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Environment Statistics in Central Asia: Progress and Prospects

Robert Ballance and Bishnu D. Pant

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ENVIRONMENT STATISTICS IN CENTRAL ASIA: PROGRESS AND PROSPECTS

Robert Ballance
Bishnu D. Pant

March 2003

Robert Balance is Adjunct Professor of Economics, Indian River Community College, Florida and Bishnu D. Pant is Principal Statistician with the Development Indicators and Policy Research Division, Economics and Research Department, Asian Development Bank. The paper has benefited from the comments of many ADB staff, in particular Ali Azimi, Douglas Brooks, and Tahir Qadri. Views expressed in the paper are those of the authors and do not necessarily reflect that of the institutions they are affiliated with.

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Foreword

The ERD Working Paper Series is a forum for ongoing and recently completed research and policy studies undertaken in the Asian Development Bank or on its behalf. The Series is a quick-disseminating, informal publication meant to stimulate discussion and elicit feedback. Papers published under this Series could subsequently be revised for publication as articles in professional journals or chapters in books.

Contents

Abbreviations

ADB	Asian Development Bank
CES	Compendium of Environment Statistics
DALY	Disability-Adjusted Life Year
DF	Driving Force
DMC	Developing Member Country
ECE	Economic Commission for Europe
EIA	Environmental Impact Assessment
EP	Environmental Pressure
EU	European Union
FDES	Framework for Development of Environment Statistics
IMF	International Monetary Fund
GDP	Gross Domestic Product
MEP	Ministry of Environmental Protection (Kyrgyzstan)
MPC	Maximum Permissible Concentration
OECD	Organization for Economic Cooperation and Development
WHO	World Health Organization

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Abstract

In 2000, the Asian Development Bank (ADB) launched a Regional Technical Assistance (RETA 5860) entitled Institutional Strengthening and Collection of Environment Statistics in Selected Developing Member Countries (DMCs), covering five Central Asian countries namely Kazakhstan, Kyrgyz Republic, Mongolia, Tajikistan, and Uzbekistan. The primary objective of RETA 5860 was to strengthen the system of collection of environment statistics. Among others, the RETA assisted these countries to prepare a Framework for Development of Environment Statistics (FDES) and to publish a Compendium of Environment Statistics (CES). The present paper makes use of the material contained in each country's FDES and CES. Other sources have been used as well, including information obtained during the various workshops and training programs and additional research produced by Asian Development Bank (ADB), Organization for Economic Cooperation and Development (OECD), Economic Commission for Europe (ECE), and other international institutions. The paper is intended to serve several purposes. First, it provides an up-to-date assessment of environmental conditions relating to air and water. Second, major flaws and gaps in the existing national statistical systems are identified and discussed and some tentative priorities for improvement are suggested. Some of the evidence presented in the paper is compelling. Hopefully, these results will serve as a catalyst for national statisticians and environment officials to continue their efforts to improve environment statistics in the region.

I. INTRODUCTION

Efforts to improve environmental conditions in Central Asia[1] must overcome some daunting challenges. First, the present governments of these countries have inherited a unique set of problems from their predecessors. A major concern is the steady deterioration of water reservoirs in the region, especially the Aral Sea Basin. Other prominent issues are the potential dangers posed by radioactivity and deposits of hazardous wastes in certain areas and the threat of desertification. The origin of these problems can be traced back to policy decisions made decades ago, but the need for an effective response is urgent.

Second, countries throughout the region have experienced a depression much deeper and more prolonged than in other transition economies (see Table 1). The depression began in 1990, shortly after the collapse of the Soviet Union. Levels of economic activity continued to fall until the mid-1990s. Growth eventually resumed but the pace of the recovery has been excruciatingly slow. So far, just two of the five countries in this study (Mongolia and Uzbekistan) have regained ground in the past decade. In Tajikistan, the latest estimate of gross domestic product (GDP) is little more than half that recorded ten years ago while in Kyrgyzstan the current figure is less than three quarters of the value in 1991. The duration and depth of this depression, coupled with the need to introduce programs of economic reform and modernization, have severely curbed policymakers' ability to address their environmental problems.

Table 1. **Annual Changes in GDP by Country, 1991-2001[a]**
(1990=100)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Kazakhstan	84.3	76.5	66.9	61.4	61.7	62.7	61.5	63.2	69.4	78.5	84.0
Kyrgyzstan	79.4	67.1	53.8	50.7	54.3	59.7	60.9	63.2	66.3	69.7	72.8
Mongolia	82.1	79.8	81.6	86.8	88.8	92.4	95.7	98.8	99.8	100.9	104.0
Tajikistan	66.0	58.7	46.2	40.4	38.6	39.3	41.3	42.9	46.4	51.1	54.1
Uzbekistan	88.9	87.3	82.5	82.5	84.1	85.7	88.9	93.7	96.8	101.6	103.2

Note: [a] GDP in local currencies at constant prices.
Source: IMF (2002).

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[1] For purposes of this study, Kazakhstan, Kyrgyz Republic, Mongolia, Tajikistan, and Uzbekistan are referred to as the "Central Asian region."

Thus, environment officials in Central Asia are required to deal with a range of problems that are probably more serious than those encountered in most emerging economies. They must find ways to overcome the harsh environmental legacy of the past, and must do in a period of financial stringency, economic uncertainty, and institutional turmoil. The latest data on air and water pollution is summarized in the following pages. The discussion also looks at the statistical systems in the five countries and identifies the more important weaknesses and shortcomings.

II. AIR POLLUTION AND RELATED STATISTICAL ISSUES

The pattern of air pollution in Central Asia differs in certain respects from that in most other emerging economies. The main reason for this distinction is the region's prolonged and deep economic recession. This section begins by reviewing the latest evidence on long-term trends in aerial emissions, including some of the more important spatial characteristics of the problem. Attention then turns to methods of data collection and systems to monitor air quality. The section concludes with an examination of the weaknesses and inherent problems in current systems of air management.

A. Long-term Trends in Aerial Emissions

Recent figures for air emissions from stationary and mobile sources are shown in Table 2.[2] During the 1990s, the volume of emissions fell substantially in Kazakhstan (52 percent) and the Kyrgyz Republic (70 percent). In Tajikistan, emissions from stationary sources dropped by 74 percent during the same period although in Uzbekistan the decline was just 13 percent between 1995 and 2000. The relative importance of the two sources also differs among the countries. In Kazakhstan and Kyrgyzstan, most emissions come from stationary sources while mobile sources are the major polluter in Tajikistan and Uzbekistan.

The overriding determinant of the changes occurring during the 1990s was the economic collapse after the breakup of the Soviet Union. A precipitous drop in industrial activity and associated inputs such as energy was the main reason for the lower levels of emissions. By mid-decade, all economies had stabilized, albeit at much lower levels of output. Since then, GDP levels have been gradually rising (see Table 1) and the volume of air emissions has either fallen very little or increased modestly.

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[2] Although Mongolia reports a fall in air emissions during the 1990s, no data is available at the national level. A set of estimates for Ulaanbaatar has been constructed from information provided in the country's compendiumand can be found in Table A1.

