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NCSEER NOTE

This report is part of a Council-funded research project entitled Environmental Resources and Constraints in the Former Soviet Republics. Twenty one reports, listed below, resulting from this project will be distributed seriatim by the Council, and will collectively become the chapters of a book to be published in 1994 by Westview Press. Eighteen of the 21 (written by other authors) deal with the fifteen former republics, and three (written by Dr. Philip R. Pryde, the Principal Investigator) are summarizing reports.

Chapter 1: The Environmental Implications of Republic Sovereignty. (Pryde)

Chapter 2: Russia - An Overview of the Federation. (Pryde)

Chapter 3: European Russia. (Kochurov)

Chapter 4: The Urals and Siberia. (Scherbakova & Monroe)

Chapter 5: The Russian Far East. (Strand)

Chapter 6: Estonia. (Soot)

Chapter 7: Latvia. (Dreifelds)

Chapter 8: Lithuania. (Kritkauskys)

Chapter 9: Ukraine. (Stebelsky)

Chapter 10: Environmental Management in Ukraine. (Freeman)

Chapter 11: Belarus. (Cherp & Kovaleva)

Chapter 12: Moldova. (Dinu & Rowntree)

Chapter 13: Georgia. (Richards)

Chapter 14: Armenia. (Valesyan)

Chapter 15: Azerbaijan. (Wolfson & Daniell)

Chapter 16: Kazakhstan. (Smith) [Distributed February 3, 1994]

Chapter 17: Turkmenistan. (Micklin)

Chapter 18: Uzbekistan. (Lubin)

Chapter 19: Kyrgyzstan. (Braden)

Chapter 20: Tajikistan. (Eicher)

Chapter 21: The View to the Future. (Pryde)



Environmental Resources and Constraints
in the Former Soviet Republics

Turkmenistan

Philip P. Micklin

Executive Summary

The following paragraphs summarize the main contents and conclusions of a chapter on Turkmenistan, which has been prepared as part of a larger work on the environmental and economic-geographic situation in each of the former Soviet republics. The full study, edited by Philip R. Pryde, will be published by Westview Press under the title "Environmental Resources and Constraints in the Former Soviet Republics. Funding assistance from the National Council for Soviet and East European Research is acknowledged with appreciation.

In this chapter, the history, physical geography and ethnography of Turkmenistan is briefly summarized, followed by a survey of its main economic resources and the main environmental constraints (climatic, seismological, etc.) that affect the country's development. The contemporary state of the development of industry and irrigated agriculture within the republic is reviewed, with a focus on the environmental disruption that has resulted from this development. The current situation with regard to biotic preservation is also reviewed, including the establishment of nature reserves and parks, and the potential for ecotourism. The administrative structure for environmental management within the country is also briefly examined, as are non-governmental environmental efforts.

Particular discussion is directed to the problems that currently exist within Turkmenistan in the areas of public health and water supply. Irrigated agriculture has produced a legacy of soil salinization, over-use of pesticides and fertilizers, and much wastage of water. Also discussed are the Kara-Bogaz-Gol problem and the dilemmas of high birth rates and low public health indices. Suggestions on how Turkmenistan could better manage its water supplies are included.

The main conclusions of the chapter are that Turkmenistan today has serious pollution and public health problems, but also is potentially a very resource-rich country. The latter refers mainly to its vast reserves of oil and natural gas which, if developed wisely, could provide the funding needed to address its public health needs. It has the advantage of being a stable (albeit autocratic) country, with good ties to both the C.I.S. and its neighboring Islamic countries.

Philip R. Pryde, June 6, 1994



Chapter 17. TURKMENISTAN

Philip Micklin

Turkmenistan is one of the five predominantly Muslim constituent republics of the former Soviet Union. The southernmost of the former Union republics, it shares a common border with Iran and Afghanistan as well as with the new states of Uzbekistan and Kazakhstan (fig. 17.1). At 35° north latitude, Kushka was the Soviet Union's southernmost city and an important entry point into Afghanistan. Turkmenistan's area is 488,100 km², and its population (on Jan 1, 1991) was 3,714,000, placing it 4th and 13th, respectively, in these categories among the former republics of the USSR. The republic is predominantly rural (55% in 1990), and is the world's fourth largest producer of natural gas.

