.02	0.02	0.02
Turkmenistan	6.04	3.76	7.77	9.84	10.11
Uzbekistan	2.81	7.56	7.73	5.98	5.58

Production of Natural Gas, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	5.76	4.79	9.68	20.94	22.13
Kyrgyz Republic	0.07	0.03	0.03	0.02	0.02
Tajikistan	0.09	0.03	0.03	0.02	0.02
Turkmenistan	68.77	29.07	38.20	51.30	51.50
Uzbekistan	33.00	39.49	45.80	48.97	50.95

Mtoe = Million tons of oil equivalent.
Source: Energy Balances of Non-OECD Countries (2008 edition).

Production of Combustible Renewables and Waste, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	0.11	0.08	0.07	0.07	0.07
Kyrgyz Republic	0.01	0.00	0.00	0.00	0.00
Tajikistan	No data available				
Turkmenistan	No data available				
Uzbekistan	0.00	0.00	0.00	0.00	0.00

Total Production of Energy, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	90.46	63.47	79.97	121.51	130.97
Kyrgyz Republic	2.50	1.26	1.44	1.45	1.49
Tajikistan	2.03	1.33	1.26	1.52	1.5
Turkmenistan	74.86	32.84	45.97	61.14	61.61
Uzbekistan	38.64	48.65	54.94	56.53	58.17

Production of Hydro Energy, Mtoe

Country	1990	1995	2000	2005	2006
Kazakhstan	0.63	0.72	0.65	0.68	0.67
Kyrgyz Republic	0.86	0.96	1.18	1.23	1.28
Tajikistan	1.42	1.26	1.20	1.43	1.42
Turkmenistan	0.06	0.00	0.00	0.00	0.00
Uzbekistan	0.57	0.53	0.51	0.53	0.54

Note: Does not include electricity output from pumped storage plants.
Source: Energy Balances of Non-OECD Countries (2008 edition).

Water Resources

Water Availability—Internal Renewable Water Resources, 2007

	Surface water: Produced internally (10^9 m^3/yr)	Groundwater: Produced internally (10^9 m^3/yr)	Overlap between surface water and groundwater (10^9 m^3/yr)	Water resources: Total internal renewable (10^9 m^3/yr)	Water resources: Total internal renewable per capita (m^3/inhab/yr)
Kazakhstan	69.32	6.1	0	75.42	4,924.79
Kyrgyz Republic	44.05	13.6	11	46.45	8,833.11
Tajikistan	63.3	6	3	66.30	9,985.18
Turkmenistan	1	0.36	0	1.36	277.58
Uzbekistan	9.54	8.8	2	16.34	605.62

Source: FAO's Information System on Water and Agriculture. www.fao.org/nr/water/aquastat/data/query/index.html

Water Availability—External Renewable Water Resources, 2007

	Surface water: Inflow not submitted to treaties (actual) (10^9 m^3/yr)	Surface water: Inflow secured through treaties (actual) (10^9 m^3/yr)	Surface water: Accounted inflow (actual) (10^9 m^3/yr)	Surface water: Outflow secured through treaties (actual) (10^9 m^3/yr)	Surface water: Total external renewable (actual) (10^9 m^3/yr)
Kazakhstan	22.16	12.03	34.19	—	34.19
Kyrgyz Republic	0	0	0	25.87	-25.87
Tajikistan	—	13.31	13.31	63.63	-50.32
Turkmenistan	1.25	44.11	45.36	22	23.36
Uzbekistan	0	55.87	55.87	21.8	34.07

— = No data available.
Source: FAO's Information System on Water and Agriculture. www.fao.org/nr/water/aquastat/data/query/index.html

Dam Capacity, 1994/1995

		Total Dam Capacity (km^3)
Kazakhstan	1994	88.75
Kyrgyz Republic	1994	21.5
Tajikistan	1994	28.97
Turkmenistan	1995	2.89
Uzbekistan	1994	19

km^3 = cubic kilometer.
Source: FAO's Information System on Water and Agriculture. www.fao.org/nr/water/aquastat/data/query/index.html

Water Use - Wastewater, 1960–2008

	Wastewater: Produced volume (10^9 m^3/yr)	Wastewater: Treated volume (10^9 m^3/yr)
Kazakhstan	1.83	0.274
Kyrgyz Republic	0.38	1.90E-04
Tajikistan	0.001	
Turkmenistan		0.025
Uzbekistan	1.492	

Source: FAO Aquastat Database. www.fao.org/nr/water/aquastat/data/query/index.html

Pressure on Water Resources, 1960–2008

	Agricultural water withdrawal as % of total renewable water resources (actual) (%)	Freshwater withdrawal as % of total renewable water resources (actual) (%)
Kazakhstan	26	30
Kyrgyz Republic	46	49
Tajikistan	69	75
Turkmenistan	97	100
Uzbekistan	108	116

Source: FAO Aquastat Database. www.fao.org/nr/water/aquastat/data/query/index.html

Salinized Area, 1960–2008

	Area salinized by irrigation (,000 ha)	Salinized area as % of area equipped for full control irrigation (%)	Area waterlogged by irrigation (,000 ha)
Kazakhstan	242	10.5	
Kyrgyz Republic	60	5.6	89.2
Tajikistan	115	16.0	
Turkmenistan	652	37.0	
Uzbekistan	2141	50.7	

ha = hectare.
Source: FAO Aquastat Database. www.fao.org/nr/water/aquastat/data/query/index.html

Major Water Agreements

Amu Darya	1992 Aral Sea Basin Water Allocation and Management (including Syr Darya but not Afghanistan); 1993 Aral Sea Basin Program and 1994 Nukus Declaration on Aral Sea Basin Management (including Syr Darya but not Afghanistan); 1999 Revised Mandate of the International Fund for Saving the Aral Sea (including Syr Darya but not Afghanistan)
Syr Darya	1992 Aral Sea Basin Water Allocation and Management (including Amu Darya); 1993 Aral Sea Basin Program and 1994 Nukus Declaration on Aral Sea Basin Management (including Amu Darya); 1998 Framework Agreement on Rational Water and Energy Use; 1999 Revised Mandate of the International Fund for Saving the Aral Sea
Lake Balkhash	2003 Kazakh–Chinese Preliminary Agreement for Joint Use and Management (for Ili-Balkhash basin)
Chui Talas	Regulation of 1983 on Water Sharing in the Chu Basin; Regulation of 1983 on Water Sharing in the Talas Basin; 2000 Kazakhstan and the Kyrgyz Republic on the Inter-State Use of Water Management Facilities of Intergovernmental Status on the Rivers Chui and Talas
Ob-Irtysh	1992 Kazakh–Russian Joint Use and Protection of Transboundary Waters (covers Ishim, Irtysh, Ural, Tobol and Volga); 2003 Kazakh–Chinese Preliminary Agreement for Joint Use and Management
Ural	1992 Kazakh–Russian Joint Use and Protection of Transboundary Waters (covers Ishim, Irtysh, Ural, Tobol and Volga)

Sources: United Nations Economic Commission for Europe. Our Waters: Joining Hands Across Borders. First Assessment of Transboundary Rivers, Lakes and Groundwaters. October 2007. www.unece.org/env/water/publications/pub76.htm
Final Report: ADB RETA 6163: Improved Management of Shared Water Resources in Central Asia Volume I: Improving Trans-Boundary Water Management on a Pilot Basis (Chu and Talas River Basins). Prepared by Chu Talas Joint River Commission and Scientific-Information Center of Interstate Commission for Water Coordination in Central Asia for Asian Development Bank, Water Resources Committee of Kazakhstan, Water Economy Department of the Kyrgyz Republic, Ministry of Water Resources and Land Reclamation of Tajikistan, Ministry of Water Resources of Turkmenistan and Ministry of Agriculture and Water Resources of Uzbekistan. December 2007.

Water Pollution Characteristics of the Syr Darya River In Kazakhstan (Kokbulak Measuring Station)

Year	Water Pollution Index*	Determinands	Average Concentration in mg/l	Factor by which the MAC is Exceeded	Water Quality
2001	1.26	Manganese	78.12	1.95	Class 3 (moderately polluted)
		Sulfates	662.41	6.63	
		Iron (2+)	0.018	3.6	
		Copper	0.00028	2.8	
2002	1.36	Manganese	58.628	1.47	Class 3 (moderately polluted)
		Sulfates	555.661	5.56	
		Iron (2+)	0.037	7.45	
		Copper	0.0039	3.9	
2003	1.92	Manganese	59.956	1.5	Class 3 (moderately polluted)
		Sulfates	486.012	4.86	
		Iron (2+)	0.036	7.19	
		Copper	0.0042	4.19	
2004	1.92	Manganese	63.768	1.59	Class 3 (moderately polluted)
		Sulfates	5,151.402	5.15	
		Iron (2+)	0.046	9.2	
		Copper	0.0034	3.38	
2005	2.03	Nitrites-nitrogen	0.04	2	Class 3 (moderately polluted)
		Sulfates	469.9	4.7	
		Manganese	53.4	1.3	
		Copper	0.0031	3.1	
2006	2.18	Nitrites-nitrogen	0.045	2.3	Class 3 (moderately polluted)
		Sulfates	507.3	5.1	
		Manganese	51.8	1.3	
		Copper	0.0034	3.4	

mg/l = milligram per liter.
* The water pollution index is defined on the basis of the ratios of measured values and the maximum allowable concentration of the water quality determinands.
Source: Ministry of Environment Protection of Kazakhstan, as cited by UNECE.

Catchment Area and Flow at Major Hydrological Stations in Amu Darya Basin, 2006

Site	Catchment (km^2)	% of Total Area	Average Annual Flow	
			Volume (km^3)	Discharge (m3/sec)
Piandj	113,500	60.1%		
Vakhsh	39,100	20.7%	18.08	573
Kafirnigan	11,590	6.1%	5.57	177
Surkhandarya	13,500	7.2%	3.08	97.6
Sherabad	2,950	1.6%	0.14	4.29
Kashkadariya	8,060	4.3%	0.86	27.2
Total Amu Darya	188,700	100.0%		

km^2 = square kilometer, km^3 = cubic kilometer.
Source: UzHydromet.

Average Daily Flow by Month at Major Stations on the Amu Darya, 2006, (m^3/sec)

Site	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Pyandj												
Vakhsh	198.0	203.0	217.0	371.0	860.0	1,000.0	1,160.0	1,290.0	611.0	369.0	340.0	262.0
Kafirnigan	71.2	149.0	150.0	299.0	393.0	477.0	181.0	107.0	71.2	58.0	69.5	93.2
Surkhandarya	33.4	66.8	95.7	193.0	300.7	187.7	102.6	64.6	38.3	27.0	27.4	33.8
Kashkadariya	12.9	25.6	28.6	40.1	75.4	53.7	31.6	15.7	10.9	8.7	11.3	11.5

Notes:
1. While some literature sources quote a basin area of Amu Darya River of up to 534,700 square kilometers, the water divide can only be correctly established in the mountainous part of the basin.
2. At present observations are not conducted at the Pyandj river.
As with the Amu Darya River, the water divide can only be correctly established in the mountainous part of the basin.
Source: UzHydromet.

Water Quality of the Amu Darya at Selected Stations, 2006, (mg/l)

Station/Indicator	Maximum Permissible Concentration	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Termez Station (1,302 km from the mouth)													
Biological oxygen demand	3	1.43	1.3	1.32	1.12	1.24	1.08	1.28	1.25	0.95	–	–	–
Dissolved oxygen	winter - > 4, summer - > 6	14.3	13.05	11.23	11.54	10.74	10.5	7.36	7.54	8.14	–	–	–
Total suspended solids		3,590	336	376	433	600	409	121	129	201	–	–	–
Chemical oxygen demand	30	24	27.3	27.7	12.8	8.98	20.1	27.9	29.9	28.2	–	–	–
Salinity	1,000	755	744.4	772.3	455.8	395.7	388.3	522.6	523	508.7	–	–	–
Kipchak Station (308 km from the mouth)													
Biological oxygen demand	3	–	1.35	1.03	2.45	2.64	1.05	1.22	0.4	–	0.22	0.51	–
Dissolved oxygen	winter - > 4, summer - > 6	–	13.53	10.91	9.6	10.3	10.2	6.62	6.7	–	7.17	9.37	–
Total suspended solids		–	15	44	202	812	100	96	49	–	38	38	–
Chemical oxygen demand	30	–	46.6	56.1	53	3.6	27.4	38.2	21.7	–	34.6	35.3	–
Salinity	1,000	–	1,471	1,436	1,758.3	945.8	580.9	719.3	642.8	–	1,060	1,095.7	–
Tuyamuyan Station (475 km from the mouth)													
Biological oxygen demand	3	–	–	1.14	–	–	1.2	1.45	–	–	–	–	–
Dissolved oxygen	winter - > 4 summer - > 6	–	–	11.37	–	–	9.6	9.95	–	–	–	–	–
Total suspended solids		–	–	188	–	–	16	12	–	–	–	–	–
Chemical oxygen demand	30	–	–	54.4	–	–	19.7	22.6	–	–	–	–	–
Salinity	1,000	–	–	1,394.9	–	–	557.5	548.8	–	–	–	–	–
Nukus Station (located 12 km after Nukus City)													
Biological oxygen demand	3	0.68	1.34	1.32	1.21	2.84	1.25	0.96	0.83	0.49	0.84	0.5	1.72
Dissolved oxygen	winter - > 4, summer - > 6	14.68	13.33	13.19	12.12	10.5	10.2	11.15	6.89	6.09	6.59	7.5	11.23
Total suspended solids		7	23	16	27	10	24	36	23	22	18	10	259
Chemical oxygen demand	30	27	37.7	44.7	45.5	57.4	39.8	38.1	43.9	46.9	45.6	47.4	34.5
Salinity	1,000												
Kizildjar Station (127 km from the mouth)													
Biological oxygen demand	3	–	–	1.08	2.75	–	1.49	1.34	1.17	–	0.41	–	–
Dissolved oxygen	winter - > 4, summer - > 6	–	–	10.88	9.32	–	10.38	10.18	6.62	–	9.88	–	–
Total suspended solids		–	–	35	21	–	25	5	16	–	8	–	–
Chemical oxygen demand	30	–	–	57.6	53	–	45.6	48.9	50.1	–	36.9	–	–
Salinity	1,000	–	–	1,506.9	1,264.1	–	936.5	881.9	1029.1	–	806.9	–	–

– = Months when observations were not conducted, km = kilometer, mg/l = milligram per liter.
Note: At present, there are 29 points of observation in the total river basin; the table presents the points located along the Amu Darya River.
Source: UzHydromet.