The picture is much the same when the volume of emissions is related to the level of GDP. Both Kazakhstan and Uzbekistan report a fall in emissions per unit of GDP throughout the 1990s. However, annual changes during the last few years of the decade reveal no clear trend. In Kyrgyzstan, the volume of emissions per unit of GDP actually rose during the decade and partial data for Tajikistan suggests that the same occurred in that country.[3]

Table 2. **Air Emissions from Stationary and Mobile Sources, 1990-2000**

	1990	1995	1996	1997	1998	1999	2000	Percent Change[a]
— volume in thousands of tons —								
Kazakhstan	7288	4094	…	…	3383	3409	3527	-51.6
Stationary Sources	4677	3097	…	2969	2328	2309	2429	-48.1
Mobile Sources	2611	997	…	…	1055	1100	1098	-57.9
Kyrgyz Republic	1644	635	…	543	730	493	…	-70.0
Stationary Sources	1198	435	…	359	532	306	…	-74.5
Mobile Sources	446	200	…	184	198	187	…	-58.1
Tajikistan	…	…	…	…	…	111	95	-14.8
Stationary Sources	115	44	30	32	33	35	30	-74.4
Mobile Sources	…	…	…	…	…	76	65	-14.7
Uzbekistan	…	2556	2174	2344	2195	2221	2268	-13.1
Stationary Sources	…	905	858	837	776	777	756	-14.1
Mobile Sources	…	1653	1316	1507	1419	1444	1512	-12.6
— kg per 1000 US dollars of GDP[b] —								
Kazakhstan	319.5	223.6	…	…	139.1	182.4	174.9	-45.3
Stationary Sources	205.0	169.1	…	…	95.7	123.5	120.4	-41.3
Mobile Sources	114.5	54.4	…	…	43.4	58.9	54.4	-52.4
Kyrgyz Republic	129.2	385.6	…	279.4	406.8	358.7	…	177.6
Stationary Sources	94.2	264.1	…	184.7	296.5	222.6	…	136.4
Mobile Sources	35.1	121.4	…	94.7	110.3	136.0	…	288.1
Tajikistan	…	…	…	…	…	93.0	86.6	-6.9
Stationary Sources	12.2	75.4	26.2	25.8	22.4	29.3	27.1	122.9
Mobile Sources	…	…	…	…	…	63.7	59.5	-6.5

continued ...

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[3] In Tajikistan, emissions from stationary sources rose by 123 percent during 1990-2000.

Table 2 (cont'd.)

	1990	1995	1996	1997	1998	1999	2000	Percent Change[a]
Uzbekistan	...	228.0	141.7	144.5	133.2	118.2	150.0	-34.2
Stationary Sources	...	80.7	55.9	51.6	47.1	41.4	50.0	-38.1
Mobile Sources	...	147.5	85.7	92.9	86.1	76.9	100.0	-32.2

Notes: [a] Ending year relative to beginning year.
[b] GDP at current prices.
Sources: Data for air emissions are taken from the Statistical Compendia for each country (RETA 5860) and ECE (2001); data for GDP (1995-2000) are from IMF (2002); GDP data for 1990 are estimated from ECE (2002).

In a typical country, economic growth and related forms of structural change will gradually alter the pattern of pollution. The emissions of some pollutants tend to rise over time while the significance of others diminishes. At the same time, the macroeconomic relationship between the level of economic activity and the volume of emissions should change. Additional investment allows the introduction of new technologies that are not just more efficient but also cleaner than their predecessors. Meanwhile, the share of heavy industry in total output tends to fall as services and new industries spring up. When these types of structural changes are reinforced by an effective program of environmental protection, the links between the level of economic activity and the volume of pollution will (hopefully) become weaker.

How do these stylistic features fit with the evidence for Central Asia? Table 3 shows the volume of various pollutants released into the atmosphere by stationary sources.[4]

Table 3. **Air Emissions from Stationary Sources, by Pollutant and Country, 1990-2000**
(in thousands of tons)

	1990	1995	1996	1997	1998	1999	2000
Kazakhstan							
Total	4700	3097	...	2969	2328	2309	2429
Dust	1500	1,085	...	688	687	...	668
Sulfur Dioxide	1480	1133	...	987	983	...	1080
Nitrogen Oxide	552	233	...	155	160	...	162
Carbon Monoxide	870	446	...	409	360	...	391
Others	298	200	...	197	117	...	128

continued ...

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[4] Unfortunately, none of the five countries are able to provide information on emissions from mobile sources by type of pollutant. In the absence of such information, this question can only be addressed for stationary sources.

Table 3 (cont'd.)

	1990	1995	1996	1997	1998	1999	2000
Kyrgyzstan							
Total	194	55	47	38	41	31	…
Dust	82	25	22	17	19	14	…
Sulfur Dioxide	56	16	140	10	11	8	…
Nitrogen Oxide	12	3	4	4	3	2	…
Carbon Monoxide	30	8	6	5	5	4	…
Others	14	3	1	2	3	3	…
Tajikistan							
Total	115	44	30	32	32	35	30
Dust	35	8	4	6	6	7	6
Sulfur Dioxide	185	3	2	2	2	2	1
Nitrogen Oxide	8	1	1	1	1	-	1
Carbon Monoxide	50	28	22	22	22	25	20
Others	4	5	1	1	1	1	1
Uzbekistan							
Total	…	905	858	837	776	777	756
Dust	…	127	123	113	104	103	115
Sulfur Dioxide	…	400	395	406	359	371	339
Nitrogen Oxide	…	78	72	75	76	72	77
Carbon Monoxide	…	148	108	87	81	69	77
HC + VOC	…	142	148	143	149	156	144
Others	…	10	12	13	7	6	5

Sources: Kazakhstan Agency on Statistics (2001); Kyrgyz Republic National Statistical Committee (2001); State Committee on Statistics of the Republic of Tajikistan (2001); State Department of Statistics (2002); ECE (2000a, 2001).

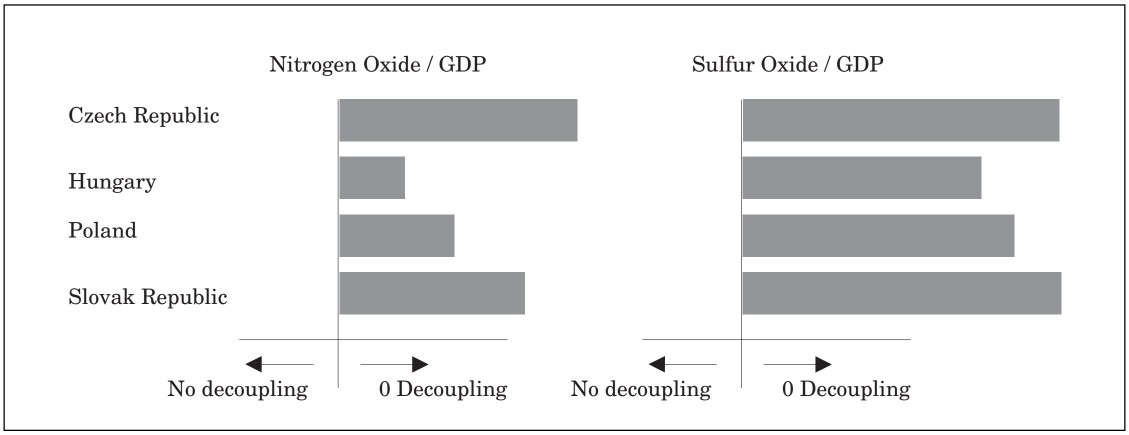
Contrary to expectations, there is no evidence of any systematic change in the relative importance of specific pollutants over time. Sulfur dioxide has consistently been the major source of air pollution in Kazakhstan and Uzbekistan, carbon monoxide generally accounts for the bulk of air emissions in Tajikistan, and dust and sulfur dioxide are the principal sources in Kyrgyzstan.

Table 4 compares short-term changes in pollution levels with the corresponding changes in GDP. The abrupt decline in economic activity during the first half of the 1990s is clearly reflected by a reduction in all pollutants. That result is to be expected since many enterprises were closed and large tracts of industrial capacity were scrapped during this period. But in later years there is no evidence that the historical relationship between positive rates of economic growth and higher volumes of emissions has weakened—despite all the structural changes occurring during the first half of the 1990s. This experience differs from that of several ex-Soviet economies in East and Central Europe. In the latter countries, a "decoupling" between these two variables has been observed in the years since independence (see Box 1).