History and Ethnicity

Turkmenistan has a long history of human habitation. Nomads have roamed the area for millennia and archaeologists have found evidence of cropping cultures in the south of the republic that date to 6000 B.C. Irrigated agriculture was in widespread use along the rivers (Amu Darya, Tedzhen, Murgab, Atrek) and at the margins of the southern mountains. During the first millennium B.C. states arose here (Margiana, Parthia, Medea) that were conquered, in turn, by the Persians and Alexander the Great. Turkic people appeared in the area by the 10th century A.D. By this time, Islam had driven other, earlier religions from the region and cities such as Merv (Mary) had become centers of Islamic culture and learning.

The Mongols (Tatars) under Genghiz Khan descended on present-day Turkmenia in the 13th century and their domination lasted 150 years until broken by Tamerlane (Timur). Uzbek tribes began the dissolution of the Timurid Empire in the early 15th century with the capture of its capital of Samarkand. Several centuries later, what is now Turkmenistan was divided between the Khanates of Khiva and Bukhoro. During the last quarter of the 19th century, the Russian Empire incorporated, by conquest, all of Turkmenia. The whole of Central Asia under the Russians was termed "Turkestan" while present-day Turkmenistan was designated "Transcaspia".

Turkestan was in political turmoil following the Bolshevik Revolution, with some groups (e.g. the Basmachi) showing organized and strong resistance to the imposition of Soviet rule. However, by 1924 most opposition had been crushed. In that year, Turkmenistan was created as a Union Republic. Under Soviet rule, as in the rest of Central Asia, Islam was disparaged and pan-Turkism suppressed, collectivisation of agriculture

implemented, and industrialization and modernization begun. Turkmenia remained a bastion of Communist orthodoxy during the period of Gorbachev reforms and the Government leaders and Party officials here (including current President Saparmurad Niyazov, a former First Secretary of the Turkmen Communist Party) were not happy with many aspects of perestroika, glasnost, and democratization that were being pushed from Moscow.

As with the other republics, statehood descended on Turkmenistan with the dissolution of the USSR at the end of 1991. After the failed August 1991 coup in Moscow, the Communist Party of Turkmenistan changed its name but continues its control of the government. The economy, as most aspects of life in Turkmenia, is still under tight control. Formal moves toward a market economy have made the least progress of any former Soviet republic, although private activities in the agricultural sector have been and continue to be significant. Political opposition is now "officially" legal but strongly discouraged.

Turkmenistan, like the other republics of the former USSR, is a multi-national state with more than 100 distinct ethnic groups recognized (Marchenkov 1990). Turkmen constitute 72% of the population, according to the 1989 census, followed by Russians (9.5%), Uzbeks (9%), Kazakhs (2.5%), Tatars (1.1%) and Ukrainians (1%). It is curious, however, that persons of Persian descent were not isolated as a census category; it would seem likely there would be many such people in Turkmenistan.

The Turkmen are descendants of the Orguz Turks who migrated here at the end of the 10th century (Zickel, 1991, p. 171-172). Traditionally a nomadic people (although forced by Soviet authorities during collectivization into more sedentary ways), the Turkmen still live predominantly in rural areas. The other nationalities, particularly Russians and Ukrainians, chiefly live in the larger cities such as Ashgabat (Ashkhabad), with 398,000 residents, Dashhowuz (Tashauz), 112,000 residents, Charjew (Chardzhou), 161,000, and Mary, 94,000. The 1989 census reported that 98% of those describing themselves as ethnically Turkmen considered the Turkmen language as their first language, with fluency in Russian listed by 25% of Turkmen respondents.

Physical Environment

The key physical feature of Turkmenistan is the vast Kara Kum (in Turkic, Kara means black and Kum means desert) which covers some 80% of the republic. This mid-latitude desert has vast tracts of sand and sand dunes but also hard surfaced areas (rocky and clay-pan [in Russian, takyr]). Average annual precipitation here is the least of any place in the FSU, ranging from 70 to 200 millimeters. Summer air temperatures can rise to nearly 50° C and in

winter fall to -35° C. The Kara Kum has an extensive but sparse vegetation cover with low bushes (e.g., camels thorn) and scattered small trees (e.g., black saksaul and acacia) common. Large areas of the Kara Kum are used for pasturing of camels and sheep. The desert has a diversity of native mammals, reptiles, insects and birds, some of them endangered.