Living Resources

Threatened Species in Each Country, Totals By Taxonomic Group

Country	Mammals	Birds	Reptiles	Amphibians	Fishes	Molluscs	Other Invertebrates	Plants	Total
Kazakhstan	16	21	2	1	13	0	4	16	73
Kyrgyz Republic	6	12	2	0	3	0	3	14	40
Tajikistan	8	9	1	0	8	0	2	14	42
Turkmenistan	9	15	1	0	12	0	5	3	45
Uzbekistan	11	15	2	0	8	0	1	15	52

Source: IUCN 2008. 2008 IUCN Red List of Threatened Species. <www.iucnredlist.org>

Red List Category, Summary of Country Totals, Animals

Country	Extinct	Extinct in the Wild	Subtotal	Critically Endangered	Endangered	Vulnerable	Subtotal	Lower Risk/ Conservation Dependent	Not Evaluated	Data Deficient	Least Concern	Total
Kazakhstan	0	1	1	7	18	32	57	0	33	12	605	708
Kyrgyz Republic	0	0	0	2	7	17	26	0	18	3	377	424
Tajikistan	0	0	0	3	10	15	28	0	15	3	368	414
Turkmenistan	0	1	1	5	12	25	42	0	19	7	400	469
Uzbekistan	0	0	0	5	11	21	37	0	20	5	395	457

Source: IUCN 2008. 2008 IUCN Red List of Threatened Species. <www.iucnredlist.org>

Red List Category, Summary of Country Totals, Plants

Country	Extinct	Extinct in the Wild	Subtotal	Critically Endangered	Endangered	Vulnerable	Subtotal	Lower Risk/ Conservation Dependent	Not Evaluated	Data Deficient	Least Concern	Total
Kazakhstan	0	0	0	7	7	2	16	0	2	11	23	52
Kyrgyz Republic	0	0	0	6	6	2	14	0	3	5	22	44
Tajikistan	0	0	0	7	3	4	14	0	4	2	14	34
Turkmenistan	0	0	0	0	1	2	3	0	3	0	6	12
Uzbekistan	0	0	0	4	7	4	15	0	3	3	19	40

Source: IUCN 2008. 2008 IUCN Red List of Threatened Species. <www.iucnredlist.org>

Total Forest Area in Central Asia, '000 ha

	1990	1995	2000	2005	2007
Kazakhstan	3,422	3,393.5	3,365	3,337	3,325.8
Kyrgyz Republic	836	847.4	858.3	869.3	873.7
Tajikistan	408	409	410	410	410
Turkmenistan	4,127	4,127	4,127	4,127	4,127
Uzbekistan	3,045	3,128.5	3,212	3,295	3,328.2
	11,838	11,905.4	11,972.3	12,038.3	12,064.7

ha = hectare.
Source: FAO Forest Resource Assessment. 2005.

Removal of Wood Products, 2005, 1000 m^3 o.b.

	Removal of Wood Products, Total	Removal of Industrial Roundwood	Removal of Wood Fuel
Kazakhstan	–	–	–
Kyrgyz Republic	37	13	25
Tajikistan	6	0	6
Turkmenistan	10	0	10
Uzbekistan	30	9	21

o.b. = fresh weight over bark.
Source: FAO Forest Resource Assessment 2005.

Designated Functions of Forest, 2005, '000 ha

	Total Area	Production	Protection	Conservation	Social Services	Multiple Purpose
Kazakhstan	3,337	0	0	15.9	12.8	71.3
Kyrgyz Republic	869	0	78.0	7.4	1.5	13.1
Tajikistan	410	5.4	10.7	83.9	0	0
Turkmenistan	4,127	0	97.5	2.5	–	0
Uzbekistan	3,295	0.2	91.5	8.3	–	–

Source: FAO Forest Resource Assessment. 2005.

UNESCO Biosphere Reserves in Central Asia

Country	Name of Biosphere	Major Ecosystem Type	Location	Total Area (hectares)	Year Designated
Kazakhstan	None				
Kyrgyz Republic	Issyk-Kul	Mixed mountain and highland system	41°08' to 42°59'N; 75°38' to 80°18'E	4,311,588	2001
	Sary-Chelek	Mixed mountain and highland system	41°21' to 41°58'N; 71°51' to 72°02'E	23,868	1978
Tajikistan	Repetek	Cold winter desert and semidesert	38°34'N; 63°11'E	34,600	1978
Turkmenistan	None				
Uzbekistan	Mount Chatkal	Mixed mountain and highland systems	41°08'N; 69°59'E West Tien Shan; Chatkal Ridge	57,360	1978

Source: UNESCO MAB Biosphere Reserves Directory. http://www2.unesco.org/mab/br/brdir/directory/database.asp

Agriculture Resources

Agriculture by Country—Latest Available Year

Country	Land Area 2007 (,000 ha)	Agricultural Land Area			Arable Land Area 2007		Total Area Equipped for Irrigation 2007		Agricultural Machinery (Tractor/ 1,000 workers)	Fertilizer Consumption (Tons) 2002		
		Area (,000 ha)	% of Land Area	Year	Area (,000 ha)	% of Land Area	Area (,000 ha)	% of Land Area	2006	Crude	Manufactured	Total
Kazakhstan	269,970.00	207,898.00	77.01	2007	22,700.00	8.408	3,556.00	1.317	45,000	0	0	64,900
Kyrgyz Republic	19,180.00	10,731.00	55.95	2006	1,353.40	7.056	1,020.60	5.321	24,531	0	0	27,600
Tajikistan	13,996.00	4,581.00	32.73	2007	710.00	5.073	722.00	5.159	22,200	No data	0	27,900
Turkmenistan	46,993.00	32,613.00	69.40	2007	1,850.00	3.937	1,800.00	3.830	50,000	0	0	97,800
Uzbekistan	42,540.00	22,640.00	53.22	2007	4,300.00	10.108	4,281.00	10.063	170,000	No data	0	718,300

ha = hectare.
Source: http://faostat.fao.org/site/339/default.aspx

Machinery In Use

Kazakhstan

Item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Balers	–	–	–	1,288[Q]	2,110[Q]	1,955[Q]	1,804[Q]	1,723[Q]	1,607[Q]	–
Ploughs	–	–	–	10,310[Q]	11,482[Q]	12,517[Q]	11,442[Q]	10,881[Q]	10,772[Q]	–
Root or tuber harvesting machines	–	–	–	150[Q]	106[Q]	122[Q]	85[Q]	64[Q]	63[Q]	–
Seeders	–	–	–	43,797[Q]	42,674[Q]	44,644[Q]	43,784[Q]	43,975[Q]	42,573[Q]	–
Agricultural tractors	108,121[Q]	64,249[Q]	54,982[Q]	52,084[Q]	50,811[Q]	50,154[Q]	48,520[Q]	47,445[Q]	45,043[Q]	45,000[Fm]
Combined harvesters – threshers	42,069[Q]	24,895[Q]	22,349[Q]	20,670[Q]	21,428[Q]	22,072[Q]	20,999[Q]	20,689[Q]	19,750[Q]	19,700[Fm]
Milking machines	5,200[Q]	2,162[Q]	1,220[Q]	979[Q]	743[Q]	812[Q]	743[Q]	695[Q]	588[Q]	580[Fm]

Kyrgyz Republic

Item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Agricultural tractors	22,000[F]	25,819[Q]	25,930[Q]	25,512[Q]	25,307[Q]	23,614[Fm]	21,921[Q]	21,051[Fm]	20,181[Fm]	24,531[Q]
Balers				1,228[Q]	1,170[Q]		706[Q]			886[Q]
Combined harvesters – threshers	3,005[Fm]	3,145[Fm]	3,280[Fm]	3,423[Q]	3,402[Q]	3,046[Fm]	2,690[Q]	2,826[Fm]	2,961[Fm]	3,637[Q]
Manure spreaders and Fert. distributors	–	–	–	424[Q]	387[Q]	–	271[Q]	–	–	272[Q]
Milking machines	–	–	–	242[Q]	201[Q]	147[Fm]	93[Q]	95[Fm]	96[Fm]	98[Q]
Ploughs	–	–	–	6,119[Q]	6,050[Q]	–	6,428[Q]	–	–	6,816[Q]
Root or tuber harvesting machines	–	–	–	277[Q]	261[Q]	–	375[Q]	–	–	369[Q]
Seeders	–	–	–	3,461[Q]	3,373[Q]	–	2,482[Q]	–	–	2,960[Q]
Threshing machines (staking, forage harvesting)	–	–	–	879[Q]	804[Q]	–	370[Q]	–	–	326[Q]
Track-laying tractors	–	–	–	5,250[Q]	5,087[Q]	–	3,339[Q]	–	–	3,637[Q]

continued next page

Machinery In Use *(continued)*

Tajikistan

Item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Agricultural tractors	28,597F	27,171F	25,745F	24,319F	22,893F	20,035Q	22,162Q	22,200Fm	22,200Fm	22,200Fm
Combined harvesters – threshers	1,235F	1,222F	1,209F	1,196F	1,180F	1,137Q	1,114Q	1,110Fm	1,100Fm	1,100Fm
Milking machines	500F	500F	500F	500F	500F	500F	500F	500Fm	500Fm	500Fm

Turkmenistan

Item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Agricultural tractors	50,000F	50,000F	50,000F	50,000F	50,000F	50,000F	50,000F	50,000Fm	50,000Fm	50,000Fm
Combined harvesters – threshers	15,000F	15,000F	15,000F	15,000F	15,000F	15,000F	15,000F	15,000Fm	15,000Fm	15,000Fm
Milking machines	520F	520F	520F	520F	520F	520F	520F	520Fm	520Fm	520Fm

Uzbekistan

Item	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Agricultural tractors	170,000F	170,000F	170,000F	170,000F	170,000F	170,000F	170,000F	170,000Fm	170,000Fm	170,000Fm
Combined harvesters – threshers	7,000F	7,000F	7,000F	7,000F	7,000F	7,000F	7,000F	7,000Fm	7,000Fm	7,000Fm

— = Data not available, F = FAO estimate, Fm = Manual Estimation, Q = Official data reported on FAO questionnaires from countries.
Source: FAOSTAT | © FAO Statistics Division 2009. Updated: 27 May 2009.