Box 1. **Evidence of Environmental Decoupling in East Europe**

Decoupling occurs when a particular environmental measure is found to be stable or decreasing while the associated economic force is growing. The OECD has developed a number of indicators to track any changes in the relationship between these two variables over time. For example, at the national level the growth rate for emissions of sulfur dioxide or nitrogen oxides can be compared with the growth rate of GDP. If GDP displays positive growth, "absolute decoupling" is said to occur when the growth rate of the environmental variable is zero or negative, that is, the pressure on the environment is either stable or falling. "Relative decoupling" occurs when the growth of the environmental variable is positive, but less than the growth of GDP. The graph below shows some recent evidence of decoupling for ex-Soviet economies in East Europe. Similar calculations could not be carried out for Central Asian countries for two reasons. First, when the level of economic activity is falling, the indicators do not necessarily imply a positive development for society as a whole. Second, the time period available to measure these trends is too brief and the data too fragmented to produce a reliable set of estimates.

Estimates of Decoupling for Sulfur Oxide and Nitrogen Oxide in Selected Countries, 1990-1998[a]



Note: The measure is defined as 1-(EP/DF) end of period/(EP/DF) start of period where EP=environmental pressure and DF=driving force. Decoupling occurs when the value of the measure is between 0 and 1.
Source: OECD (2002).

Table 4. **Short-term Changes in GDP and Emissions from Stationary Sources, 1990-2000**
(percentage change for the period indicated)

		1995/1990	1996/1995	1997/1996	1998/1997	1999/1998	2000/1999
Kazakhstan	GDP	-38.6	0.5	1.6	-1.9	2.7	12.9
	Total	-34.1	…	…	-5.3	…	5.3[a]
	Dust	-27.7	…	…	-0.1	…	-2.7[a]
	Sulfur Dioxide	-23.5	…	…	-0.4	…	9.8[a]
	Nitrogen Oxide	-57.7	…	…	2.7	…	1.4[a]
	Carbon Monoxide	-48.7	…	…	-11.8	…	8.4[a]
Kyrgyzstan	GDP	-49.3	7.1	10.0	2.1	3.7	5.0
	Total	-71.6	-14.5	-19.1	7.9	-24.4	…
	Dust	-69.5	-12.0	-22.7	11.8	-26.3	…
	Sulfur Dioxide	-71.4	-12.5	-28.6	10.0	-27.3	…
	Nitrogen Oxide	-75.0	33.3	0.0	-25.0	-33.3	
	Carbon Monoxide	-73.3	-25.0	-16.7	0.0	-20.0	…
Tajikistan	GDP	-59.6	-4.4	1.7	5.31	3.7	8.3
	Total	-62.0	-31.3	6.3	1.6	8.0	-14.8
	Dust	-78.6	-40.0	40.0	1.6	12.5	-13.9
	Sulfur Dioxide	-84.0	-32.1	-5.3	0.0	0.0	-22.2
	Nitrogen Oxide	-88.1	-50.0	80.0	-11.1	-77.5	566.7
	Carbon Monoxide	-44.5	-19.1	-2.2	1.8	10.7	-18.5
Uzbekistan	GDP	-17.5	1.9	1.9	3.7	5.4	3.4
	Total	…	-5.2	-2.4	-7.3	0.2	-2.8
	Dust	…	-3.3	-8.1	-8.3	-0.9	11.9
	Sulfur Dioxide	…	-1.2	2.8	-11.5	3.3	-8.8
	Nitrogen Oxide	…	-7.8	4.3	1.3	-5.1	5.7
	Carbon Monoxide	…	-26.9	-19.7	-6.6	-14.4	11.5

Note: [a] Percentage change 2000/1998.
Sources: Data for air emissions from Table 3; data for GDP from IMF (2002).

There are several reasons why trends in Central Asia differ from those in other transition economies. First, many of the industrial enterprises that have managed to continue operations rely on outdated technologies and processing equipment that are poorly maintained. Second, private dwellers and some industrial enterprises (including thermal power stations) have reverted to using solid fuels of local origin with a high caloric value and sulfur content. Third, the air pollution abatement technologies found in many enterprises are either obsolete and inefficient or not used at all. Fourth, when the economies of the region began to recover, idle capacity was simply returned to service without incorporating new technologies or improved systems of abatement. Finally, new investment remains at a very low level throughout the region, and in some countries is nonexistent. The lack of capital denies enterprises access to new technologies that are generally not only more efficient but also cleaner. Instead, capital-starved firms have been forced to introduce cost-saving measures that are second-best and entail substantial environmental costs.

B. Spatial Characteristics

Describing air pollution in Central Asia would not be complete without considering the spatial characteristics of the problem. Specific data for all five countries may be obtained from the authors. In Kazakhstan, emissions have fallen over time but the air quality in the most polluted regions has not improved appreciably. The three provinces (Karagandinskaya, Pavlodarskaya,) and Voctochno-Kazakhstankaya) with the highest pollution levels accounted for 64 percent of the national total in 1990 and 74 percent in 2000.[5]

Recent data on the quality of air in Kazakhstan's major cities is shown in Table 5. Estimates are expressed in terms of the IZA5 index, a measure commonly used during the Soviet era. The index records the exceedences of five representative pollutants, together with their toxicity classes. The air is considered polluted if the index is higher than 5. Nine of the cities in the table report excessive levels of pollution in 2000 and in six cities the index has consistently exceeded the acceptable maximum over the past ten years. In each case a small group of specific industries and firms—typically nonferrous metallurgy plants, coal-fired power plants, producers of building materials, and petroleum refining operations—account for a disproportionate amount of total emissions. In the most polluted cities, the average concentrations of sulfur dioxide, nitrogen oxide, carbon monoxide, and toxic hydrocarbons have been rising each year and regularly exceed the corresponding maximum permissible contaminations (MPCs). More generally, air quality in most of Kazakhstan's cities has improved but high concentrations of many pollutants are still a matter of considerable concern in many locations.

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[5] The volume of pollution in the three provinces fell from 3 million tons in 1990 to 1.8 million tons in 2002.

Table 5. **Air Quality in Kazakhstan's Major Cities, 1990-2000**
(index of air quality)

	1990	1995	1996	1997	1998	1999	2000
Aktau	9.1	7.5	10.3	9.8	5.7	4.3	4.6
Aktobe	7.5	8.6	10.7	12.8	...	...	10.0
Almaty	7.9	12.3	15.3	12.5	9.8	...	9.9
Astana	1.8	2.1	1.3	1.2	1.3	0.6	1.7
Atyrau	2.7	1.0	2.4	1.9	2.5	2.3	2.5
Balkhash	16.8	3.6	2.6	2.3	...	...	3.3
Zhezkazgan	6.7	4.9	6.2	4.4	...	...	7.5
Karaganda	7.5	4.4	2.3	2.5	...	...	4.6
Kostanai	3.2	1.9	3.6	3.9	...	...	2.9
Leninogorsk	17.1	8.1	11.0	9.2	11.2	...	10.0
Pavlodar	2.5	2.1	2.8	1.7	2.3	2.2	2.3
Petropavlovsk	7.3	3.9	5.1	5.0	6.6	4.3	6.8
Semipalatinsk	9.5	6.3	4.9	4.7	...	...	4.0
Taraz	14.7	4.5	6.4	7.2	7.5	8.2	7.8
Temirtau	13.9	5.4	7.6	8.6	...	...	6.9
Uralsk	2.4	2.5	2.2	2.2	...	...	1.4
Ust-Kamenogorsk	21.8	8.6	13.0	14.8	14.4	17.6	17.8
Shymkent	13.9	6.1	7.7	8.6	7.1	8.8	10.0
Ekibastuz	3.6	2.1	1.3	1.2	1.3	0.6	1.7

Source: Kazakhstan Agency on Statistics (2001).