The Kopet-Dag mountains stretch along the southern periphery of Turkmenistan and form the border with Iran and Afghanistan. Although rising to nearly 3000 meters, they lack an alpine character and in many places are barren and dissected, reminding one of badlands (Alpat'yev *et al.* 1977, 15-16). Nevertheless, many of the deep, steep, north-trending valleys on the Turkmen side are forested, contain streams, and are picturesque. A number of these have long been used for recreational and resort purposes. The highest point in the republic (3139 m.), however, is in the Kugitang-tau Mountains on the eastern border with Uzbekistan.

Although Turkmenistan is mainly desert, the country's physical environment is characterized by several important water resources. The Amu Darya, the heaviest flowing river in Central Asia with an average annual discharge of 63 km^3 , flows through and along the boundary of the extreme eastern part of the republic. Surface flow also arrives in streams from the foothills and mountains on the south and southeast of the republic (e.g., Tejen (Tedzhen) and Murgab rivers). In all, the republic has access to aggregate surface flow resources of around $70 \text{ km}^3/\text{yr}$ (Goskomstat SSSR 1989, 64), although exploitable ground water resources are estimated at only 2 km^3 .

On the west Turkmenia borders on the Caspian Sea, the world's largest lake. In the northwest corner of Turkmenistan is a gulf on the Caspian Sea called the Garabogazkol (Kara-Bogaz-Gol), which is fed by over-flow from the Caspian. It is very rich in mineral salts, such as sodium sulfate.

In the northern part of Turkmenia, along its border with Karakalpakistan, lies Lake Sarykamysh. With an area of 3000 km^2 and volume of over 30 km^3 , this is among the larger lakes in the former USSR. It is unusual in that it grew from a much smaller, saline lake in the early 1960s owing to large inflows of used irrigation water (Micklin 1991a, 57-58). As a result, it is highly polluted with pesticide and fertilizer residues.

Physical Constraints to Development

The chief physical constraint to development for Turkmenistan is aridity. "Water is life" here; without a large and ensured supply of this resource there can be no significant industrial development nor large population centers, only extensive livestock raising based on desert and foothill pastures. Although Turkmenistan has access to significant water resources, there are

problems. More than 90% of available river flow is in the Amu Darya into which there is essentially no flow from Turkmen territory (it is generated almost totally upstream in Tadjikistan). Further, the waters of the Amu Darya are under very heavy stress from huge withdrawals by Uzbekistan, both upstream and downstream from Turkmenistan. The much smaller ground water supply is plagued by its dispersed nature, frequent high salinities, and natural losses via evapo-transpiration. Thus, water usage in the republic may already be above what is sustainable, providing a barrier to further water-intensive development.

There are two other constraints that deserve mention. Southern Turkmenia, where most of the population lives, is a zone of maximum seismicity. Very powerful earthquakes occurred here in 1946 and 1948. The latter temblor destroyed Ashkhabad (Ashgabat) and killed a reported 110,000 persons (Marchenkov 1990).

The other problem relates to the Caspian Sea. Cyclical long-term fluctuations in the Caspian sea level pose problems for development along that water body in Western Turkmenistan. Port facilities in Krasnovodsk, as at other locations around the Caspian, have had to adjust to a 3 meter drop in surface elevation between 1930 and 1978, followed by a 1.5 meter rise since 1978. For additional discussions of the Caspian Sea, see sections on the Caspian in the chapters on Azerbaijan and Kazakhstan.

Natural Resource Advantages and Existing Industry

Turkmenistan has considerable resource potential. Most important are oil and natural gas deposits. Production of oil reached a peak of 15 million metric tons in 1975 and in 1990 was 5.7 million, fourth among the former republics of the USSR (Sagers 1990). Natural gas production has climbed steadily and reached 88 billion cubic meters in 1990 or 11% of national production, putting Turkmenistan in second place among former Soviet republics after the RSFSR. Natural gas fuels electrical generating plants in all the major cities, and total reserves are estimated at 8 trillion cubic meters. Mineral resources of note are the brines of the Garabogazkol (Kara-Bogaz-Gol), the large gulf on the Caspian Sea in northwestern Turkmenia, from which mirabilite (sodium sulfate decahydrate) and other commercially valuable salts are extracted. Other resources found in the republic include potash, iodine, bromine, and sulfur.