Fisheries and Aquaculture

Capture Production of Fish, Crustaceans, Mollusks, and Others in Central Asia, 1996–2006, tons

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Kazakhstan	44,273	31,826	25,000F	36,170	36,620	21,654	24,910	25,371	33,896	34,888	35,148
Kyrgyz Republic	160F	120F	80F	48	52	57	48	14	7	7F	7F
Tajikistan	40F	75F	100F	80F	78F	137	181	158	184	184F	184F
Turkmenistan	9,014	8,179	7,014	9,058	12,228	12,749	12,812	14,543	14,992	15,000F	15,000F
Uzbekistan	1,494	3,075	2,799	2,908	3,306	2,341	1,564	1,349	1,230	2,000F	3,400

t = metric ton.
Note: discrepancies noted in 2005–2006 data, with this table for Kazakhstan and Uzbekistan
Source: http://ftp.fao.org/fi/STAT/summary/a2.pdf

Total Value of International Trade of Seven Fishery Commodity Groups in Central Asia, 2002–2006, US$,000

	IMPORTS					EXPORTS				
	2002	2003	2004	2005	2006	2002	2003	2004	2005	2006
Kazakhstan	11,957	14,304	16,357	23,962	33,738	17,714	21,536	33,139	53,638	50,589
Kyrgyz Republic	1,431	2,444	2,569	2,638	3,949	1	—	11	6	18
Tajikistan	258f	377f	423f	517f	954f					
Turkmenistan	162f	424f	521f	860f	617f	479f	20f	214f	104	27f
Uzbekistan	1,514f	1,159f	1,558f	20,238	1,213f	195f	11f	28f	337f	444f

— = data not available.
F FAO estimate.
Note: Discrepancies noted in 2005–2006 data, with this table for Kazakhstan and Uzbekistan.
Source: http://ftp.fao.org/fi/STAT/summary/a6ybc.pdf

Peoples and Cultural Traditions

Unesco World Heritage List, by Country

Country	Property Inscribed	Year Listed	Site Name
Kazakhstan	3	2003	Mausoleum of Koja Ahmed Yasawi
		2004	Petroglyphs within the Archeological Landscape of Tamglay
		2008	Saryarka—Steppe and Lakes of Northern Kazakhstan
Turkmenistan	3	1999	State Historical and Cultural Park "Ancient Merv"
		2005	Kunya Urgench
		2007	Parthian Fortresses of Nisa
Uzbekistan	4	1990	Itchan Kala
		1993	Historic Centre of Bukhara
		2000	Historic Centre of Shakhrisyabz
		2001	Samarkand—Crossroads of Culture

Source: http://whc.unesco.org/en/list/stat#s1

Toward Sustainable Development

MDG Indicators—Eradicate Extreme Hunger and Poverty – Hunger Indicators

Country	Proportion of Population, Undernourished, 1993–1995	Proportion of Population Undernourished, 2001–2003
Kazakhstan	<2.5	8
Kyrgyz Republic	21.0	4
Tajikistan	22.0	61
Turkmenistan	12.0	8
Uzbekistan	8.0	26

Note: Age group is 0–59 months.
*Based on country data - The figure is the one produced and disseminated by the country (including data adjusted BY THE COUNTRY to meet international standards).
Source: http://mdgs.un.org/

Prevalence of Underweight Children Below 5 Years of Age in Kazakhstan

	1995	1999	2006
Moderately underweight, % *	8.3	4.2	4
Severely underweight, %	1.5	0.4	0.8

Source: http://mdgs.un.org/

MDG Indicators—Improved Maternal Health Through Reduction of Maternal Mortality

Country	Maternal Mortality Ratio Per 100,000 Live Births, 2005	Proportion of Births Attended by Skilled Health Personnel, %	
Kazakhstan	140[a, b]	26	2006
Kyrgyz Republic	150[a, b]	36	2006
Tajikistan	170[a, b]	56	2005
Turkmenistan	130[a, b]	45	2006
Uzbekistan	24[c]	38	2006

[a]The figure is modeled by the agency when there is a complete lack of data on the variable being estimated. The model is based on a set of covariates—other variables for which data are available and that can explain the phenomenon.
[b]Classified under the group of countries with no appropriate maternal mortality data for the period 1995–2005.
[c]Classified under the group of countries with generally complete civil registration system (with at least 90% of deaths estimated to be registered) and good attribution of cause of death (less than 20% of deaths lack accurate cause-identification).
Source: http://mdgs.un.org/, updated 14 July 2008.

MDG Indicators—Improve Maternal Health Through Universal Access to Reproductive Health

Country	Current contraceptive use among married women 15–49 years old, any method, %		Adolescent birth rate, per 1,000 women		Antenatal Care Coverage (At Least One Visit And At Least Four Visits)					
					Antenatal care coverage, at least one visit, %		Antenatal care coverage, at least four visits, %		Unmet need for family planning, total, %*	
Kazakhstan	50.7	2006	28.6	2007 [a]	99.9	2006 [e]	70.0	1999 [g]	8.7	1999
Kyrgyz Republic	48.7	2006	25.8	2005 [b]	96.9	2006 [e]	81.1	1997 [h]	11.6	1997
Tajikistan	37.9	2005	27.3	2005 [c]	77.1	2005 [f]	No data		No data	
Turkmenistan	61.8	2000	19	2001 [a]	99.1	2006 [e]	82.8	2000 [i]	10.1	2000
Uzbekistan	64.9	2006	25.5	2006 [d]	99.0	2006 [e]	78.5	1996 [j]	13.7	1996

[a]Source: Registration National Statistics.
[b]Source: Registration UNSD and WPP2006.
[c]Source: Survey 2004–2005 MICS.
[d]Source: Survey 2005–2006 MICS.
[e]Source: MICS 2006, Reanalyzed by UNICEF HQ, April 2007.
[f]Source: MICS 2005, Reanalyzed by UNICEF HQ, April 2007.
[g]Source: DHS 1999, Final report.
[h]Source: DHS 1997, Final report.
[i]Source: DHS 2000, Final report.
[j]Source: DHS 1996, Final report.
*Source: DHS.
Source: http://mdgs.un.org/ (updated 14 July 2008).

Indicators to Reverse the Spread of HIV/AIDS

Country	HIV prevalence among population aged 15–24 years People living with HIV, 15–49 years old, %, 2007	AIDS deaths, 2007	Condom use at the last high-risk sex Among 15–24 year old women, %		Among 15–24 year old men, %		Condom use to overall contraceptive use among currently married women 15–49 year old, %		Proportion of women aged 15–24 years with comprehensive correct knowledge of HIV/AIDS, %		Antiretroviral therapy coverage among people with advanced HIV infection, %, 2007
Kazakhstan	–	–	32	1999	65	1999	9.5	2006	22	2006	23
Kyrgyz Republic	0.1	<500	56	2006	–		12.1	2006	20	2006	14
Tajikistan	0.3	<500	–		–		3.7	2005	3	2005	6
Turkmenistan	–	–	–		–		3.2	2000	5	2006	–
Uzbekistan	0.1	<500	61	2006	50	2002	3.2	2006	31	2006	24

– = data not available.
Source: http://mdgs.un.org/

MDG Indicators—Tuberculosis

Tuberculosis Incidence Rate Per Year Per 100,000 Population

Country	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Kazakhstan	90.00	111.10	130.00	141.20	146.30	148.10	148.00	143.80	137.10	130.30
Kyrgyz Republic	109.80	124.60	130.00	134.90	134.90	133.30	128.30	125.20	123.90	122.70
Tajikistan	86.10	97.40	104.70	117.40	135.70	153.50	164.90	180.70	192.20	203.80
Turkmenistan	113.60	136.60	142.10	130.20	114.40	109.30	102.00	97.10	89.90	78.20
Uzbekistan	80.00	85.10	88.60	92.70	101.80	109.60	113.50	113.50	117.50	121.50

Tuberculosis Prevalence Rate Per Year Per 100,000 Population

Country	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Kazakhstan	137.00	166.40	138.90	145.00	151.00	151.20	155.40	152.80	147.90	142.10
Kyrgyz Republic	165.70	148.20	146.80	157.00	169.70	153.30	145.20	140.20	137.40	136.70
Tajikistan	141.10	159.50	170.70	192.20	222.10	250.20	261.00	281.70	287.90	297.70
Turkmenistan	113.60	136.60	142.10	130.20	114.40	109.30	102.00	97.10	89.90	78.20
Uzbekistan	122.70	129.70	135.40	140.40	150.80	145.70	153.00	149.70	146.60	144.60

Tuberculosis Death Rate Per Year Per 100,000 Population

Country	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Kazakhstan	12.00	14.80	17.40	17.50	18.60	18.00	19.80	19.20	18.30	17.40
Kyrgyz Republic	16.00	18.20	19.00	19.70	19.70	19.50	18.70	18.30	18.10	17.90
Tajikistan	16.50	18.60	19.90	22.50	26.00	29.40	31.30	34.70	37.00	39.20
Turkmenistan	10.80	13.00	13.50	13.50	12.80	12.40	11.60	10.90	10.20	9.50
Uzbekistan	10.90	11.50	12.20	12.70	14.20	14.60	15.20	15.80	16.40	16.90

continued next page

MDG Indicators—Tuberculosis *(continued)*

Tuberculosis Detection Rate Year Per 100,000 Population

Country	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Kazakhstan	-	4.10	79.10	93.80	92.50	95.00	86.80	81.20	73.70	68.60
Kyrgyz Republic	3.50	30.80	57.50	41.90	48.00	-	55.80	60.70	65.60	63.20
Tajikistan	-	-	-	-	-	2.30	-	11.40	22.90	32.70
Turkmenistan	-	-	-	17.00	36.40	41.70	42.60	33.20	43.60	58.10
Uzbekistan	-	0.40	1.90	4.20	7.40	22.00	20.80	29.30	37.40	48.20

Tuberculosis Treatment Rate Per Year Per 100,000 Population

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Kazakhstan	-	-	79.30	79.20	78.60	77.80	77.70	74.50	72.40	71.10
Kyrgyz Republic	87.50	75.60	82.20	82.80	82.20	81.00	81.90	84.50	85.10	84.70
Tajikistan	-	-	-	-	-	-	78.50	86.00	83.80	86.20
Turkmenistan	-	-	-	-	69.50	74.90	77.30	82.40	86.40	81.10
Uzbekistan	-	-	78.40	78.50	80.50	76.00	79.80	81.00	78.30	80.50

Source: UN Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx (Data updated by MDG: 14 July 2008 as of 21 May 2009).

Carbon Dioxide Emissions (CO_2), thousand metric tons

Country	1992	1995	2000	2004
Kazakhstan	259,400.3088	173,583.6929	139,809.9215	200,277.8776
Kyrgyz Republic	11,046.5016	4,626.8454	4,645.1768	5,726.7294
Tajikistan	20,582.4959	5,169.4548	3,996.2452	5,004.4722
Turkmenistan	28,058.0408	35,368.6032	37,322.7304	41,725.9327
Uzbekistan	118,164.2044	106,153.4711	129,012.7269	137,907.1222

Source: UN Millennium Development Goals. http://mdgs.un.org (Data updated 1 August 2007 as of 23 May 2009).

Consumption of All ODS, metric tons

Country	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Kazakhstan	1541.60	1970.50	829.60	597.90	346.20	146.90	64.00	45.50	40.00	79.90
Kyrgyz Republic	89.50	70.70	67.90	53.80	67.00	50.20	47.30	36.50	16.40	8.80
Tajikistan	51.60	60.10	52.40	28.70	29.40	12.60	5.90	3.10	3.50	3.60
Turkmenistan	27.20	40.80	19.80	23.60	62.10	10.90	44.40	59.20	27.30	22.40
Uzbekistan	57.90	120.10	53.10	44.20	18.10	0.80	2.30	1.80	3.50	[1]

Note: [1] Data not reported: Party in noncompliance with its Obligation under the Montreal Protocol to Report data for that year at the time of publication of the data.
Source: UN Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx (Data updated by MDG: 14 July 2008 as of 23 May 2009).

Consumption of Ozone Depleting CFCs in ODP, metric tons

Country	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Kazakhstan	668.80	1,025.50	730.00	523.90	290.00	112.00	30.40	11.20	0.00	0.00
Kyrgyz Republic	69.60	56.80	52.40	53.50	53.00	38.00	33.00	22.90	8.10	5.30
Tajikistan	48.20	56.30	50.70	28.00	28.30	11.80	4.70	0.00	0.00	0.00
Turkmenistan	26.40	25.30	18.60	21.00	57.70	10.50	43.40	58.40	17.90	16.80
Uzbekistan	53.00	119.80	52.80	41.70	15.30	0.00	0.00	0.00	0.00	[1]

CFC = chlorofluorocarbon.
Note: [1] Data not reported: Party in noncompliance with its Obligation under the Montreal Protocol to Report data for that year at the time of publication of the data.
Source: UN Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx (Data updated by MDG: 14 July 2008 as of 23 May 2009).

Proportion of Total Water Resources Used, %

Country	1990	1995	2000
Kazakhstan	33.4[2]	29.3[3]	30.5[4]
Kyrgyz Republic	53.4[3]	49.0[4]	49.0[5]
Tajikistan	75.2[2]	74.3[3]	74.8[4]
Turkmenistan	100.1[2]	96.1[3]	99.6[4]
Uzbekistan	124.0[4]	115.2[5]	115.7[6]

Notes:
[1] Values is less than 5%.
[2] Data refers to 1988–1992.
[3] Data refers to 1993–1997.
[4] Data refers to 1998–2002.
Source: UN Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx (Data updated by MDG: 14 July 2008 as of 23 May 2009).

Proportion of Population Using Solid Fuels, %

Country	1999	2000	2003
Kazakhstan	–	–	5
Kyrgyz Republic	–	–	76[2]
Tajikistan	75	–	–
Turkmenistan	–	5[1]	–
Uzbekistan	–	–	72[2]

– = data not available.
Notes:
[1] Values is less than 5%.
[2] For low- and middle-income countries with a GNI per capita below US$10,500, and for which no household solid fuel use data are available, a regression model based on GNI, percentage of rural population and location or non-location within the Eastern Mediterranean Region is used to estimate the indicator.
Source: UN Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx (Data updated by MDG: 14 July 2008 as of 23 May 2009).

Access to Safe Drinking Water and Basic Sanitation, 2006

Country	Proportion of Population Using an Improved Water Source, %			Proportion of Population Using Improved Sanitation Facilities, %		
	Total	Urban	Rural	Total	Urban	Rural
Kazakhstan	96	99	91	97	97	98
Kyrgyz Republic	89	99	83	93	94	93
Tajikistan	67	93	58	92	95	91
Turkmenistan		–			–	
Uzbekistan	88	98	82	96	97	95

– = data not available.
Source: UN Millennium Development Goals Indicators. http://mdgs.un.org/unsd/mdg/Data.aspx (Data updated by MDG: 14 July 2008 as of 23 May 2009).

Bibliography

AMID DESERTS, STEPPES, AND MOUNTAINS

Babaev, A.G. 1999. *Desert Problems and Desertification in Central Asia*. Heidelberg: Springer.