In Kyrgyzstan, levels of air pollution are monitored in five cities, although seven of the country's 16 monitoring stations are in the capital city, Bishkek. Not surprisingly, Bishkek appears to be the most heavily polluted, accounting for 34-37 percent of the country's total pollution by stationary sources throughout the 1990s. When measured in terms of per capita emissions, pollution levels in Bishkek are about 2.5 times the national average. However, the data in Table 6 indicates problems in other cities as well. Data from other studies support this view, showing that average annual concentrations of dust, sulfur dioxide, carbon monoxide, and nitrogen oxide exceeded national standards (MPCs) in several cities during the 1990s (ECE 2001, chapter 7).

Table 6. **Percentage of Samples Exceeding the MPCs for Main Pollutants in Kyrgyzstan, 1996-1997** (as a percentage of total samples)

	Nitrogen Oxide				Carbon Monoxide				Dust			
	Industrial Areas		Residential Area		Industrial Areas		Residential Area		Industrial Areas		Residential Area	
	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997	1996	1997
Bishkek	39	40	26	39	45	40	26	15	29	61	8	7
Kara-Balta	35	24	—	2	…	…	…	…	12	15	…	…
Osh	52	31	37	35	1	—	1	—	—	—	—	—
Tokmok	1	5	—	2	—	…	—	…	—	1	…	…

Source: Kyrgyz Republic National Statistical Committee (2001).

It is reasonable to conclude that air pollution is a serious problem in Kyrgyzstan's cities but a high degree of uncertainty must be assigned to the available statistics. One drawback is the small number of stations in operation and the simplicity of the criteria used to determine their location. Averages are also computed from a very few observations and sometimes combine data from stations located in markedly different environments.[6] Another reason for concern is that the measurements themselves are performed manually according to somewhat antiquated methods that were used in the former Soviet Union. Finally, the national standards maximum allowable concentrations (MACs) are not comparable with international standards set by the World Health Organization (WHO) because different averaging times and statistical expressions are employed.

Less is known about the quality of air in Mongolia. However, a limited amount of information is supplied in the country's CES and this has been used to construct a set of estimates for the capital city, Ulaanbaatar. Approximately 30 percent of the country's population lives in Ulaanbaatar but the volume of air emissions in 2000 was more than 147,000 tons. This figure is roughly equivalent to the reported total for the entire country of Uzbekistan in the same year.

Anecdotal evidence offers several reasons for the poor quality of air. First, Ulaanbaatar's thermal power stations and coal-fired boiler heating stations are equipped with extremely rudimentary pollution control devices. Second, a large majority of the population depends on highly inefficient, coal-using stoves for heating and cooking. A third source of pollution is the transportation sector. The number of automobiles in Mongolia is rising rapidly, although the country's fleet of vehicles is ancient and its highway systems are not designed for the present levels of traffic. Moreover, there is apparently no program for the regulation of emissions and no incentives to upgrade the vehicle fleet.

There is limited information on the spatial distribution of air pollutants in Tajikistan but data reported in the CES show that the bulk of all emissions is concentrated in one region and an overwhelming proportion—more than 76 percent of the countrywide total—occur in just one city, Tursun-Zade. These statistics, however, are presumably estimates and must be treated with great caution.[7] More details reported elsewhere in the CES indicate that MPCs were exceeded in Dushanbe in 1999-2000 for hydrogen sulfide, carbon monoxide, sulfur, formaldehyde, nitrogen dioxide, and ozone. An accurate picture of the spatial distribution in the country is not possible but the bits of data that are available are sufficient to suggest the existence of serious problems in specific locations and/or regions.

In Uzbekistan where air quality was monitored in 39 cities and towns, approximately 40 percent of all emissions from stationary sources occur in the Tashkent oblast and that share has been rising steadily since 1995. The situation is worst near industrial zones where the maximum

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[6] In at least some cases, for example, annual average values have been computed from no more than 225-250 observations taken over the course a year from several stations.

[7] In fact, monitoring activities have been sharply reduced in recent years and are now carried out in only two cities, Dushanbe and Kurgan-Tube.

hourly concentrations of pollutants are reported to significantly exceed national standards. Chemical and metal industries are among the most prolific polluters. These industries have plants located around Almalyk, Chirchik, Samarkand, and Fergana where the highest levels of emissions are reported. About 1,500 of all stationary air pollution sources (3 percent of the total) are not equipped with dust and acid gas controls while existing equipment is reported to be functioning with an efficiency rate not higher than 70 percent.

C. Methods of Data Collection

In general, any national program to assess air quality employs several methods in combination. These may include:

(i) a network of monitoring stations;
(ii) one or more models that can be used for interpolation and prediction; and
(iii) a set of emission inventories developed through estimation (for example, using emission factors), and direct measurement of emissions from large industrial point sources.

The combined use of these tools can yield reliable indications of air quality. Rudimentary versions of each method can be found in Central Asia, but their application and efficacy leaves much to be desired.

The monitoring systems currently in operation around the region are far less robust than they were a decade ago. The data in Table 7 summarizes the main features for each of the five countries included in this study. Kazakhstan and Uzbekistan have the most comprehensive systems but all countries—even those with very meager capabilities—have had to scale back their operations in recent years. Monitoring networks in Kyrgyzstan, Mongolia, and Tajikistan are especially limited. In fact, the combined number of stations currently in operation in these three countries is fewer than in either Kazakhstan or Uzbekistan. Issues such as sampling methods or the criteria used to determine the location of stations are of little consequence when monitoring capabilities are so limited. More importantly, the data being produced in these circumstances are too incomplete and imprecise to be used by policymakers or environmental specialists.

Although the monitoring systems in Kazakhstan and Uzbekistan are the most extensive, the quality of the data is still suspect. In Kazakhstan, the number of sites monitored, types of pollutants, and frequency of sampling have all been scaled back in recent years. In Almaty, only two of 13 stations were actually functioning in 1999 and at present five are in operation. No information is available on the situation in Uzbekistan but other observers have noted that the number of stations is inadequate and that equipment is obsolete. Accordingly, questions have been raised about the quality of the data (ECE 2001, 71-72).

Table 7. **Air Monitoring Systems and Sampling Procedures**

	Present Scope	Recent Changes in Scope and Procedures	Criteria for Location of Sites	Sampling Procedures
Kazakhstan	Monitoring operations are conducted in 51 sites in 19 cities and towns (2000).	The number of monitoring sites and pollutants monitored were both reduced during the 1990s. The number of samples taken during a 24-hour period was also reduced.	Location is determined according to a city's population size and the specific air emission burden. There is one background monitoring station in a rural area.	Generally, four samples are taken per day at each station. Samples are taken 1.5-3.5 meters from the ground at 20-30 minute intervals.
Kyrgyzstan	There are 16 monitoring stations in the country (2000). Stations are located in Bishkek (7), Tokmok (2), Kara-Balta (2), Cholpon-Ata (2), and Osh (3).	There has been a reduction in both the number of pollutants monitored and the number of observations per station.	Stations are located to cover the maximum population, assuming that each station is representative within a radius of 5 km. Location also takes into account various zones (residential, industrial, and near major polluters) in a very basic manner.	All stations monitor sulfur dioxide, carbon monoxide, and nitrogen oxide while other pollutants are measured at three stations. Sampling is done manually according to methods used in the former Soviet Union. The number of observations used to compute annual values is often very small (230-250) and data are combined from stations located in different environments.

continued ...