Although often overlooked, Turkmenia's solar and wind resource potential is considerable. Solar radiation is the highest in the former USSR at 35 kilowatt-hours/km² while daytime wind speeds average 3--5 meters/second (Mints 1969, 279-280; Pryde, 1984). There has been some development of solar (water heating) and wind (farmstead electricity and mechanical pumping) but the potential has hardly been touched. The former USSR's Solar

Energy Research Institute was located at the new suburb of Bikrova, outside Ashgabat. It is not known what Turkmenistan plans to do with this facility.

As is true of the rest of the Central Asian republics, Turkmenistan's industrial development is much below the average for the former USSR. The chief heavy industry is oil and gas extraction with some local petrochemical production. Light industry is well developed here (at least as compared to heavy industry) with primary focus on processing of raw cotton and production of cotton textiles, wool processing and weaving, and silk production. Turkmen carpets are world famous with a large share of the production sold internationally.

Irrigated agriculture plays a key role in the Turkmen economy. In 1990, the area with irrigation facilities reached 1.203 million hectares, accounting for about 6% of the USSR's irrigated zone (Goskomstat SSSR 1991a, 489--492). Cotton, grown on 52% of these lands, is the chief crop. Turkmenia in 1990 produced 18% of Soviet raw cotton, second after Uzbekistan. Food crops (grains, vegetables, melons, and fruits) and fodder were raised on the remaining irrigated lands. The desert zone of Turkmenistan is important for the pasturing of sheep and goats, of which there were 5.5 million head in 1990. Camels are also an important part of both the Kara-Kum and the rural economy, serving as beasts-of-burden as well as sources of meat, milk, and hides (Figure 17.2).

Major Environmental Problems

Turkmenistan faces a variety of environmental/resource management problems. As is the case in the other republics of the former USSR, the largest Turkmen cities, such as Ashgabat (Ashkhabad), Charjew (Chardzhou), Dashhowuz (Tashauz), and Krasnovodsk, as well as smaller settlements where industry, mining, and thermal power plants are located, suffer from water quality deterioration and air pollution. Although there were thousands of point sources of air pollution in the republic in 1988, only 38 percent were equipped with pollution reduction equipment and these often worked poorly (Mnatsakanian, pp. 108-112). Transportation is the chief contributor to air pollution in the larger cities. Charjew was the only Turkmen city listed among the 90 most polluted in the USSR in 1990.

Water pollution from industry and municipal sources was the lowest in the USSR in 1989 (irrigation return flows are not counted in these statistics). For Turkmenistan as a whole, water and air pollution is less serious than in most former Soviet republics because of a low level of industrialization, small number of vehicles, and low population density. However, return irrigation flows containing pesticides, herbicides, mineral fertilizers, and defoliants, particularly from cotton fields, are a serious problem.