FAO Aquastat. 1998. Kazakhstan. www.fao.org/nr/water/aquastat/countries/kazakhstan/index.stm

Bekturova, G. and O. Romanova, eds. 2007. *Traditional Land Management Knowledge in Central Asia: Resource Pack*. New York: United Nations Development Programme - Global Mechanism. www.caresd.net/site.html?en=1&id=1819

International Fund for Saving the Aral Sea (IFAS), Interstate Sustainable Development Commission (ISDC), Scientific-Information Center (SIC) and UNEP. 2007. *Sub-Regional Integrated Environmental Assessment: Central Asia*. Ashgabat: UNEP. http://ekh.unep.org/files/IEA-eng.pdf

Schillhorn van Veen, Tjaart et al. 2005. *Kazakhstan: Rangelands in transition - the resource, the users, and sustainable use.* Europe and Central Asia Environmentally and Socially Sustainable Development Series Report No. 31384 Vol. 1. Washington, DC: World Bank.

Terrestrial Ecoregions of the World. 2001. WWF Ecoregions. National Geographic.com. www.nationalgeographic.com/wildworld/terrestrial.html

United Nations Environment Programme (UNEP). 2006. *Global Deserts Outlook.* Nairobi. www.unep.org/geo/gdoutlook/

WWF–US: World Wildlife Fund–Ecoregions. www.worldwildlife.org/wildworld/profiles/terrestrial_pa. html#tempgrass

FIVE COUNTRIES OF CENTRAL ASIA

ADB. ADB Statistical Database System Online. https://sdbs.adb.org/sdbs/index.jsp

FAO FAOSTAT. www.fao.org/faostat

United States Library of Congress. *Country Studies*. http://lcweb2.loc.gov/frd/cs

United Nations Development Programme. *Human Development Report 2007/2008*: http://hdrstats.undp.org

United Nations. United Nations Millennium Development Goals Indicators. http://mdgs.un.org

_____. 2007. World Development Indicators. http://publications.worldbank.org/WDI

KAZAKHSTAN

ADB. 2005. *Kazakhstan: Country Strategy and Program Update 2006–2008*. www.adb.org/Documents/CSPs/KAZ/2005/default.asp

_____. 2008a. *Asian Development Outlook 2008.* Manila.

_____. 2008b. *Asian Development Outlook 2008: Subregional Summaries*. Manila.

_____. 2008c. *Country Analysis Brief: Kazakhstan.* www.eia.doe.gov/emeu/cabs/Kazakhstan/pdf.pdf

_____. 2008d. *Kazakhstan 2008 Fact Sheet*. Manila.

_____. 2008e. *Kazakhstan Country Brief 2008*. www.worldbank.org.kz/servlets/GoogleCachedLinkProvider?CID=KDKJi8n006oJ&full_url=www.worldbank.org.kz/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/KAZAKHSTANEXTN/0,,contentMDK:20629270~menuPK:361877~pagePK:141137~piPK:141127~theSitePK:361869,00.html&domain=www.worldbank.org.kz

Convention on Biological Diversity. *Kazakhstan - Details.* www.cbd.int/countries/profile.shtml?country=kz#status (accessed 2 December 2008)

Embassy of the Republic of Kazakhstan. *Astana.* http://kazakhembus.com/index.php?page=astana

Energy Information Administration (EIA). 2009. *Kazakhstan Energy Profile.* http://tonto.eia.doe.gov/country/country_energy_data.cfm?fips=KZ

FAO Aquastat. 1998. *Kazakhstan*. www.fao.org/nr/water/aquastat/countries/kazakhstan/index.stm

FAO Statistics Division. *Commodities: Kazakhstan*. www.fao.org/es/ess/top/country.html?lang=en&country=108

Glukhovtsev, Igor and Lyailya Yermekbayeva. 2001. *Integrating Biodiversity into the Tourism Sector: Best Practice and Country Case Studies Kazakhstan.* Almaty: Biodiversity Planning Support Programme, Public Centre on Conservation of Biological Diversity in the Republic of Kazakhstan. www.unep.org/bpsp/Tourism/Case%20Studies%20(pdf)/KAZAKHSTAN%20(Tourism).pdf

MDG Monitor. 2007. *Kazakhstan Profile.* www.mdgmonitor.org/factsheets_00.cfm?c=KAZ&cd=

National Aeronautics and Space Administration (NASA). *Ural River Delta, Kazakhstan*. http://earth.jsc.nasa.gov/EarthObservatory/Ural_River_Delta,_Kazakhstan.htm (accessed 27 May 2008)

Schillhorn van Veen, Tjaart et al. 2005. *Kazakhstan: Rangelands in transition—The resource, the users, and sustainable use.* Europe and Central Asia Environmentally and Socially Sustainable Development Series Report No. 31384 Vol. 1. Washington, DC: World Bank.

United Nations. www.un.org

United States Department of State. 2009. *Background Note: Kazakhstan.* www.state.gov/r/pa/ei/bgn/5487.htm

United States Department of the Interior. 2005. US Geological Survey Minerals Yearbook: Commonwealth of Independent States. Vol. III.

United States Department of Agriculture. Kazakhstan Wheat Production: An Overview. www.fas.usda.gov/pecad2/highlights/2005/03/Kazakh_Ag/index.htm

United States Library of Congress - Federal Research Division. 2006. *Country Profile: Kazakhstan*. http://lcweb4.loc.gov/frd/cs/profiles/Kazakhstan.pdf

Water Watch. *COM.NL nederlandse commerciële extensi*e. www.waterwatch.com.nl

World Bank. 2005. *Saving a Corner of the Aral Sea.* http://go.worldbank.org/UI222F8DY0

KYRGYZ REPUBLIC

ADB. 2004. *Kyrgyz Republic: Country Environmental Analysis*. Manila.

_____. 2005. *Country Gender Assessment: Kyrgyz Republic (A Gendered Transition: Soviet Legacies and New Risks).* Manila.

_____. 2007. *The Kyrgyz Republic Natural Resource Sector Study*. Manila. www.adb.org/Documents/CACILM/Kyrgyz-Republic-Natural-Resource-Sector-Study.pdf

_____. 2008. *Asian Development Outlook 2008*. Manila.

_____. 2008. *Kyrgyz Republic 2008 Fact Sheet*. Manila.

Curtis, E.C. 1997. *Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan Country Studies.* Washington, DC: Federal Research Division Library of Congress.

Eurasian Development Bank (EDB). 2008. *Water and Energy Resources in Central Asia: Utilization and Development Issues*. Industry Report. April 24. www.eabr.org/media/img/eng/research-and-publications/AnalyticalReports/Report_2_water_and_energy_EDB.pdf

Everett-Heath, John. 2005. *Bishkek.* Concise Dictionary of World Place-Names. Oxford: Oxford University Press. www.encyclopedia.com/doc/1O209-Bishkek.html; http://www.encyclopedia.com/doc/1O209-Bishkek.html

MDG Monitor. www.mdgmonitor.org
Ministry of Environmental Protection. 1998. Kyrgyz Biodiversity Strategy and Action Plan. Bishkek. www.cbd.int/doc/world/kg/kg-nbsap-01-en.pdf
Orexca. *Bishkek City Cities and Places in Kyrgystan*. www.kyrgyzstan.orexca.com/bishkek_kyrgyzstan.shtml
School of Russian and Asian Studies. *Bishkek*. www.sras.org/bishkek
UNEP and GRID Arendal. *About Kyrgyzstan.* http://enrin.grida.no/htmls/kyrghiz/soe2/english/kyrgiz.htm (accessed 26 November 2008)
United Nations Department of Economic and Social Affairs Population Division. 2007. *World Urbanization Prospects: The 2007 Revision*. www.un.org/esa/population/publications/wup2007/2007WUP_Highlights_ web.pdf
United States Library of Congress - Federal Research Division. www.loc.gov/index.html
World Bank. Kyrgyz Republic Country Brief 2007. http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/KYRGYZEXTN/0,,menuPK:305770~pagePK:141132~piPK:141107~theSitePK:305761,00.html
_____. 2007. *World Development Indicators 2007*. http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:21298138~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html

TAJIKISTAN

ADB. 2004. *Country Environmental Analysis Tajikistan*. Manila.
_____. 2005. *Country Strategy and Program Update 2006–2008: Tajikistan.* Manila. www.adb.org/Documents/CSPs/TAJ/2005/cspu-taj-2005.pdf
_____. 2008. *Asian Development Outlook 2008*. Manila.
_____. 2008. *Tajikistan 2008 Fact Sheet*. Manila www.adb.org/Documents/CSPs/TAJ/2005/csp0200.asp
Australian Centre for International Agricultural Research. *Plant Genetic Resources in Central Asia and Caucasus. Tajikistan: Biodiversity.* www.cac-biodiversity.org/tjk/tjk_biodiversity.htm
Carius, A., M. Feil, and D. Tanzler. 2003. *Addressing Environmental Risks in Central Asia Risks Policies Capacities*. UNDP Environmental Governance Series. Berlin: OSCE, UNEP, and UNDP. wwwz.envsec.org/pub/envsec_undp_ca_study.pdf
Encyclopædia Britannica. 2008. *Dushanbe*. www.britannica.com/EBchecked/topic/174410/Dushanbe (accessed 2 September 2008)
Government of Tajikistan. 2004. *Constitution of the Republic of Tajikistan*. Dushanbe. http://unpan1.un.org/intradoc/groups/public/documents/untc/unpan003670.htm
www.rrcap.unep.org/pub/ea/IEA-CA_2007_eng.pdf
International Fund for Saving the Aral Sea (IFAS), Interstate Sustainable Development Commission (ISDC), Scientific-Information Center (SIC) and UNEP. 2007. *Sub-Regional Integrated Environmental Assessment: Central Asia.* Ashgabat: UNEP. http://ekh.unep.org/files/IEA-eng.pdf and at www.rrcap.unep.org/pub/ea/IEA-CA_2007_eng.pdf
Lonely Planet. *Dushanbe*. www.lonelyplanet.com/worldguide/tajikistan/dushanbe/
MDG Monitor. 2008. *MDG Profile: Tajikistan*. www.mdgmonitor.org/factsheets_00.cfm?c=TJK&cd=762
UNEP/GRID Arendal. 2002. *Tajikistan 2002 State of the Environment Report.* http://enrin.grida.no/htmls/tadjik/soe2001/eng/
United States Department of the Interior – Geological Survey. 2007. *2005 Minerals Yearbook: Commonwealth of Independent States*. http://minerals.usgs.gov/minerals/pubs/country/2005/myb3-2005-am-aj-bo-gg-kz-kg-md-rs-ti-tx-up-uz.pdf
United States Library of Congress - Federal Research Division. *Country Profile: Tajikistan, January 2007*. http://memory.loc.gov/frd/cs/profiles/Tajikistan.pdf

TURKMENISTAN

ADB. 2006. *Central Asian Countries Initiative for Land Management (CACILM) National Programming Framework*. Manila.
_____. 2006. CACILM in Brief: Land Degradation in Central Asia. Manila. www.adb.org/Documents/CACILM/CACILM-InBrief.pdf
_____. 2008. *Turkmenistan Fact Sheet 2008*. Manila.
Advantour. *Turkmen National Traditions – Traditions of Hospitality.* www.advantour.com/turkmenistan/traditions.htm
Embassy of Turkmenistan. *History of Turkmenistan.* www.turkmenistanembassy.org/turkmen/history/history.html
FishBase. www.fishbase.org
Infoplease. *Turkmenistan.* www.infoplease.com/ipa/A0108058.html
The World Delta Database. Amu Darya Delta. www.geol.lsu.edu/WDD/ASIAN/AmuDarya/amu_darya.htm
United States Library of Congress – Federal Research Division. 2007. *Country Profile: Turkmenistan*. www.loc.gov/index.html
Wall Street Journal. 2009. *Turkmenistan Open Its Doors*. 7 February. http://online.wsj.com/article/SB123395835621158239.html?mod=article-outset-box
World Bank. 2006. Turkmenistan Country Brief. http://go.worldbank.org/AOBXB94BB0
World Resources Institute. *EarthTrends.* http://earthtrends.wri.org

UZBEKISTAN

ADB. 2006. *Uzbekistan Country Strategy and Program (2006–2010)*. www.adb.org/Documents/CSPs/UZB/2006/csp2006-2010.pdf
_____. 2008a. *Asian Development Outlook 2008.* www.adb.org/Documents/Books/ADO/2008
_____. 2008b. *Uzbekistan Fact Sheet 2008*. Manila.
Advantour. *Tashkent, Uzbekistan*. www.advantour.com/uzbekistan/tashkent.htm
Australian Centre for International Agricultural Research. *Plant Genetic Resources in Central Asia and Caucasus. Country Profile: Uzbekistan*. www.cac-biodiversity.org/uzb/uzb_country.htm
Bashiri, Iraj. 1998. *Tashkent*. Bashiri Working Papers in Central Asia and Iran. www.angelfire.com/rnb/bashiri/Tashkent/Tashkent.html
Encyclopædia Britannica. 2008. *Tashkent.* www.britannica.com/EBchecked/topic/583849/Tashkent (accessed 2 September 2008)

ENERGY RESOURCES

Bogombayev, E., and U. Mateyev. 2008. Prospects for Renewable Energy in Kyrgyzstan. *Development and Transition Newsletter* 10: July.
Central Asia–Caucasus Institute. 2008. *Renewable Energy in Uzbekistan: A Key to Future Development?* May. www.silkroadstudies.org/new/inside/forum/CACI_2008_0521.html
Cochran, J. 2008. *Kazakhstan's Potential for Wind and Concentrated Solar Power.* Kazakhstan Institute of Management Economics and Strategic Research. www.kimep.kz/files/downloads/research/Cochran_Wind_and_Concentrated_Solar.pdf
Efficiency and Greenhouse Gas Abatement (PREGA). 2006. *Tajikistan Country Report. Country Energy Situation and Prospects*. January. www.adb.org/REACH/TAJ-country-report.pdf
European Bank for Reconstruction and Development. 2002. *Renewable Energy Resource Assessment 24.0 Tajikistan*. http://ebrdrenewables.com/sites/renew/Shared%20Documents/Country%20Notes/old%20website%20country%20profiles/Tajikistan.pdf
Renewable Energy Initiative. 2005. *Turkmenistan Country Profile*. http://ebrdrenewables.com/sites/renew/countries/Turkmenistan/profile.aspx

GEF and UNDP. 1997. Biodiversity Conservation National Strategy and Action Plan of Republic of Uzbekistan. Tashkent. http://bpsp-neca.brim.ac.cn/books/actpln_uzbek/index.html

International Center for Agricultural Research in Dry Areas (ICARDA). 2005. ICARDA in Central Asia and the Caucasus A Decade of Achievements*Ties that Bind No.* 12. Aleppo.