Table 7 (cont'd.)

	Present Scope	Recent Changes in Scope and Procedures	Criteria for Location of Sites	Sampling Procedures
Mongolia	There are eight monitoring stations in Mongolia, two of which are in Ulaanbaatar (2001).	A plan to create a network of monitoring stations was approved in 1995 but only a few stations are operational. In 2000, the sampling frequency per stations was reduced from three times a day to once a day.	No criteria are given.	Testing is conducted at the country's central laboratory but no description of sampling methods or procedures is provided. Apparently, no aggregation of results across the eight reporting stations is attempted but the result would have little meaning in any case.
Tajikistan	The monitoring system consists of five stations in two cities, Dushanbe and Kurgan-Tube (2000).	In 1990, 21 stations existed in seven cities. The number of pollutants being monitored has been greatly reduced.	There is no information on the criteria for location.	There is no information on sampling procedures.
Uzbekistan	The national system consists of 69 stations located in 39 towns and cities (2001).	There is no information on changes in the scope. Observers note, however, that the equipment in use is obsolete and question the reliability of the data.	No criteria are given.	A total of 22 pollutants are monitored.

Source: Kazakhstan Agency on Statistics (2001); Kyrgyz Republic National Statistical Committee (2001); State Committee on Statistics of the Republic of Tajikistan (2001); State Department of Statistics (2002).

The fragmented nature of the monitoring systems in Central Asia is not the only reason for concern about data quality. Authorities have also been forced to reduce the number of pollutants that are monitored. Frequently, the indexes that are subsequently produced using the reduced set of pollutants are simply presented alongside earlier estimates calculated on the basis of the original set. The result is that the new index typically shows an improvement in conditions but this is a statistical anomaly owing to the reduced coverage.

The inability to maintain an adequate network of monitoring stations is apparent when examining the data on mobile sources of pollution—mainly traffic-related emissions. Traffic, along with energy and heavy industry, is a major source of air pollution in all five countries. There are good reasons to suspect that the volume of traffic emissions has been increasing rapidly (see Box 2). The fact that traffic emissions are highly concentrated in urban areas adds to the severity of the problem. In order to supplement the scanty information gathered by monitoring, statisticians estimate vehicle emissions on the basis of quantities of fuels sold at service stations. A reliable set of results would require detailed information on characteristics such as the vintage of the vehicle fleet, kilometers driven, driving patterns, and other indicators that do not exist.

Box 2. **The Growing Problem of Traffic-related Emissions**

Traffic reportedly accounts for 60-90 percent of air emissions in many Central Asian cities and as much as 90 percent of emissions of lead. Moreover, there is anecdotal evidence suggesting that the volume of traffic-related emissions in urban areas has been rising, even in periods when total emissions have fallen. There are several reasons for the problem. First, the number of passenger cars is growing exponentially. In Mongolia, the number of automobiles rose over 450 percent between 1990 and 2000. A large but unknown increase is also reported in Kyrgyzstan and in Kazakhstan—the country with the largest fleet of passenger cars—where the number rose by 24 percent in 1990-2000. The number of cars per capita is low but has also been growing at a staggering pace. Second, the average age of each country's vehicle fleet is old (considerably more than ten years) and poorly maintained. In Kyrgyzstan, inspections have shown that up to 40 percent of vehicles exceed the standards for toxicity and smoke emissions, while in Kazakhstan spot checks revealed that emissions of about 80 percent of cars are 2-3 times higher than the national standard. Third, existing procedures for inspection and enforcement of standards are haphazard and widely flaunted. For example, the illegal practice of introducing lead additives to commercial petrol is a region-wide problem. It occurs even in Kazakhstan, a country which produces its own petrol, of which as much as 80 percent is lead-free. The illegal use of lead additives is estimated to add as much as one gram of lead per liter of fuel. Finally, the new cars imported into the region usually come with catalytic converters but many are removed after reaching the local market.

In the case of stationary sources, countries generally rely on the enterprises themselves to report emission values. Independent inspections are conducted and pollution limits are determined by law, with fees and fines sometimes levied. However, few countries (if any) have sufficient manpower and expertise to carry out a thorough program of inspections.[8] Statisticians are often forced to resort to a "bottom-up" method of estimation to determine total pollution by stationary sources. Their calculations are based on the annual reports that operators of emission sources are obliged to provide to authorities, and there is a strong likelihood of underestimation.

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[8] In Bishkek, for example, there are only eight inspectors to control 800 point sources, with an average of 40 controls per month (ECE 2000b, 95).

D. Systems of Air Management

There is growing pressure for Central Asian countries to improve their management systems and bring them more closely in line with the guidelines recommended by the WHO. If the economic recovery in the region gains strength, levels of air pollution will inevitably grow and so, too, will the need to modernize and upgrade national standards and emission limits. Statisticians can expect that the demands placed on them will increase significantly over the next decade.

Table 8 summarizes the main features of the air management systems in use today. All countries share several common characteristics. Much of the legal framework is either inherited from the Soviet era or consists of new laws modeled on earlier Soviet legislation and standards. The systems are also decentralized with local authorities playing a key role in enforcing legislation. This arrangement, too, is reminiscent of the Soviet approach when the oblast and city environmental protection departments fulfilled similar tasks. Standards and emission limits are set in terms of the MPCs for each pollutant, with the methods of determining these limits closely following the earlier Soviet techniques. Finally, enterprises are obligated to monitor their own emissions and report the results to regulators. Inspections by state and/or local authorities are another essential part of this reporting procedure. Fines and other penalties can be imposed, though these can vary from one oblast to another.

From this description it is clear that the standards and emission limits employed in the Soviet era, known as GOST, are an integral part of the air management system.[9] The continued reliance on GOST has several drawbacks. These criteria are sometimes less strict than those employed in the European Union (EU) or in the United States and have not been updated since Soviet times. Nor are they comparable with internationally adopted guidelines and generally accepted limits such as those advocated by WHO.[10]

The large number of MPCs that have been officially adopted is another source of problems. In Kazakhstan, about 1500 pollutants are included in the air management system, though it is possible to monitor only a few. Similarly, Uzbekistan's legal framework identifies 457 harmful substances but the statistical coverage is again incomplete.[11] The capabilities of the region's air management systems are easily overwhelmed and there is a need for some rationalization. This would require that a reduced number of pollutants be assigned a high priority and that the means for proper monitoring must be ensured. Modernization of the systems is also urgent. The GOST standards and emissions limits have not been updated and therefore do not reflect the requirements and technologies currently in use in major polluting industries such as transport and energy.

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[9] GOST was the main organization involved in the development and approval of standards in the former Soviet Union.

[10] Comparisons between GOST and the standards adopted by WHO or the EU are complicated because the MPCs used in the Soviet system are not set on an annual basis.

[11] Uzbekistan does carry out a special series of inspections each year, measuring the concentration of air pollutants in 136 settlements around the country. However, only four to 39 different pollutants are measured, depending upon the nearby industrial facilities.