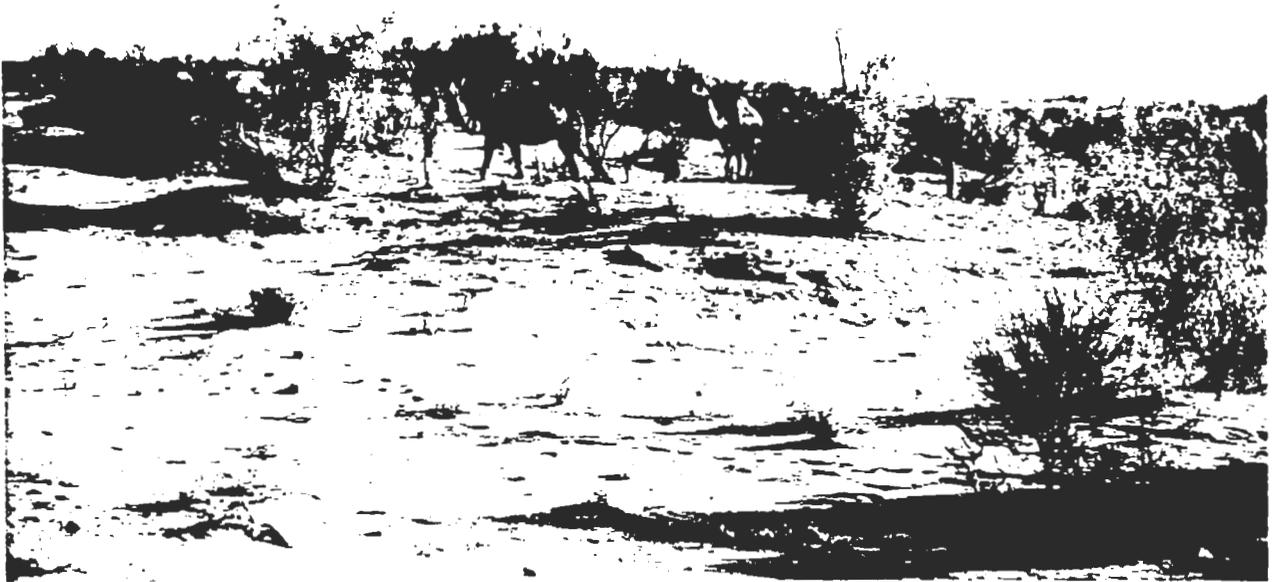


Figure 17.2. Camels, some domesticated and some feral, are a familiar feature of the Kara Kum Desert in Turkmenistan.



Figure 17.3. Entrance to the Repetek Biosphere Reserve near Charjew, one of the former Soviet Union's most important desert research stations.

The chief environmental issues for Turkmenia are to develop a rational management plan for its huge desert regions, to deal effectively with the problems of irrigated agriculture and water management, and to contend with rapid population growth and health problems. Covering 80% of the republic, the Kara-Kum desert has constrained settlement and economic development of Turkmenia to a narrow strip near the base of the moisture-capturing Kopet-Dag mountains in the south, to oases along the Amu Darya on the east, and to several coastal settlements on the Caspian Sea in the west. The accepted wisdom under Soviet rule, which has not changed with independence, is that the desert must be used to further economic development. The problem, of course, is how to do this without severe degradation of the resource and while providing protection for critical desert ecosystems and species.

In 1962, the Desert Institute of the Turkmen Academy of Sciences was established in Ashkhabad to study the desert and develop plans for its utilization, protection, and improvement. Programs have been implemented to study desert soils and water resources in order to formulate a rational plan for their use, to find means of stabilizing sand dunes and protecting structures from them, to develop cropping systems suitable for use in the desert, to find means for improving the quality of desert pastures, and to aid in the study and preservation of critical ecosystems and biota. The Institute operates a system of desert research stations and manages the Repetek International Biosphere Reserve (Figure 17.3). The Desert Institute has extensive international contacts and runs an international training course on desertification for UNEP (United Nations Environment Programme).

The work of the Desert Institute and other organizations has led to the development of ecologically sound methods for more intensive economic use of the Kara Kum. However, such efforts are still mainly limited to the experimental stations and have not received broad dissemination. In spite of an on-going program to combat desertification in the Kara-Kum (defined as the intensification or spreading of desert conditions in arid regions), this process continues (Figure 17.4). This is partially the result of natural occurrences (e.g. climate change), but most results from human influences. The most serious and widespread negative impacts result from overgrazing, which degrades and simplifies vegetation communities, exacerbates erosion, impoverishes the soil, and depletes ground water (through withdrawals for livestock). Earlier this century, widespread cutting of brush and small trees for firewood caused serious damage. In more recent decades, industrial development, particularly for oil and gas extraction, with its accompanying need for new roads and settlements, has caused serious harm.



Figure 17.4. An effort to stabilize the shifting sands of the Kara Kum, and limit the spread of the desert (desertification). Photo by P. P. Micklin.