Islamic Educational, Scientific and Cultural Organization (ISESCO). 2007. *ISESCO in the Tashkent International Fair*. www.isesco.org.ma/english/culture/culturalPolicies/2007/tashkent.php

Lonely Planet. *Tashkent.* www.lonelyplanet.com/worldguide/uzbekistan/tashkent

MDG Monitor. *Uzbekistan UN MDG 7: Ensure Environmental Sustainability*. www.mdgmonitor.org/factsheets_00.cfm?c=UZB#

Silk Road Adventures. *Silk Road Discovery Beijing to Tashkent*. www.silkroad-adventure.com/Tour_B_T.html

State Committee of the Republic of Uzbekistan on Statistics. 2006. *Environmental Situation and Utilization of Natural Resources in Uzbekistan. Facts and Figures 2000–2004*. Tashkent.

UNDP. 2007. MDGs in Central Asia and the Southern Caucasus: An Overview. Technical Background Paper for the ADB-ESCAP-UNDP Conference on MDGs in Central Asia and the Caucasus. 19–20 July. Bishkek.

United States Department of the Interior—Geological Survey. 2007. 2005 *Minerals Yearbook: Commonwealth of Independent States*. http://minerals.usgs.gov/minerals/pubs/country/2005/myb3-2005-am-aj-bo-gg-kz-kg-md-rs-ti-tx-up-uz.pdf

United States Library of Congress. 2007. Uzbekistan: Geography. http://countrystudies.us/uzbekistan/15.htm

Visit Uzbekistan – Tourism Board of Uzbekistan. *Some facts about Uzbekistan*. www.visituzbekistan.eu/

World Bank. 2008. *Uzbekistan Country Brief 2008.* www.worldbank.org.uz/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/UZBEKISTANEXTN/0,,menuPK:294197~pagePK:141132~piPK:141107~theSitePK:294188,00.html

MINERAL RESOURCES

Asia Policy Research Co. Ltd. 2006. Mining Sector Background Brief. Discussion paper for Central Asia Regional Economic Cooperation Business Development Forum, September, ADB, Manila. www.adb.org/Documents/Events/2006/CAREC-BDF/mining-sector-en.pdf

Bogdetsky, V., ed. 2001. *Mining Industry and Sustainable Development in the Kyrgyztan*. London: International Institute for Environment and Development.

British Geological Survey. 2008. *World Mineral Production 2002–2006*. Keyworth, Nottingham. www.bgs.ac.uk/mineralsuk/downloads/WMS_archive/WMP2002_2006_eBook/flash.html#/1/

Geological Association of Canada. 2006. The Tien Shan Belt: Golden Heart of Central Asia. *The Gangue* 88. 14p. www.gac.ca/chapters/gangue/Gang88.pdf?bcsi_scan_B90AE85AF6AB15C6=0&bcsi_scan_filename=Gang88.pdf

International Fund for Saving the Aral Sea (IFAS), Interstate Sustainable Development Commission (ISDC), Scientific-Information Center (SIC) and UNEP. 2007. *Sub-Regional Integrated Environmental Assessment: Central Asia*. Ashgabat: UNEP. http://ekh.unep.org/files/IEA-eng.pdf

International Monetary Fund. 2005. Republic of Kazakhstan: Statistical Appendix. *IMF Country Report* No. 05/239. Washington, DC. www.imf.org/external/pubs/ft/scr/2005/cr05239.pdf

Levine, R.M. and G.J. Wallace. 2007. The Mineral Industry of the Commonwealth of Independent States. The Mineral Industries of Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. In *2005 Minerals Yearbook*. Volume III. Area Reports: International. http://minerals.usgs.gov/minerals/pubs/country/2005/myb3-2005-am-aj-bo-gg-kz-kg-md-rs-ti-tx-up-uz.pdf

Levine, R.M. et al. 2007. The Mineral Industries of Europe and Central Eurasia. In *2005 Minerals Yearbook*. Volume III. Area Reports: International. http://minerals.usgs.gov/minerals/pubs/country/2005/myb3-sum-2005-europe-eurasia.pdf

North Atlantic Treaty Organization (NATO). 2008. *Uranium Extraction and Environmental Security in the Central Asian Republics*. www.nato.int/issues/science-environmental-security/projects/5/background.html

Oxus Gold. *Amantaytau Goldfields*. www.oxusgold.co.uk/agf-operations.asp

World Bank. 2002. Kazakhstan: Strategic Review of the Mining and Metallurgy Sector. Report No. 24708-KA. www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2002/10/04/000094946_02092504033561/Rendered/PDF/multi0page.pdf

_____. 2002. *Kyrgyz Republic: Update on the Mining Sector.* Report No. 24709-KY. www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2002/10/04/000094946_02092504033862/Rendered/PDF/multi0page.pdf

WATER RESOURCES

ADB. 2007. *Final Report on Improved Management of Shared Water Resources in Central Asia Volume I: Improving Transboundary Water Management on a Pilot Basis (Chu and Talas River Basins)*. ADB RETA 6163. Manila.

_____. 2008. *ADB Supports Water Resource Management in Uzbekistan*. Manila. www.adb.org/Media/Articles/2008/12762-agricultural-productivity-improvements/default.asp

Baetov R. 2005. *Lake Issyk-Kul Experience and Lessons Learned Brief (Lake Basin Management Initiative)*. Cholpon-Ata, Kyrgyz Republic. www.iwlearn.net/publications/ll/lakeissykkul_2005.pdf

CAWaterInfo. Portal of Knowledge for Water and Environmental Issues in Central Asia. www.cawater-info.net

Caspian Environment Programme (CEP). 2004. *Caspian Sea: General Background*. www.caspianenvironment.org/caspian.htm

Committee for Water Resources of Ministry of Natural Resources and Environment Protection Government of Kazakhstan. 2002. *Identification of Priority Issues in Seven Major River Basins in Kazakhstan*. Problem Identification and Prioritisation Workshop in The Ural-Caspian Basin Workshop Protocol, 9 August, Atyrau. www.worldbank.org/eca/kazakhstan/water/Ural_eng.pdf

Kreuzberg, E. Ecosystem Approach in Basin Management in Central Asia: from Theory to Practice (on the Example of Ili-Balkhash basin). CAREC: Almaty. www.icsu-asia-pacific.org/resource_centre/EA%20in%20Basin%20mgmy%20Kazakhstan.pdf

Lake Net World Lakes Network. *Lake Profile: Issyk-Kul.* www.worldlakes.org/

Lal, R., M. Suleimenov, and B. A. Stewart. 2007. *Climate Change and Terrestrial Carbon Sequestration in Central Asia*. Amsterdam: Taylor and Francis Group.

Informational Net. *Water Problems of Kazakhstan*. http://water.unesco.kz

International Fund for Saving the Aral Sea (IFAS), Interstate Sustainable Development Commission, Scientific-Information Center, and United Nations Environment Programme (UNEP). 2007. *Sub-Regional Integrated Environment Assessment: Central Asia*. Ashgabat: UNEP. http://ekh.unep.org/files/IEA-eng.pdf

International Lake Environment Committee Foundation (ILEC). *World Lakes Database*. www.ilec.or.jp/database/database.html

International Union for Conservation of Nature (IUCN), International Water Management Institute, the Ramsar Convention Bureau, and World Resources Institute (WRI). 2003. *Watersheds of the World*. http://multimedia.wri.org/watersheds_2003/index.html

Interstate Commission for Water Coordination of Central Asia. www.icwc-aral.uz/

Kostarev, S. 2008. Russian-Kazakh Transboundary Water Management Skills (the Irtysh River Basin). Paper presented at the International Conference on Water Resource Systems Management under Extreme Conditions. Moscow. 4–5 June. International Network of Basin Organizations (INBO), www.inbo-news.org/euro-riob/moscow/papers/2008_06_05_ECWATEK_Kostarev.pdf

Panella, Thomas. 2008. Transboundary Water Management in the Chu Talas Basins and Regional Cooperation for Water Resources in Central Asia. Paper presented at CAREC Senior Officials' Meeting. Baku. 25–26 September. Manila: ADB. www.adb.org/Documents/Events/2008/Senior-Officials-Meeting-CAREC/Water-Resource-Management.pdf

Ramsar Convention on Wetlands. www.ramsar.org

Ramsar Convention on Wetlands. 2007. *Conclusions of the First International Ural River Basin Workshop.* 13–16 June. Orenburg. www.ramsar.org/pdf/mtg/mtg_ural_basin2007_conclusions.pdf

Savoskul, O.S., et al. 2003. *Water, Climate, Food, and Environment in the Syr Darya Basin.* Contribution to the project ADAPT. www.weap21.org/downloads/AdaptSyrDarya.pdf

Severskiy, I. et al. 2005. *Aral Sea, GIWA Regional Assessment 24.* Kalmar: University of Kalmar on behalf of UNEP. www.unep.org/dewa/giwa/publications/r24.asp

Stolberg, F., et al. 2006. *Caspian Sea GIWA Regional Assessment 23.* Kalmar: University of Kalmar on behalf of UNEP. www.unep.org/dewa/giwa/publications/r23.asp

United Nations. 2004. *Strengthening Cooperation for the Rational and Efficient Use of Water and Energy Resources in Central Asia.*

United Nations Development Programme (UNDP). 2007. *Water - Critical Resource for Uzbekistan.* UNDP Energy and Environment Unit, Uzbekistan. www.undp.uz/en/publications/publication.php?id=70

United Nations Economic Commission for Europe. 2007. *Our Waters: Joining Hands Across Borders. First Assessment of Transboundary Rivers, Lakes and Groundwaters.* www.unece.org/env/water/publications/pub76.htm

United Nations Environment Programme (UNEP). 2004. *Lake Balkhash.* www.grid.unep.ch/activities/sustainable/balkhash/index.php

Ural Basin Project. http://uralbas.ru/ural.htm

Urchinov, Zh. U. 1995. Fisheries in the Zarafshan River Basin. In *FAO Fisheries Circular* No. 894 FIRI/v9529. www.fao.org/docrep/V9529E/v9529E06.htm

Valentini, K.L., Orolbaev E.E, and Abylgazieva A.K. 2004. *Water Problems of Central Asia.* Bishkek: International Strategic Research Institute under the President of the Kyrgyz Republic.

LIVING RESOURCES

Aladin, Nick. 2003. Desiccation of the Aral Sea. In *Great Lakes Experiences and Global Applications*, Proceedings Document 18. 24 June. Illinois: De Paul University. www.glc.org/announce/03/symp/abstract_aladin.pdf

AME Info. 2005. *Saving the Houbara*. 19 June. www.ameinfo.com/62663.html

ARKive. *Saker Falcon (*Falco cherrug*)*. Available. www.arkive.org/saker-falcon/falco-cherrug/info.html?section=glossaryAndReferences#reference_2 (invalid URL)

Baetov R. 2005. *Lake Issyk-Kul Experience and Lessons Learned Brief (Lake Basin Management Initiative)*. Cholpon-Ata, Kyrgyz Republic. www.iwlearn.net/publications/ll/lakeissykkul_2005.pdf

Birdlife International. 2009. *Species Factsheet: Houbara Bustard* (Chlamydotis undulata*)* www.birdlife.org/datazone/species/index.html?action=SpcHTMDetails.asp&sid=2769&m=0

_____. 2009. Species Factsheet: *Saker Falcon* (Falco cherrug). www.birdlife.org/datazone/species/index.html?action=SpcHTMDetails.asp&sid=3619

Caprinae Specialist Group 1996. *Capra falconeri*. In IUCN 2007. *2007 IUCN Red List of Threatened Species*. www.iucnredlist.org. (accessed 30 September 2008)

Carruthers, Douglas. 2008. *Beyond the Caspian.* Alcester: Read Books.