Table 8. **Framework, Standards, and Enforcement Practices in Air Management**[a]

	Legal Framework	Quality Standards and Emission Limits	Inspections and Reporting Practices
Kazakhstan	The legal system is inherited from the Soviet era. It relies on Soviet standards (GOST) to regulate fuel quality, vehicle emissions, methods of determining the MPC of different pollutants, the use of dispersion modeling and steps in the EIA procedure.	MPCs exist for about 1500 substances. These are specified for 20-minute and daily averages, but no yearly averages have been set. Data is collected for few of these 1500 pollutants, however.	Enterprises must monitor their own emissions using both emission measurements and mass balance calculations. Authorities conduct inspections of enterprises at least once a year and may make their own measurements. Vehicles are inspected annually.
Kyrgyzstan	A national law on management of air quality was approved in 1999 but is based on an old Soviet law from 1981. The present law does not fix standards or limit emission values. Local authorities can adopt their own measures to deal with specific pollutants.	Standards (MPCs) and emission limits are set on the basis of a simplified model that was also applied in the former Soviet Union. MPCs for vehicles take into account their type and age.	Enterprises monitor their own emissions and provide these results to the authorities annually. The calculations generally use emission factors based on energy and material inputs.
Uzbekistan	A national law was adopted in 1996 but the regulations for its implementation were developed in the Soviet era. The law requires an EIA and a health assessment to be carried out in industrial zones and areas with dense traffic.	MPCs were developed in the early 1990s. They refer to 457 harmful substances and specify limits for short term (20-30 minutes), daily, monthly, and yearly concentration. Standards for all mobile sources are based on GOST.	Enterprises are obliged to report air emissions to national authorities.

Note: [a] Information for Mongolia and Tajikistan is incomplete, though both countries apparently rely upon GOST to determine MPCs and emission limits.

Sources: Kazakhstan Agency on Statistics (2001); Kyrgyz Republic National Statistical Committee (2001); State Committee on Statistics of the Republic of Tajikistan (2001); State Department of Statistics (2002); ECE (2000a, 2000b, and 2001).

Improvements in the existing systems could also require authorities to overhaul their procedures for regulation and control of emissions. Other approaches could reduce the inspection burden (which is substantial) and prove to be a more effective means of ensuring that the best available technologies will be adopted (see Box 3). Yet another weakness of the current system of emission control is that firms may comply with the required MPC in ways that do not yield an actual reduction in emissions—for example, by simply raising the smokestack or negotiating an extension to the diameter of the protective sanitary zone. Finally, many firms lack the equipment to monitor their own emissions and their use of air-source sampling is rare. The rough estimates they make when reporting to authorities (often using emission factors based on energy and material inputs) raise many doubts about accuracy and place a greater burden on statisticians.

Box 3. **Setting Emission Limits in Kazakhstan**

Emission limits for each stationary source are determined according to methods inherited from the Soviet era. The procedure relies mainly on inspections. Limits are set on a case-by-case basis according to MPCs and dispersion models that were also adapted from the Soviet period. One drawback is that MPCs exist for about 1,500 substances. Some are more stringent than WHO guidelines but enforcement can be lax, even if the limits are exceeded for long periods of time. Moreover, only few of the 1,500 pollutants are actually monitored. Another weakness is that the procedure can be very time-consuming, requiring that local authorities evaluate the technical properties of each individual enterprise. Finally, emission permits must be issued every year and fees vary from one oblast to another.

In contrast, most western countries determine emission limits on the basis of the technology in use. This approach encourages use of the best available technologies, which are generally cleaner as well as more efficient than alternatives. Uniform emission fees are generally set for the whole country, although local authorities usually have the option of reducing fees if the firm is willing to invest in cleaner technologies or abatement techniques. Finally, the western approach provides a transparent set of conditions for potential investors.

The development of completely satisfactory systems of air management may still be some years off but at least some steps to modernize and rationalize existing systems are needed now. Even this intermediate move will have significant repercussions for environment statisticians, involving numerous improvements in monitoring practices, estimation methods, and other procedures.

III. WATER RESOURCES AND INFORMATION SYSTEMS

Concerns about the quality and availability of water have a long history in Central Asia. Both problems are man-made to a large extent. During the Soviet era, many heavy industries were established in the region. This subsector eventually became as large as that in many industrialized countries, but without the equivalent environmental safeguards and controls. As a result, large amounts of hazardous material were released into the environment, leaving groundwater and major rivers heavily polluted. Water shortages can be attributed in part to the ambitious schemes for development of the agricultural sector. This section examines latest data on water quantity and quality; the monitoring networks and statistical systems that support water management in the region; and issues on water supply that are at the heart of transborder disputes.

A. Water Supply

An idea of how water resources are distributed around the region is found in Table 9. The percentage of the population with access to improved water sources is greater than in most other developing countries (with the exception of Tajikistan). Mongolia has the largest per capita resources but this figure is misleading since 95 percent of all surface water flows out of the country. At the other end of the spectrum is Uzbekistan with freshwater resources that are only 5-7 percent of those in neighboring countries. Uzbekistan's water shortages are underlined by the fact that withdrawals are several times greater than its total water resources.[12] Finally, the pivotal role of irrigation is apparent in the data for agricultural withdrawals. This use accounts for a disproportionate share of all freshwater withdrawals in all countries except Mongolia.

Table 9. **Water Supply and Uses by Country, 2000**

	Access to Improved Water Sources			Freshwater Resources per Capita (in m^3)	Total Freshwater Withdrawals (percent of total water resources)	Agricultural Withdrawal (percent of total freshwater withdrawal)
	Total Population (percent)	Urban Population (percent)	Rural Population (percent)			
Kazakhstan	91	98	82	7342	30.7	81
Kyrgyzstan	77	98	66	9559	21.7	94
Mongolia	60	77	30	14632	1.2	53
Tajikistan	53[a]	90[a]	20[a]	12763	14.9	92
Uzbekistan	85	96	78	668	356.1	94

Note: [a] 1994.
Source: Kazakhstan Agency on Statistics (2001); Kyrgyz Republic National Statistical Committee (2001); State Committee on Statistics of the Republic of Tajikistan (2001); State Department of Statistics (2002).

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[12] The low figure for Mongolia (1.2 percent) is again misleading since such a large portion of all freshwater resources flow out of the country.

More details with regard to the water systems of each country are found in Table 10. First, the distribution of water resources within each country is highly uneven with some areas subject to severe water constraints. Second, the effects of shortages are compounded by the poor quality of water in some parts of each country. Water quality in these areas is generally unsuitable for human consumption or irrigation (see Box 4). Third, because surface water is the primary source of supply, each country's network of rivers plays a critical role. The transborder character of all water systems means that existing agreements on water allocation are a critical determinant of supplies.

Table 10. **Main Features of Water Systems in Recent Years**

	Distribution	Volume of Water Resources	River Systems
Kazakhstan	Resources are unevenly distributed with an excess of water in the north and northeast and a shortage in the southwest and center of the country.	Total water resources are about 450 km^3 per year, of which 250 km^3 are freshwater sources (rivers, lakes, glaciers).	The potential use of river water is 100 km^3 per year. In the years with minimum flows, the potential use is 58 km^3.[a]
Kyrgyzstan	Most of the country has a positive water inflow but for about 15 percent of the territory there is a negative balance with water lost due to recharging underground aquifers, irrigation, and evaporation. In the south, transborder quotas are too small to allow for irrigation of around 1.6 million km^2 of arable land.	The country has ample reserves of surface water and groundwater. The annual drain of surface waters is roughly 44 billion m^3 per year. In the early 1990s, groundwater resources available for abstraction were about 3.4 billion m^3/year. That total has probably decreased, because some pumping systems have been abandoned and maintenance is poor.	The country's six river systems account for almost half of total water volume. There are nearly 2000 lakes but their total storage capacity is just 10 percentof total runoff, meaning that they play only a role in regulating the water flow.
Mongolia	Mongolia's average renewable water resources of the country are plentiful but the water amount per unit area of land is very low. The northern part of the country has sufficient resources, but the steppe and Gobi regions, which together represent	Estimated total water resources in the country are 39 km^3 and the annual potential water resources is 35 km^3 including about 18 percent groundwater resources. However, much of this water flows out of the country.	Mongolia has approximately 3,800 streams and rivers; 3,500 lakes; and 187 glacial rivers. The three major watersheds of the country drain to the Arctic, Pacific, and Central Asian closed basin. Water levels in many lakes are dropping and river flows are highly variable.

continued ...