Laudable efforts have been made in Turkmenia to preserve critical desert ecosystems and their biota, including the creation of several nature reserves, as shown in Figure 17.1. Nevertheless, a variety of plants and animals are under threat. Animal species are in the gravest condition with two apparent extinctions having occurred (e.g., the desert leopard and the scaly woodpecker). Other species threatened with extinction are the Asiatic wild ass (*kulan*), Bukhara deer, desert gazelle (*dzheyran*), desert sparrow, and bustard (Pryde, 1987). A number of other animal species are becoming rare including several lizards (e.g. gray baran), the cobra, a number of predatory birds, some types of jerboa, the Turkestan polecat, the steppe cat, and the honey badger. To help forestall additional extinctions, several other natural preserves known as zakazniki have been created in Turkmenistan (Table 17.1).

Population growth and the related question of human health is a formidable problem for Turkmenistan. The population is small at 3.7 million and the average density is low at 7.6 persons/km² (1990 figures). But being mainly desert, the areas that can support dense human habitation must have access to large fresh water supplies, and are therefore limited to several locations along the Amu Darya, Kara Kum Canal, and places away from these that receive water by pipeline. In light of a limited water supply and the extensive manner in which water is used for irrigation, meeting the needs of a slowly growing population would be difficult. But population is burgeoning here. In 1990, the rate of natural increase was 2.7%, up from 2.6% in 1980, commensurate with the more rapidly growing developing countries of the world. If this rate continues, population would double every 26 years. Fertility is evidently dropping (although slowly) in Turkmenia as in the rest of former Soviet Central Asia, which means an eventual slowing of population growth. Nevertheless, barring some catastrophe, Turkmenistan's population will become much larger in the next century before stabilizing.

In terms of human health, Turkmenistan is in the worst condition of any republic of the former USSR. It ranks at the bottom in two important health measures: infant mortality (in 1990, 45.2 per 1,000; the USSR average was 21.8) and life expectancy (in 1990, 66.4 years; the USSR average was 69.3) (Goskomstat SSSR 1991a, 92,94). It is second lowest in the number of physicians per capita, and second highest in cases of typhoid and brucellosis (Feshbach and Friendly, 1992, p. 280).

The health of mothers and children is particularly poor. This is a result of frequent pregnancies, widespread poverty, malnutrition, poor prenatal care, and in general poor health conditions, particularly in the rural areas where the majority of the population lives. Conditions are particularly bad in Dashhowuz (Tashauz) Oblast where only 23% of the population has running water, infant mortality rates are 75 per 1,000, every third child and fourth mother dies

Table 17.1: Preserved Areas in Turkmenistan

Type of Preserve (a)	Number	Total area(b)	Average size (b)	% of Re-public (c)
Nature Reserves (zapovedniki)	8	11114.16	1389.27	2.28
Zapovedniki that are Biosphere Reserves	1	346.00	346.00	0.07
National Parks	0	0.00		0.00
Natural Preserves (zakazniki)	12	6070.00	505.83	1.24
Total	21	17184.16	818.29	3.52

Zapovedniki (date created)	Hectares
Amu-Dar'ya (1982)	50506
Badkhyz (1941)	87680
Kaplankyr (1979)	570000
Kopetdag (1976)	49793
Krasnovodsk (1968; 1932)	262037
Kugitan (1986)	27100
Repetek (1928)	34600
Syunt-Khasardag (1979)	29700
Total:	1111416

(a) For the definition of each type of preserve, see Appendix 2 to Chapter 1.

(b) In square kilometers.

(c) Area of Turkmenistan equals 488,100 sq. km.

Source: Pryde, 1991.

in labor, and 70% of the population suffers from one or more chronic illnesses (Micklin 1991b). Drinking water here contains 30 times the acceptable levels of pesticides, nitrates, and other pollutants, primarily owing to heavy applications of these chemicals on the region's cotton fields.