Center for Russian Nature Conservation. 2001. *Russian Conservation News* No. 26 (Summer). www.wild-russia.org/html/crnc.htm

Center for Russian Nature Conservation. 2002. *Russian Conservation News* No. 28 (Winter). www.wild-russia.org/html/crnc.htm

*Convention on International Trade in Endangered Species (*CITES). www.cites.org/eng/resources/species.html

_____. 2008. *Export Quotas for Specimens of Species included in the CITES Appendices for 2008*. www.cites.org/common/quotas/2008/ExportQuotas2008.pdf

Conservation International. *Biodiversity Hotspots—Mountains of Central Asia*. www.biodiversityhotspots.org/xp/hotspots/central_asia/Pages/default.aspx

Deer Specialist Group. *Cervus elaphus* ssp. *bactrianus*. In: IUCN 2007. *2007 IUCN Red List of Threatened Species.* www.iucnredlist.org (accessed 1 October 2008)

Fergus, M., and J. Jandosova. 2004. *Kazakhstan: Coming of Age*. Stacey International.

Glukhovtsev, G., and L. Yermekbayeva. 2001. *Integrating Biodiversity into the Tourism Sector: Best Practices and Country Case Studies Kazakhstan.* Almaty: Biodiversity Planning and Support Programme, UNEP. *www.unep.org/bpsp/Tourism/Case%20Studies%20(pdf)/KAZAKHSTAN%20(Tourism).pdf*

International Center for Agriculture Research in Dry Areas (ICARDA). 2005. ICARDA in Central Asia and the Caucasus: A Decade of Achievements. *Ties that Bind* No. 12. Aleppo.

International Union for Conservation of Nature (IUCN). 2008. *2008 IUCN Red List of Threatened Species.* www.iucnredlist.org

Krever, V., et al., eds. 1998. *Biodiversity Conservation in Central Asia: An Analysis of Biodiversity and Current Threats and Initial Investment Portfolio.* Moscow: WWF Russia. www.wwf.ru/resources/publ/book/eng/36

Lovgren, S. 2006. *World's Largest Sheep Are "Icons" of Threatened Region, Naturalist Says*. In *National Geographic News*. 7 March. http://news.nationalgeographic.com/news/2006/03/0307_060307_afghanistan.html

Mack, G. R., and A. Surina. 2005. *Food Culture in Russia and Central Asia.* Oxford: Greenwood Publishing Group.

Mallon, D.P. 2003. *Saiga tatarica.* In *2007 IUCN Red List of Threatened Species.* www.iucnredlist.org (accessed on 30 September 2008)

Mallon, D. et al. Mountains of Central Asia. In Mittermeier, Russell A. et al. 2005. *Hotspots Revisited: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions.* Conservation International.

Ministry of Environmental Protection. 1998. *Kyrgyz Republic Biodiversity Strategy and Action Plan.* Bishkek. www.cbd.int/doc/world/kg/kg-nbsap-01-en.pdf

National Geographic. *Snow Leopard.* http://animals.nationalgeographic.com/animals/mammals/snow-leopard.html

National Geographic. Przewalskis Horse. http://animals.nationalgeographic.com/animals/mammals/przewalskis-horse.html

Red List of Republic of Kazakhstan. www.redbookkz.info/en/index.html

Red List of Republic of Kazakhstan. *Desert Monitor* (Varanus griseus*)*. www.redbookkz.info/species.php?num=118&lang=en

Red List of Republic of Kazakhstan. *Tian Shan Red Bear* (Ursus arctos isabellinus). www.redbookkz.info/species.php?num=115&lang=en

Republic of Tajikistan. 2002. *Tajikistan State of the Environment Report – Forest Resources.* http://enrin.grida.no/htmls/tadjik/soe2/eng/htm/forest/state.html

Saiga Conservation Alliance. www.saiga-conservation.com

Savvaitova, K.A., and T. Petr. 1999. Fish and Fisheries in Lake Issyk-kul (Tien Shan), River Chu and Pamir lakes. In T. Petr (ed.) Fish and Fisheries at Higher Altitudes: Asia. FAO *Fisheries Technical Paper* No. 385. Rome: FAO. www.fao.org/docrep/003/x2614e/x2614e10.htm

Schaller, G. B., and A. Kang. 2008. Status of Marco Polo Sheep *(Ovis ammon polii)* in China and Adjacent Countries: Conservation of a Vulnerable Subspecies. *Oryx*. 42 (1) January.

Snow Leopard Trust. *Snow Leopard Fact Sheet.* www.snowleopard.org/external_files/media/Snow-Leopard-Fact-Sheet.pdf

Tortoise & Freshwater Turtle Specialist Group. 1996. *Testudo horsfieldii*. In *2007 IUCN Red List of Threatened Species*. www.iucnredlist.org (accessed 1 October 2008)

Turkmenistan: the Golden Age with support State News Agency of Turkmenistan. http://turkmenistan.gov.tm/_eng/2008/08/10/print:page,1,address_of_president_of_turkmenistan.html

Ultimate Ungulate. *Fact Sheet: Markhor (*Capra falconeri*).* www.ultimateungulate.com/Artiodactyla/Capra_falconeri.html

Ultimate Ungulate. *Fact Sheet: Goitered Gazelle (*Gazella subgutturosa*).* www.ultimateungulate.com/Artiodactyla/Gazella_subgutturosa.html

United Nations Environment Programme (UNEP). 2002. *New CMS Agreement to Save the Bukhara Deer from Extinction Concluded by Central Asian Environment Ministers*.16 May. www.unep.org/Documents.Multilingual/Default.asp?DocumentID=248&ArticleID=3051&l=en

WWF. 2007. *Bukhara Deer Reintroduced in Kazakhstan*. 16 February. www.panda.org/wwf_news/news/?94380/Bukhara-deer-reintroduced-in-Kazakhstan

_____. *Brown Bear Ecology and Habitat*. www.panda.org/about_our_earth/species/brown_bear/brownbear_ecology_habitat/

_____. *Caspian Lowland Desert*. www.worldwildlife.org/wildworld/profiles/terrestrial/pa/pa1308_full.html

Yesipov, A., and H. Bykova. 2008. Desert Monitor. In *Discovery Central Asia* No. 21 (Summer). www.discovery-central-asia.com/archive/2007/summer2007/sm3.html

AGRICULTURE

ADB. 2006. Proposed Loan and Asian Development Fund Grant Republic of Tajikistan: Sustainable Cotton Subsector Project (Project No. 38603). October 2006.

Baas, Stephen. 1996. *Pastoral Livestock Development in Central Asia*. FAO, Rome. www.fao.org/sd/rodirect/ROan0009.htm

Brylski, P., Schillhorn van Veen, T., and Paavo Eliste. 2001 *Kyrgyz Republic Mountain Rangeland and Forest Sector Note.* ECSSD Environmentally and Socially Sustainable Development Working Paper No 33. Washington, DC: World Bank.

Buknall, J. et al. 2003. *Irrigation in Central Asia: Social, Economic and Environmental Considerations*. World Bank. http://siteresources.worldbank.org/ECAEXT/Resources/publications/Irrigation-in-Central-Asia/Irrigation_in_Central_Asia-Full_Document-English.pdf

CGIAR. 2008. *CGIAR Program For Sustainable Agricultural Development in Central Asia and the Caucasus Annual Report (2007–2008).* Tashkent: Program Facilitator Unit. www.icarda.cgiar.org/cac/files/astana/PFU_ANNUAL_REPORT.pdf

_____. 2008. *A Decade of Partnership for Sustainable Development in Central Asia and the Caucasus*. Tashkent.

CIMMYT. 2004. *Central Asian Nations: Different Paths to Development*. www.cimmyt.org/english/docs/ann_report/recent_ar/D_Support/centralasian.htm

De Martino, Luigi, et al, eds. 2005. *Environment and Security: Transforming Risks into Cooperation - Central Asia - Ferghana / Osh / Khujand Area*. UNEP. http://enrin.grida.no/security.cfm?article=10

Encyclopædia Britannica. 2009. *Fergana Valley*. Available. www.britannica.com/EBchecked/topic/204603/Fergana-Valley

FAO. 1995. A Profile of Kazakhstan's Agricultural Reforms. In *The State of Food and Agriculture 1995.* FAO Agriculture Series No. 28. Rome: FAO. www.fao.org/docrep/V6800E/V6800E0h.htm

_____. Aquastat Country Profiles and Fact Sheets: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan. www.fao.org/nr/water/aquastat/countries/index.stm

_____. AquaStat: FAO's Information System on Water and Agriculture. www.fao.org/nr/water/aquastat/main/index.stm

Gillham, F. M., et al. 1995. *Cotton Production Prospects for the Next Decade*. World Bank Technical Paper 287. Washington, DC: World Bank.

Gintzburger, G., et al. 2003. *Rangelands of the Arid and Semi-Arid Zones in Uzbekistan*. Aleppo: ICARDA.

Hall, M., et al.,eds. 2001. *Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World.* Rome and Washington, DC: FAO and World Bank. ftp://ftp.fao.org/docrep/fao/003/Y1860E/Y1860E00.PDF

ICARDA. 2005. ICARDA in Central Asia and the Caucasus: A Decade of Achievements. *Ties that Bind* No. 12. Aleppo.

_____. 2007. Integrated Feed and Livestock Production in the Steppes of Central Asia. IFAD Technical Assistance Grant No. 425. www.ifad.org/lrkm/tags/425.htm

Iñiguez, Luis. 1999. Helping Hands to Restore Livestock Production in Central Asia. *ICARDA Caravan* Issue No. 10, Winter/Spring 1999. www.icarda.cgiar.org/Publications/Caravan/Caravan10/Car104.HTML

International Water Management Institute. http://centralasia.iwmi.org/areg.html

Library of Congress, Federal Research Division. *Country Studies*. http://lcweb2.loc.gov/frd/cs/

Luis, et al. 2005. Livestock Production in Central Asia: Constraints and Opportunities. *ICARDA Caravan* Issue No. 22. www.icarda.org/Publications/Caravan/Caravan22/Caravan22.htm

Morgounov, A.I. et al. 2005. International Cooperation for Winter Wheat Improvement in Central Asia: Results and Perspectives. *Turkish Journal of Agriculture and Forestry* 29 : 137–142. http://journals.tubitak.gov.tr/agriculture/issues/tar-05-29-2/tar-29-2-6-0404-19.pdf

Schillhorn van Veen, Tjaart et al. 2005. *Kazakhstan: Rangelands in Transition - the Resource, the Users, and Sustainable Use.* Europe and Central Asia Environmentally and Socially Sustainable Development Series Report No. 31384 Vol. 1. Washington, DC: World Bank. ftp://ftp.fao.org/docrep/nonfao/lead/x6156e/x6156e00.pdf

Tarr, D. and E. Trushin. Did the Desire for Cotton Self-Sufficiency Lead to the Aral Sea Environmental Disaster? A Case Study on Trade and the Environment. *Trade Policy and WTO Accession for Development in Russia and the CIS: A Handbook*. Ves Mir.

Torgoev, I., Y. Aleshin, and G. Ashirov. 2008. Impacts of Uranium Mining on the Environment of Fergana Valley in Central Asia. *Uranium, Mining and Hydrogeology* 285–294. Berlin: Springer.

United Nations Development Fund for Women (UNIFEM). 2005. *The Ferghana Valley: Current Challenges.* Kyrgyz Republic, Bishkek.

USDA. www.fas.usda.gov/pecad2/highlights/2005/03/Kazakh_Ag/index.htm

Water Wiki. *Situation in Central Asia.* UNDP. www.waterwiki.net/index.php/Situation_in_Central_Asia#Water.2C_a_constraint_resource_and_challenge

FISHERIES AND AQUACULTURE

Caspian Environment Program (CEP). *Animals of the Caspian Sea*. www.caspianenvironment.org/biodiversity2.htm

_____. *Caspian Sea: Background*. www.caspianenvironment.org/caspian.htm

FAO. 2004. FAO Statistical Yearbook 2004. Rome: FAO.

_____. 2006. FAO Fishery and Aquaculture Statistics 2006. www.fao.org/fishery/publications/yearbooks

_____. 2008a. Capture fisheries and aquaculture in the Kyrgyz Republic: Current Status and Planning. *FAO Fisheries Circulars Series No. 1030*. ftp://ftp.fao.org/docrep/fao/011/i0229e/i0229e.pdf

_____. 2008b. Report of the Regional Scoping Workshop on the Use of Irrigation Systems for Fish Production in Central Asia. Tashkent, Uzbekistan, 17–20 July 2007. *FAO Fisheries Reports Series No. 843*. ftp://ftp.fao.org/docrep/fao/010/i0075e/i0075e00.pdf (English), ftp://ftp.fao.org/docrep/fao/010/i0075r/i0075r00.pdf (Russian)

_____. 2008c. Report of the Regional Workshop on Inland Fisheries and Aquaculture in Central Asia: Status and Development Prospects. Beymelek, Turkey,. 11–14 December 2007. *FAO Fisheries Reports, Series No. 862*. ftp://ftp.fao.org/docrep/fao/011/i0240b/i0240b00.pdf

Magzumovich, K. 2007. Kazakhstan Country Review. 2007. In FAO. 2008. Report of the Regional Scoping Workshop on the Use of Irrigation Systems for Fish Production in Central Asia. Tashkent, Uzbekistan, 17–20 July. *FAO Fisheries Reports* No. 843. ftp://ftp.fao.org/docrep/fao/010/i0075e/i0075e00.pdf (English)

Petr, T, ed. 1999. Fish and Fisheries at Higher Altitudes: Asia. *FAO Fisheries Technical Paper No. 385*. Rome: FAO.