Table 10 (cont'd.)

	Distribution	Volume of Water Resources	River Systems
	70 percent of the country's total area, face water scarcity or water unsuitable for irrigation and human consumption.		
Tajikistan	The availability of adequate water supplies varies widely within the country with some regions reporting severe deficits. Water quality is a serious problem is some areas.	Potential underground water reserves are estimated to be 19 km^3 per year but "operational" reserves are only 2.8 km^3 per year. The availability of surface water is uncertain owing to a 10-fold increase in irrigation needs in some areas and the excessive pollution of several rivers.	There are 11 river systems and several reservoirs and lakes. Apparently, there is no complete inventory of water systems.
Uzbekistan	There are severe water shortages in the western part of the country owing to irregular distribution of groundwater supplies. At present, more than 30 percent of the population drinks and otherwise uses water that does not meet national and international quality standards.	The total amount of water available for abstraction is currently 49 billion m^3 per year (including transborder allocations). Only about 5 percent of this comes from groundwater.	A total of 12 river systems exist in 2 basins. Most surface waters are located within the Aral Sea basin, an area that includes the largest rivers.

Note: [a] The minimum flow is assumed to be available 95 percent of the time.
Sources: Kazakhstan Agency on Statistics (2001); Kyrgyz Republic National Statistical Committee (2001); State Committee on Statistics of the Republic of Tajikistan (2001); State Department of Statistics (2002); ECE 2000a, 2000b, and 2001; and World Bank 1999, 2000.

B. Water Quality

Data on water quality is generally inferior to that referring to water supplies. The main reason for this disparity is that water shortages are immediately recognizable and tend to receive high priority in any statistical program. Problems of water quality are not so readily apparent and generally receive less emphasis. The consequences of this distinction are probably accentuated by other statistical shortcomings discussed later in this section. Thus, any assessment of water quality in Central Asia must necessarily be tentative and less than complete.

Box 4. **Water Quality and Quantity in Specific Provinces and Communities**

The availability of drinking water is an especially serious issue in Mongolia. Supplies are limited even in Ulaanbaatar and other urban centers but the problem is most acute for the ger community, which receives only about 10 liters per day/person. This amount is far below the suggested requirements for refugee camps (16 liters per day/person). In Kyrgyzstan, nearly 600 villages with more than 700,000 inhabitants 22 percent of the rural population—have no access to piped water. Over half these villages are in the Osh region where there are no shallow underground water sources. As a result, these communities rely on untreated surface water, including that from irrigation canals. Tests of tap water conducted in Kazakhstan in 1999 showed that in one province (East Kazakhstan) 47 percent of samples exceeded microbiological standards. In three other provinces, 20-26 percent of all samples did not meet chemical standards. A similar round of tests was conducted in Uzbekistan in 2000. Microbiological standards were breached on average by 10-14 percent of all samples in most provinces, and in one month 69 percent of the samples for one province were unsatisfactory. In the same series of tests, chemical quality standards were breached by 70 percent of the samples in the Uzbek province of Karakalpakstan. More generally, over 30 percent of the population drink and use water that does not meet national and international quality standards.

Some of the available evidence is found in Table 11. Based on this information, problems of water quality appear to be most severe in Uzbekistan and least serious in Kyrgyzstan. In general, Central Asia's problems of water quality are perhaps more acute than those faced in most other developing countries outside Africa.

A more general assessment is given in the second column of Table 11. Water quality varies significantly within each country. Not surprisingly, problems are most serious for consumers in small towns and rural areas. The quality of water in urban areas (especially the largest cities) is somewhat better. Groundwater is heavily polluted in some countries and several large rivers in the region are known to be extremely polluted.

During the 1990s, the incidence of water-related diseases was also increasing in most countries. Such a trend is an ominous one, suggesting that water quality may actually be deteriorating over time.

At least one important reason for the poor quality of water is indicated in the third column of Table 11. The water treatment plants currently in operation throughout the region are obsolete and poorly maintained. In fact, many do not function and others can no longer meet national standards. In some of the worse cases, countries report that no more than a third of all existing treatment plants are capable of operating on a regular basis and that funds for maintenance have not been provided for more than ten years.

The broader consequences of a long-term deterioration in water quality should not be underestimated. Figure 1 shows disability-adjusted life years (DALYs) due to air pollution and water and sanitation in several countries. Central Asian countries especially Tajikistan, Turkmenistan, and Uzbekistan pay a very heavy price owing to a lack of clean drinking water and urban sanitation. Within the region, the health burden inflicted by water-related problems is probably greater than that attributed to air pollution.

C. Monitoring Operations and Statistical Systems

The statistical systems in each country are remarkably elaborate, and to simplify the discussion, three crucial characteristics are singled out for attention here. They include:

(i) division of statistical responsibilities among various institutions,
(ii) extent of monitoring operations, and
(iii) related statistical procedures.

Table 11. **Water Quality and Water Treatment Systems**

	Indicators of Water Quality	General Assessment of Water Quality	Water Treatment Systems
Kazakhstan	At the national level, 10 percent of all tap-water samples did not meet chemical standards in 1999. Failure rates were much higher in some oblasts, ranging between 17 and 27 percent. Microbiological standards were exceeded in 5.6 percent of the samples at the national level.	Water resources are heavily polluted throughout the country. The Nura River is extremely polluted, with approximately 50 tons of mercury in its sediments in one section below Temirtau. Groundwater is also polluted with oil, heavy metals, fluorine, pesticides, radioactive contamination and other toxic substances. It does not meet national standards for drinking water in most populated areas.	The degradation of technology and of waste-water treatment plants puts increasing pressure on the country's water systems. In major cities, approximately 70 percent of buildings are connected to a central sewage system, but elsewhere sewage systems are rare. In these areas, sewage is stored in reservoirs, which are sometimes located very close to drinking-water wells without a proper protection zone. Water supply pipes and sewers are often in close proximity and leakage of both is common due to poor maintenance.

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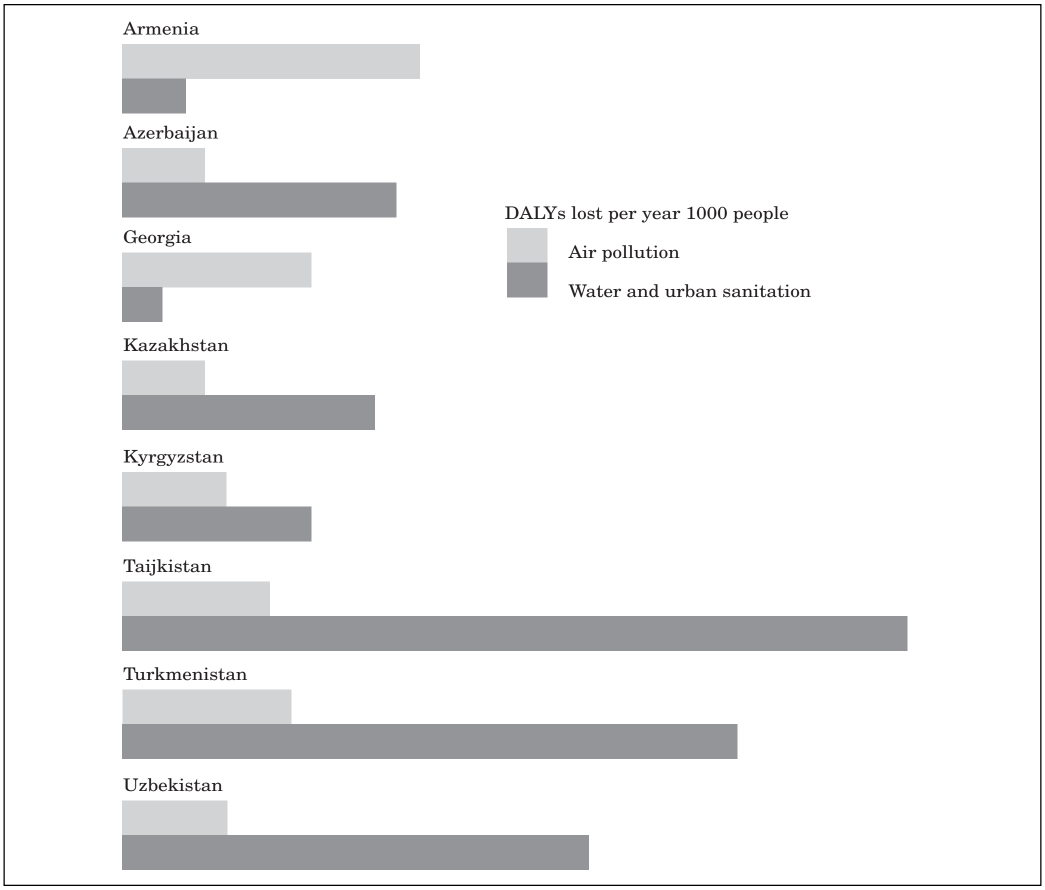
Table 11 (cont'd.)