Problems of Water Management

The interrelated issues of irrigated agriculture and water management are paramount for Turkmenistan. The republic withdrew 22.6 km³ in 1990 for all uses and irrigation accounted for 77% of this total. Turkmenia has access to around 70 km³ of surface flow and about 2 km³ of replenishable ground water which, at first glance, implies a significant reserve in this resource. But most of this "reserve" is in the Amu Darya whose waters are shared with Tajikistan and Uzbekistan. Both Turkmenistan (via the Kara Kum Canal) and Uzbekistan make huge withdrawals from this river. In truth, the waters of the Amu Darya are already overused, resulting in a variety of adverse environmental consequences, particularly the desiccation of the Aral Sea (see sections on the Aral Sea in chapters 16 and 18). Thus, Turkmenistan's water situation is poor. Increases in diversion from the Amu Darya, the only source from which large new amounts of fresh water might be taken, have been and continue to be opposed by downstream Uzbekistan and Karakalpakistan. Not only may it be impossible for Turkmenistan to increase water withdrawals from the Amu Darya but, conceivably, they may have to reduce them (Micklin 1991a, pp. 42-82).

There are ways for Turkmenistan to cope with this problem. The first priority is to improve delivery efficiency, a measure of the ratio of water arriving at the field to water withdrawn at the source. In 1990 transportation losses in irrigation here were around 7.5 km³, or 43% (Goskomstat SSSR 1991b, 81). Lining the larger earthen irrigation canals (with concrete, clay, or plastic) could cut these losses significantly (perhaps to as low as 10-15%) and save considerable water. However, the savings would not be as great as one might think since gross savings must be corrected for diminished return irrigation flows. Also, the cost of lining the huge length of earthen canals in Turkmenistan would be enormous. Improvements in irrigation efficiency at the field through such measures as better levelling, use of advanced technologies such as drip and subsurface, and more precise application control would also be of great benefit, but, again costly. These measures would also improve yields and diminish the widespread problems of secondary soil salinization and water logging of irrigated lands.

The most controversial water management issue for Turkmenia is the Kara Kum Canal. Begun in 1954, this canal now stretches 1100 km westward from the Amu Darya at Kerki to



Figure 17.5. The Kara Kum Canal near the capital city of Ashgabat, with concrete sides being installed to limit water loss. Photo by P. P. Micklin.

Gazanjyk (Kazandzhik) (Figure 17.5). A pipeline carries drinking water from here to Krasnovodsk on the Caspian. In the mid 1980s, withdrawals into the canal were 10--12 km³/yr, accounting for around 50% of all water withdrawn in the republic (Kirsta 1989). The original intent was to extend the Canal southward from Gazanjyk to the Atrek River with an increase of headworks diversion to 17 km³/yr. Most of the water is used to irrigate some 800,000 hectares, two-thirds of the republic total (Marchenkov 1990). The canal also provides municipal and industrial water for settlements along its route. The canal mainly has been under attack because of its contribution to the desiccation of the Aral Sea, although a water management expert from Turkmenia has pointed out it accounted for only 15% of the water "lost" to the Aral from the 1960s to the mid 1980s (Kirsta, 1989). The canal is unlined along almost all of its course and loses considerable water through infiltration. This has led to the formation of a zone of lakes and wetlands adjacent to the Kara Kum from which huge amounts of water evaporate and transpire. Lining of the canal would go far to reduce water losses but, given its length and cross section, the cost would be immense.

Turkmenistan has two other water-related environmental management problems that need mention. First is the problem of the Garabogazkol (Kara-Bogaz-Gol), a large, very saline gulf off the Caspian in the northwest part of the republic. Formerly, it was connected to the Caspian by a narrow channel and as noted earlier, has been a source of mineral salts. But in 1980, a dam was built across the channel to block flow to the gulf as a means to help stabilize the level of the Caspian (the level of which had been falling for decades, but already was rising again by this time). The gulf went from 10,000 km² to 2,000 km² in two years with adverse effects on the commercial salt industry based upon its brines. The dried bottom also became a source of dust/salt storms that harmed surrounding areas. The gulf would have dried completely, but in the mid-1980s a pipeline was built from the Caspian to partially restore inflow (Shabad, 1985). Since then its area has increased somewhat but still is much less than in 1980.

The second issue is Lake Sarykamysh. This large lake (3,000 km²) has formed from irrigation drainage water since the early 1960s. It is saline (around 12 grams/liter) but, nevertheless has become home for a variety of fishes, many of which used to be endemic to the Aral Sea. It also serves as a haven for migratory birds. The major problems of Sarykamysh are high levels of toxic chemicals contained in the irrigation inflow which have contaminated the fish and birds (thus ending a significant commercial fishery in 1987), and rising salinity. A plan to divert a large share of its inflow to the Aral Sea would likely mean rapid desiccation

and salinization of the lake, as well as possible pollution of the Aral Sea (Micklin 1991a, 57-58; 1991b).