Van Anrooy, R. 2007. Aquaculture production and opportunities for development in Central Asia. *FAO Aquaculture Newsletter (FAN)* No.38. Rome: FAO. ftp://ftp.fao.org/docrep/fao/010/a1441e/a1441e05.pdf

PEOPLES AND CULTURAL TRADITIONS

Absolute Astronomy. *Yurts*. www.absoluteastronomy.com/topics/Yurt

Dostuck Trekking www.dostuck.com.kg/

Equiworld. *Prezwalskis Horse*. www.equiworld.net/uk/horsecare/Breeds/prezwalski/index.htm

Falconry Information Clearinghouse www.falconry.com/

Foundation for the Preservation of the Przewalskii Horse www.treemail.nl/takh/

Horse Breeds of the World www.kyhorsepark.com/Museum/breeds.php?pageid=8

HorseWeb www.horseweb.com/

Iranian Chamber Society. *History of Iran: Achaemenid Empire*. www.iranchamber.com/history/achaemenids/achaemenids.php

Kuzmina, E. E and Victor H. Manir (ed). 2008. *The Prehistory of the Silk Road*. Philadelphia: University of Pennsylvania. Available (preview): http://books.google.com.ph/books?id=5FzANyya1BEC&pg=PA68&lpg=PA68&dq=camels+central+asia&source=bl&ots=s05wLGu85r&sig=ydmeGjLGBSXyaBu7ZTUs2Bdr7U8&hl=en&ei=wAHxSZysMIKUkAX66tHtCg&sa=X&oi=book

Dodykhudoeva, L. 2002. *The Socio Linguistic Situation and Language Policy of the Autonomous Region of Mountainous Badakhshan: The Case of the Tajik Language*. http://lapica-unesco.cesca.es/congres/taller/taller2/Dodykhudoeva.html

Maslow, J. 1997. *The Golden Horses of Turkmenistan*. *Silk Road Foundation*. www.silk-road.com/artl/maslow.html

Naison Group. *The Tajik Language*. www.naison.tj/EN/TAJIK_LANGUAGE/tajik.shtml

Oriental Express Central Asia. www.orexca.com

PBS www.pbs.org

PBS Nature. *Wild Horses of Mongolia with Julia Roberts*. www.pbs.org/wnet/nature/mongolia/

Powerhouse Museum. *Beyond the Silk Road: Arts of Central Asi*a. www.powerhousemuseum.com/previous/beyond_silk.asp

Sairam Tourism www.sairamtour.com/

SpongoBongo. *Guide to Central Asian and Chinese Rugs*. www.spongobongo.com/CenAsia.htm

The Falconer's Web www.falconers.com/

US Library of Congress www.loc.gov

University of Michigan Museum of Zoology Animal Diversity Web. Equus Caballus Przewalskii. http://animaldiversity.ummz.umich.edu/accounts/equus/e._caballus_przewalskii$narrative.html

Webring. *Falconry Webring*. www.webring.com/hub?ring=falconry

Wikipedia www.en.wikipedia.org

Yurt Info. www.yurtinfo.org

NATURAL RESOURCES, ENVIRONMENT, AND POVERTY

Bauer, A., et al. 2008. The World Bank's New Poverty Data: Implications for the Asian Development Bank. *ADB Sustainable Development Working Paper Series*. No. 2. Manila.

Central Asia Regional Economic Cooperation. 2009. *Central Asia and Caucasus Disaster Risk Management Initiative. Status Report*. Prepared for CAREC Senior Officials' Meeting, Ulaanbaatar, Mongolia, 27–29 May.

Governments of Uzbekistan, Kazakhstan, Kyrgyz Republic, Tajikistan, and Turkmenistan. 2001. *Regional Environmental Action Plan for Central Asia*. http://waterwiki.net/index.php/Central_Asia_Regional_Environmental_Action_Plan

Hugo, G. 2003. *Urbanisation in Asia: An Overview.* Paper prepared for Conference on African Migration in Comparative Perspective. Johannesburg, South Africa. http://pum.princeton.edu/pumconference/papers/2-Hugo.pdf

Hussain, A. 2007. Middle East and Central Asia: Riding the Crest of the Oil Boom. IMF. www.imf.org/external/pubs/ft/survey/so/2007/CAR1030A.htm

International Fund for Saving the Aral Sea (IFAS), Interstate Sustainable Development Commission (ISDC), Scientific-Information Center (SIC) and UNEP. 2007. *Sub-Regional Integrated Environmental Assessment: Central Asia*. Ashgabat: UNEP. http://ekh.unep.org/files/IEA-eng.pdf

Mansoor, A., and B. Quillin. 2007. *Migration and Remittances: Eastern Europe and the Former Soviet Union*. Washington, DC: World Bank. http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/ECAEXT/0,,contentMDK:21173991~pagePK:146736~piPK:146830~theSitePK:258599,00.html

Taryannikova, R. 2009. Sustainable Land Management to Combat Desertification in Republic of Uzbekistan. Paper presented in the International Conference on Combat Desertification. Beijing, China.

UNDP. 2005. Central Asia: Human Development Report. New York. http://hdr.undp.org/en/reports/regionalreports/europethecis/name,3281,en.html

_____. 2008. *Human Development Report 2007/2008 06 Commitment to health: Resources, Access and Services.* http://hdrstats.undp.org/en/indicators/50.html

UNDP Kazakhstan. 2008. *National Human Development Report 2008 Climate Change and its Impacts on Kazakhstan Human Development. A*stana. www.undp.kz/img/docs/en/1625.pdf

Ustyan, I. 2005. C*ountry statement Tajikistan - Policies affecting forest land use and forest products markets.* Dushanbe: UNECE/FAO Workshop. www.unece.org/timber/docs/other_mtgs/2005krtiny/reports/tjk_pol_e.pdf

with special attention to land degradation. An Issue Paper in the Asia-Pacific Forum for Environment and Development Expert Meeting held in People's Republic of China on 23 January 2003. APFED3/EM/03/DOC.4 www.apfed.net/apfed1/pdf/APFED3_EM_doc4.pdf

TOWARD SUSTAINABLE DEVELOPMENT

ADB. 2000. *Technical Assistance for the Regional Environmental Action Plan in Central Asia*. TAR: OTH 33547. www.adb.org/Documents/TARs/REG/tar_oth33547.pdf

_____. 2006. *Urbanization and Sustainability in Asia: Good Practice Approaches in Urban Region Development*. Manila.

_____. 2007. Bishkek MDG Forum. *MDGs in Central Asia and the Southern Caucasus*. www.adb.org/Documents/Events/2007/MDGs-in-Central-Asia/default.asp

Akerlund, U. 2006. *Urban and Peri-urban Forestry and Greening in West and Central Asia: Experiences, Constraints and Prospects*. Rome: FAO.

Bandara, A. et al. 2004. Poverty in Central Asian Countries. *Bulletin on Asia-Pacific Perspectives 2004/05*.

Celis, D., and E. De Pauw. 2005. "Hot spot" assessment of land cover change in the Cwana region using AVHRR satellite imagery. Proceedings of the First International conference on Remote Sensing and Geoinformation Processing in the Assessment and Monitoring of Land

Hugo, G. 2003. Urbanisation in Asia: An Overview. Paper presented in the Conference on African Migration in Comparative Perspective. Johannesburg, South Africa, 4–7 June. http://pum.princeton.edu/pumconference/papers/2-Hugo.pdf

International Fund for Saving the Aral Sea (IFAS), Interstate Sustainable Development Commission (ISDC), Scientific-Information Center (SIC) and UNEP. 2007. *Sub-Regional Integrated Environmental Assessment: Central Asia*. Ashgabat: UNEP. http://ekh.unep.org/files/IEA-eng.pdf and at www.rrcap.unep.org/pub/ea/IEA-CA_2007_eng.pdf

Regional Environmental Centre for Central Asia (CAREC). www.carecnet.org/en

Pomfret, R., and K. Anderson K– 2001. Economic Development Strategies in Central Asia since 1991. *Asian Studies Review 25 (2):* 185–200.

Taryannikova, R. 2009. *Sustainable Land Management to Combat Desertification in Republic of Uzbekistan. International Conference on Combat Desertification*. Beijing, People's Republic of China.

World Bank. 2005. Growth, Poverty and Inequality. Eastern and the Former Soviet Union. Washington, DC.

_____. 2005. *World Development Indicators 2005*. Washington, DC.

_____. 2009. *World Development Indicators*. http://publications.worldbank.org/WDI (accessed 23 April 2009)

World Health Organization (WHO) Regional Office for Europe. *Population Health in Central Asia: Life Expectancy*. www.euro.who.int/document/obs/pophealth.pdf

REMOTE-SENSING IMAGES AND ASSOCIATED DATA

Land Cover Facility. *Global Inventory Modeling and Mapping Studies (GIMMS)*. www.landcover.org

MDA Federal. 2004. USGS. *Landsat Enhanced Thematic Mapper Plus (ETM+) images: GeoCover circa 2000*. www.landcover.org

Warehouse Inventory Search Tool (WIST). *Moderate Resolution Imaging Spectroradiometer (MODIS)*. https://wist.echo.nasa.gov/api/

Shuttle Radar Topography Mission (SRTM) images: All 3-D perspective images are produced using Digital Elevation Model (DEM) data from the National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission. Data are downloaded from Consultative Group on International Agricultural Research Consortium for Spatial Information (CGIAR CSI) website (http://srtm.csi.cgiar.org) (Jarvis A., H.I. Reuter, A. Nelson, and E. Guevara. 2008. Hole-filled seamless SRTM data V4. Cali: Colombia: International Centre for Tropical Agriculture).

Taryannikova, R. 2009. Sustainable Land Management to Combat Desertification in Republic of Uzbekistan. International Conference on Combat Desertification, 22–24 January, Beijing, People's Republic of China.

The World Database on Protected Areas (WDPA). www.wdpa.org

Abbreviations

ADB	Asian Development Bank
FAO	Food and Agriculture Organization of the United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization

Acknowledgments

Preparation and production of the Central Asia Atlas of Natural Resources involved a broad group of specialists from many fields. Their contributions are greatly appreciated:

In Central Asia, advice and comments on content were given by the Central Asian Countries Initiative for Land Management (CACILM) Multicountry Secretariat in Bishkek, Kyrgyz Republic; and by the heads of the National CACILM secretariats in Kazakhstan, the Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan.

Advice was also provided by the members of CACILM Steering Committee composed of representatives of the Canadian International Development Agency (CIDA), Global Environment Facility (GEF), Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), International Center for Agricultural Research in the Dry Areas (ICARDA), International Fund for Agricultural Development (IFAD), Swiss Agency for Development and Cooperation (SDC), United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), and World Bank.

Asian Development Bank (ADB) resident missions in Kazakhstan, the Kyrgyz Republic, Tajikistan, and Uzbekistan provided helpful comments.

At ADB headquarters, overall supervision was provided by Juan Miranda, director general, Central and West Asia Department. Draft sections were reviewed by John Whittle, principal agricultural economist; Donneth Walton, senior rural development specialist; Hans Siewert Woldring, rural development specialist; Bayanjargal Bayanjargal, energy specialist; and Armin Bauer, senior economist. Judy Vermudo handled all the international coordination and liaison. Ritchie-Bella Lozada assisted in encoding statistical data. Advice on maps was provided by Herman Ramos of ADB's Office of Administrative Services, and on design and production by Carolyn Cabrera Dedolph, Muriel Ordoñez, Vicente Angeles, and Anthony Victoria of ADB's Publishing Unit.

Contributors

Concept and content	Robert Everitt and Mark Kunzer, ADB
Writers	David Schwartz and Jay Maclean
Editor	Jay Maclean
Researchers	Aloisa Guadalupe Santos, David Schwartz, and Noemi S. Bayawa
Thematic maps	Vladislav Sibagatulin, GIS Service Ltd., Bishkek, Kyrgyz Republic
Remote sensing images	Changyuan Ji
Copy editor	Ma. Priscila del Rosario
Book design and layout	Mike Cortes for Design Muscle, Inc. (www.flexdesignmuscle.com). Manila, Philippines

SOURCES OF REMOTE-SENSING IMAGES AND ASSOCIATED DATA

General

1. Landsat Enhanced Thematic Mapper Plus (ETM+) images: GeoCover circa 2000, MDA Federal (2004), USGS. Downloaded from the Global Land Cover Facility (www.landcover.org), University of Maryland at College Park.

2. Moderate Resolution Imaging Spectroradiometer (MODIS): All MODIS data used are downloaded from Warehouse Inventory Search Tool (WIST) at https://wist.echo.nasa.gov/api/

3. Global Inventory Modeling and Mapping Studies (GIMMS), Land Cover Facility (www.landcover.org).

4. Shuttle Radar Topography Mission (SRTM) images: All 3-D perspective images are produced using Digital Elevation Model (DEM) data from the National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission. Data downloaded from Consultative Group on International Agricultural Research Consortium for Spatial Information (CGIAR CSI) website (http://srtm.csi.cgiar.org) (Jarvis A., H.I. Reuter, A. Nelson, and E. Guevara. 2008. Hole-filled seamless SRTM data V4. Cali: Colombia: International Centre for Tropical Agriculture).

Protected Areas

The World Database on Protected Areas (WDPA) (www.wdpa.org/).

Waterlogging and Soil Salinity

Raisa Taryannikova, Sustainable Land Management to Combat Desertification in Republic of Uzbekistan. International Conference on Combat Desertification, 22–24 January, 2009, Beijing, People's Republic of China.