Resource Management and the Future of Turkmenistan

Turkmenistan, like the other former republics, faces an uncertain future. There has been more stability and continuity here since the dissolution of the Soviet Union than in any other republic. Ethnic troubles have been minor and the old Communist regime and management system remains in place, albeit under a nationalist guise. For resource and environmental management, this has meant continuance of "business as usual". The basic resource management agencies (e.g., ministry of water management, ministry of water resources, and the State Committee for Nature Protection [Goskompriroda]) continue their work as before, and with the same leadership. Grass-roots environmentalism exists but has a low profile, and there are no prominent citizen environmental groups. Opposition to governmental positions and policies is still strongly discouraged and suppressed; it would be difficult for an environmental group to arise unless it had clear governmental approval.

Nevertheless, an independent Turkmenistan must forge a new set of resource and environmental management policies and strategies. Continuance of the old ways, appropriate in a situation with strong central management from Moscow, does not have long-term viability. Turkmenistan has signed the CIS agreement on "Interaction in the field of Ecology and Environmental Protection." This commits the republic to be ecologically responsible, cooperate with other CIS republics in environmental matters, and abide by international agreements to which the former Soviet Union (FSU) is a party. The republic is also in the process of developing new trade relations within the FSU.

Natural gas is, by far, its most valuable resource. Natural gas production fell substantially after independence as Turkmenia lost its buyers within the FSU (Sagers 1992). But after contentious negotiations over pricing, it has signed new and more favorable natural gas delivery agreements with Ukraine, Armenia, and Azerbaijan. Turkmenistan is also looking to sell its gas outside the FSU. One proposal on the table is construction of a gas pipeline for delivery of this fuel to Europe through Iran and Turkey. It also has a contract with an Argentine company to further develop its oil fields. There is intent to build a railroad to Iran as part of the development of economic and other relations with its large Muslim neighbor to the south.

Turkmenistan is fortunate to have an abundance of natural gas which can command high prices or favorable terms of trade, not only in the FSU but on the world market. Gas can be

used with the developed Western nations as it was with Ukraine: not only to obtain money but critical technical assistance for development of this and other resources. Hence, Turkmenistan, in spite of its "third world" social and economic conditions, has an advantage over seemingly much better off republics (e.g., the Baltic States) who must rely on agricultural products and market-deficient manufactured goods, which command low prices in international trade, to obtain much needed hard currency and foreign technology. Wisely developed and managed, natural gas could provide the means for Turkmenia to resolve or alleviate its most serious resource and environmental problems. Of course, this requires a commitment by the Government to pursue these goals, which cannot be automatically assumed.

If this effort is undertaken, what are the highest priorities? Slowing population growth and raising living standards is essential. These two efforts are interconnected and could be promoted by a variety of programs aimed at improving educational opportunities and health and medical services, particularly for women. The water issue is also critical. Improvements in irrigation efficiency must be pursued both for economic and environmental reasons. Over the longer term, irrigation of cotton should be reduced with a portion of the freed water relegated to environmental improvement (i.e., left in the Amu Darya) and the balance reserved for appropriate, relatively non-polluting industrial development, food production, and water supply uses. This would be in harmony with existing programs to enhance education and raise living standards.

Reaching agreements with the other states in the basin of the Aral Sea on the management of the shared water resources of the Amu Darya, and a joint approach to the human and environmental problems of the region, are also critical. Two recent actions indicate a start has also been made here. In early 1992, the governments of the Central Asian republics and Kazakhstan entered into discussions to create a "Council of Presidents" to coordinate the management of all resources in the basin of the Aral Sea (Micklin 1992). And in February 1992, the five republics signed an agreement for the joint management and protection of interstate water resources.

If success can be obtained by Turkmenistan in the efforts to reduce population growth rates, improve public health, rationalize water usage, and judiciously develop its natural gas resources, the nation's future could be more promising than its past. There is little to suggest, however, that any of the above goals can be easily accomplished.

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