Photo Credits

Front Cover		Nikolay Kuznetsov, WWF Russia
Back Cover		Christopher Herwig
Front and back dust jacket		
flaps		Walter Callens
iv–v		Christopher Herwig
vi		Ivan Abrams
Amid Deserts, Steppes, and Mountains		
1		Walter Callens
3		Kelly Cheng
5		Christopher Herwig
6–7		Christopher Herwig
9		Boris Karpov
10–11		Christopher Herwig
13	upper	Nikolay Kusnetsov, WWF Russia
	lower	Christopher Herwig
14–15		Nikolay Kusnetsov, WWF Russia
16–17		Yann Arthus Bertrand, Altitude
18–19		Christopher Herwig
20–21		Christopher Herwig
22	upper	Vsevolod Tarasevich
	lower	Hugues Bissot
23	upper	Ian Gill, ADB
	lower	Maria Golovnina
The Five Countries of Central Asia		
24	top to bottom	
		Boris Karpov
		Maria Golovnina
		Ivan Abrams
		Maria Golovnina
		Christopher Herwig
		Christopher Herwing
		Christopher Herwig
25	top to bottom	
		Christopher Herwig
		Laurent Bellot
		Christopher Herwig
		Christopher Herwig
		Paul H. Kuiper
		Christopher Herwig
		Christopher Herwig
		Christopher Herwig
Kazakhstan		
30	upper	Nikolay Kusnetsov, WWF Russia
	lower	Romana Chapman
31		Ian Gill, ADB
32	top left	Christopher Herwig
	top right	Maria Golovnina
	middle	Christopher Herwig
	bottom	Christopher Herwig
33	top	Christopher Herwig
	middle	Christopher Herwig
	bottom	Christopher Herwig
Kyrgyz Republic		
34	upper	Christopher Herwig
	lower	NSEC Kyrgyz Republic
35		Christopher Herwig
36	top left	Christopher Herwig
	top right	Christopher Herwig
	middle	Ian Gill, ADB
	bottom	Christopher Herwig
37		Ivan Abrams
	views	Ivan Abrams
	of	Lastochkin Oleg
	Bishkek	Alan Cordova, www.alancordova.com
Tajikistan		
38	upper	Christopher Herwig
	lower	Christopher Herwig
39		Christopher Herwig
40	top	Christopher Herwig
	middle	Maria Golovnina
	bottom	Maria Golovnina
41	left	Christopher Herwig
	right	Max Atanasov
	top	Christopher Herwig
	middle	Christopher Herwig
	bottom	Christopher Herwig
Turkmenistan		
42	upper	Christopher Herwig
	lower	Ivan Abrams
43		Anthony Asael
44	top left	NSEC Turkmenistan
	middle left	NSEC Turkmenistan
	bottom left	NSEC Turkmenistan
	right	NSEC Turkmenistan
45	upper	Christopher Herwig
	lower	Hanming Huang
Uzbekistan		
46	upper	Kelly Cheng
	lower	Christopher Herwig
47		Jeremy Ingham
48	top left	Christopher Herwig
	top right	NSEC Uzbekistan
	middle	Matthieu Paley
	bottom	Ian Gill, ADB
49	above left	Christopher Herwig
	above right	Ian Gill, ADB Photobank
	upper	Torrione Stefano
	lower	Christopher Herwig
Energy Resources		
50		Christopher Herwig
51	inset	Ian Gill, ADB
53	upper	Christopher Herwig
	lower	Antoine Gyori
54		Antoine Gyori
		Ustinenko Anatoly
55	upper	Christopher Herwig
	lower	Reza
56		Sergei Ilnitsky
57		Guillaume Baurand, baurand.net
58		Gerd Ludwig
59		Ian Gill/ADB Photobank
60		Christopher Herwig
61	left	Helen Macdonald
	upper right	Martin Solli
	lower	Development and Transition (www.developmentandtransition.net)
Mineral Resources		
62–63		Gerd Ludwig
	upper right	Visuals Unlimited
	lower right	Ustinenko Anatoly
65	above left	Shepard Sherbell
	above right	Tobias Hoeck
66	upper left	Alfredo Dagli Orti
	upper middle	Gerd Ludwig
	upper right	Michel Setboun
	lower	Vladimir Maltsev, Eugenenii Voidakov & www.orexca.com
67		Visuals Unlimited
Water Resources		
68–69		Kazuyoshi Nomachi
	upper right	Robert Everitt
	lower right	Dr. Alexander Nesaka
71		Maria Golovnina
72	upper	Matthieu Paley
	lower	Denisov Roman
74	upper	Yann Arthus Bertrand
	lower	Christopher Herwig
75		Christopher Herwig
76	above	Christopher Herwig
	right	Corbis
78	upper left	Mary Alice Treadway
	lower left	Robert Everitt
	right	Dr. Rafael Litvak
79	upper	Bugaev Vladimir
	lower	Vladimir Menkov
80		Christopher Herwig
81	upper	Ratushenko
	lower	Ibrahimjon
82	upper	Gerd Ludwig
	lower	Matthieu Paley
83	upper	David Turnley
84		Antoine Lambroschini
85	top	Will Rankin, 2006
	middle	Ian Hadingham aka Jelltex
	bottom	Nick Leonard
87	left	Korytnikov Stanislav
	upper right	Paul Rudkin
	lower right	Ivan Abrams
88		Ian Mcilwraith
89		Ratushenko
90		Ratushenko
91		Ian Mcilwraith
		Ian Gill, ADB
Living Resources		
94		Valentina V. Marochkina, WWF Russia
	inset	Dr. Chris Magin/IUCN
95	upper	Sam Panthak
	lower	The Tiger Foundation, www.tigers.ca
97		Christopher Herwig
98	upper	Dr. Chris Magin, IUCN
	lower	Dr. Tatyana M. Bragina, WWF Russia/Kazakhstan

99		Dr. Tatyana M. Bragina/ WWF Russia/Kazakhstan
100	top	Christopher Herwig
	middle	Shidlovskiy
	bottom	Dean Conger
101		Korytnikov Stanislav
102		Robert Everitt
103		Garth Willis, www.alpinefund.org
		Flavijus Piliponis
		Ratushenko
105		Christopher Herwig
106	upper	ValentinaV. Marochkina WWF Russia/Kazakhstan
	lower	Obukhov
107		Tobias Hoeck
108		Christopher Herwig
109	upper	Komila Rakhimova
	lower	Ulf Stahle
110	upper left	Ivan Abrams
	upper right	Ivan Abrans
	lower	Christopher Herwig
111		Robert Everitt
112	upper	Christopher W. Humphries
	lower	Stefan Meyers/ardea.com
113	upper	NHPA/Photoshot
	lower left	Jennifer Comstock
	lower right	Natalia Soldatova, c/o Olga Pereladova/WWF Russia
114	upper left	Bobkov Vyacheslav
	upper right	Ryspek Baidavletov, c/o Olga Pereladova/WWF Russia
	lower	Ekaterina Sidorenko
115	left	Khalifa Mohammed Al Attita
	right	Ibrahim Nassar Al-Nassar
116	top	Guy Haimovitch, whoisguy@gmail.com
	middle	Ray Wilson
	bottom	Guy Haimovitch, whoisguy@gmail.com
117	upper left	Kalinichev V.
	upper right	Shannon Crownover/ Caviar Emptor/Seaweb
	lower left	Dr. Alexander Naseka
	lower right	Dr. Alexander Naseka
118	upper	Guifre Miguel i Fageda
	lower	C. Loades, Fauna & Flora Inernational
119	above left	Grigory Gusev
	above right	www.wild-natures.com
	lower left	Nick Leonard
	lower right	Korytnikov Stanislav

Agriculture

120		Christopher Herwig
	inset	CACILM
123	upper	Tobias Hoeck
	bottom	Robert Everitt
125	upper	Robert Everitt
	lower	Korytnikov Stanislav
126		Daniel Zollinger
127	upper	Christopher Herwig
	lower	Gennadiy Ratushenko/ World Bank
128	top left	Susan Schoenian
	top center	Christopher Herwig
	upper right	Antoine Gyori
	middle left	Susan Schoenian
	middle right	Ian Gill, ADB
	bottom	Susan Schoenian
130	upper	Christopher Herwig
	lower	David Beatty/Robert Harding, World Imagery
131	upper	Dimitry Dudin
	lower	Korytnikov Stanislav
132	upper	Ian Gill, ADB
	lower	Ian Gill, ADB
134	upper	Christopher Herwig
	lower	Christopher Herwig
135	upper	Nikolay Kuznetsov, WWF Russia
	lower	Robert Everitt
136	top	Zelma
	middle	Christopher Herwig
	bottom	CACILM
137	top	Christopher Herwig
	middle	Christopher Herwig
	bottom	Christopher Herwig

Fisheries and Aquaculture

138		Christopher Herwig
139		Antoine Gyori
		Leonard L. Lovshin
		Department of Fisheries and Allied Aquacultures, Auburn University
140	top left	Tomasz Gomulka
	top middle	Olga Kotukova
	top right	Polyakov Alexander
	middle	Marie Stein
	bottom	www.Fishbase.org
141	upper	Hansjurgen Burkard/Bildeberg
		Caviar Emptor/Sea Web
	lower	Shannon Crownover, Caviar Emptor/Sea Web

Peoples and Cultural Traditions

142	above	Christopher Herwig
	upper right	Christopher Herwig
	lower right	Christopher Herwig
145	clockwise from top	Christopher Herwig
		Ivan Abrams
		Christopher Herwig
		Christopher Herwig
146		www.antiquesprint.com
		Kelly Cheng
147	clockwise from left	Christopher Herwig
		Grinberg Fred
		Ian Mcilwraith
		Ian Gill, ADB
		Christopher Herwig
148	upper	Christopher Herwig
	lower	Reza
149	upper	Christopher Herwig
	lower	Andrei Smirnov

Natural Resources, Environment, and Poverty

150		Christopher Herwig
	upper left	Christopher Herwig
	lower left	Alisa Mazur
152	upper	Maria Golovnina
	lower	Maria Golovnina
153	top	Hugues Bissot
	middle	CACILM Kazakhstan Project
	bottom	CACILM Brochure
154		UZGIP Institute Report
156		UZGIP Institute Report
157		Vladimir Levin/CBA/UNDP
158	in the box	Christopher Herwig
		NASA
159	upper	Christopher Herwig
	lower	David Samuel Robbins
160		Korytnikov Stanislav
161	top	Christopher Herwig
	middle	Dimitry Dudin
	bottom	Robert Everitt
162	upper	NSEC Kyrgyz Republic
	lower	NSEC Kyrgyz Republic
163		Rustam Mezafarov

Toward Sustainable Development

165		Christopher Herwig
		Tobias Hoeck
166	upper	Ian Gill, ADB
	lower	Ian Gill, ADB
167	upper	Ian Gill, ADB
	lower	Ian Gill, ADB
168	upper	NSEC Uzbekistan
	lower	Gennadiy Ratushenko, World Bank
169	left	Gennadiy Ratushenko, World Bank
	right	Christopher Herwig
170		Christopher Herwig
171		Sergei Chirikov
172	above left	ADB
	above right	Christopher Herwig
173	top	Christopher Herwig
	middle	ADB
	bottom	Ian Gill, ADB
174		Reza
175	upper	Christopher Herwig
	lower	Christopher Herwig
176	upper	Ivan Abrams
	lower	Christopher Herwig
177		Vaiden Zaitsev aka xbody
		Rene Eberle
178–179		Robert Everitt

Subject Index

Geographical Index

CENTRAL ASIA ATLAS OF NATURAL RESOURCES

The *Central Asia Atlas of Natural Resources* brings together a wealth of information related to living and nonliving natural resources in the five countries of Central Asia—Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan. It contains an array of maps based on geographic information systems and remote sensing images, numerous photographs, tabulations of important data, and extensive descriptive text that together illustrate and describe the region's bountiful natural resources, its diversity of peoples, and their progress toward sustainable development.

Highlights include geographic and climatic features; environmental, economic, and social profiles; energy, minerals, and water resources; ecoregions and ecosystems; major fauna and flora; agriculture and fisheries; peoples and cultural traditions; and progress toward sustainable development. Also included is extensive tabulation of the status and trends in exploitation and conservation of living and nonliving resources, as well as economic and social statistics.

About the Asian Development Bank

ADB aims to improve the welfare of the people in the Asia and Pacific region, particularly the nearly 1.9 billion who live on less than $2 a day. Despite many success stories, the region remains home to two thirds of the world's poor. ADB is a multilateral development finance institution owned by 67 members, 48 from the region and 19 from other parts of the globe. ADB's vision is a region free of poverty. Its mission is to help its developing member countries reduce poverty and improve their quality of life.

ADB's main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

About the Central Asian Countries Initiative for Land Management

The Central Asian Countries Initiative for Land Management (CACILM) is a partnership between the Central Asian countries—Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, and Uzbekistan—and the international donor community to combat land degradation and improve rural livelihoods and adapt to climate change in these countries. CACILM's goal is to restore, maintain, and enhance the productive functions of land in Central Asia, leading to improved economic and social well-being of those who depend on these resources while preserving the ecological functions of the land. CACILM implements a comprehensive and integrated approach to sustainable land management that can produce benefits at the local, national, and global levels.

Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 632 4444
Fax +63 2 636 2444
Website: www.adb.org
Email address: information@adb.org

Printed in Hong Kong, China