	Indicators of Water Quality	General Assessment of Water Quality	Water Treatment Systems
Kyrgyzstan	Because monitoring operations are extremely limited and increasingly unreliable, a clear picture of water quality does not exist. Most water bodies are thought to suffer only low levels of pollution, but there are exceptions. In certain instances contamination is several hundred times greater than the MPC.	About 90 percent of all drinking water comes from underground sources. In urban areas, the quality is reported to be reasonably good. Some towns and rural areas rely on surface water and the quality is uneven. In addition, several hundred villages depend on wells that have no disinfecting equipment.	Less than 30 percent of all waste water is treated by mechanical, biological or physico-chemical processes. In 1999, the country had 350 wastewater treatment units but 40 percent did not operate at all. Another 30 percent failed to meet government standards, mainly because they had received no funds for maintenance or repair since 1991.
Mongolia	The water monitoring system is limited but only a few rivers are classified as "dirty." The dirtiest rivers, however, are some of the largest in the country and the MPCs for some materials are exceeded by 2-8 times.	The occurrence of water-borne diseases is on the rise, suggesting that water quality is deteriorating.	In 1997, the country had 121 wastewater treatment plants but only 45 operated on a regular basis. Others did not function or were unable to comply with national standards. The number of plants that operate regularly declined during the 1990s.
Tajikistan	No information is provided on this topic.	In 2000, 41 percent of the population depended on water from rivers, canals, and irrigation ditches. The incidence of water-related diseases (e.g., malaria, acute intestinal infection, and bacterial dysentery) rose dramatically in the 1990s.	The efficiency of the treatment plants still in operation is reported to be only 30-40 percent. The country's 106 sewage systems are also in dire condition. In 2000, more than 2,700 breakdowns in sewage systems were reported.
Uzbekistan	Most waterways are reported to be moderately or considerably polluted. Presently, 40 percent of all fresh groundwater is unsuitable for drinking and the proportion is rising.	The quality of water is often unsatisfactory. More than one-third of the population uses drinking water that does not meet national standards.	Many cities have installations that only partially treat sewage. The efficiency of installations is about 50 percent for both municipal and industrial waste-water treatment because of obsolete equipment and technology

Sources: Kazakhstan Agency on Statistics (2001); Kyrgyz Republic National Statistical Committee (2001); State Committee on Statistics of the Republic of Tajikistan (2001); State Department of Statistics (2002); ECE (2000a, 2000b, and 2001); World Bank (1999).

A rough idea of the division of labor among the national institutions that are responsible for water resources can be obtained from Table A2. The table indicates which institutions regulate and monitor water resources and provides a brief description of their tasks.[13] The network of institutional links in each country is surprisingly complex, particularly in view of the rather modest scope of each program. Such an intricate (and somewhat unrealistic) division of labor creates organizational problems for statisticians. For example, it becomes very difficult to agree on a statistical strategy that will meet users' needs and government priorities. Moreover, even if such a strategy could be agreed, it would probably not be possible to organize the data in a way that would yield a satisfactory information system. The existing responsibilities for water statistics and information systems are simply too widely dispersed among ministries and their functions overlap (see Box 5).

Figure 1. **Mortality and Illness from Environmental Causes**



Source: OECD (1999, chapter 2).

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[13] The table refers only to Kazakhstan, Kyrgyzstan, and Uzbekistan. Insufficient information was available to draw up a similar list of institutions in Mongolia or Tajikistan.

The lack of any clear-cut statistical plan may simply reflect the fact that policymakers have yet to devise an overall strategy for dealing with water resources and have not clearly specified their own priorities. But in any case, the absence of a more coherent approach is hard to justify in a period of financial stringency when there is an urgent need to reduce duplication and bolster efficiency.

Box 5. **Water Monitoring Systems in Kyrgyzstan**

Responsibilities for monitoring are spread across a number of institutions. Kyrgyzstan's State Agency for Meteorology (Hydromet) in the Ministry of Environmental Protection (MEP) monitors the quantity and quality surface water. In 1991, Hydromet operated a nationwide network of about 180 stations and relied on two laboratories to test samples using traditional wet chemistry. Today, it monitors only on the Chu River and conducts occasional tests of Lake Issyk-Kul following an accidental discharge of cyanides in 1998. The State Committee for Geology and Mineral Resources, also in the MEP, monitors groundwater quality and quantity but its activities have been scaled back since 1995 (see Table 10). The Ministry of Health monitors the quality of drinking water. The Environmental Monitoring Department of the MEP monitors the purification performances of municipal waste-water treatment plants and major industrial enterprises. The Department has an office and laboratory in each oblast. Its inspectors are responsible for enforcing 1,200 water standards, although the laboratories can test for only 20. The data accumulated by the Department is neither processed nor transmitted to others, being used only for inspection purposes. The Ministry of Agriculture and Water Resources monitors the quantity and quality of groundwater and surface water in irrigated areas; it tracks the release of pesticides, fertilizers, and minerals; and is responsible for a number of trans-border issues. Licenses for water abstraction are issued by the Ministry of Agriculture and Water Resources, while the MEP grants permits for water discharges and collects fines and fees for these discharges. In 1998, a compulsory reporting system for all water users and dischargers (public and private) was introduced. Emitters must conduct their own monitoring operations within 500 meters of the point of discharge. The results of self-monitoring are to be checked regularly by the central inspection laboratory of the MEP, but that procedure has been interrupted owing to a lack of funds.

There is no evidence that these overlapping responsibilities are a source of major problems, but a simpler organization would probably produce more efficient results in this period of financial stringency. The present division of labor also makes it very difficult to implement an integrated strategy for water monitoring or to construct an information system for water resources that would be demand-driven and adequately reflect the government's priorities.

Table 12 describes the monitoring networks in four of the five countries and notes several statistical deficiencies. Monitoring activities were drastically scaled back during the first half of the 1990s and there is no evidence that the downward trend has been reversed in recent years. Much of the equipment in use today is obsolete and poorly maintained, and a number of laboratories have either been closed or no longer have the ability to conduct the required analysis. At the same time, the scope of data collection has been reduced. Drinking water and large portions of national water systems are no longer monitored in some areas, groundwater is rarely monitored (even though the use of these supplies is growing), and the frequency of sampling has been curtailed.

The ability of governments to enforce regulations has also been seriously diminished. Most countries require emitters to monitor their own discharges. However, the number of inspections performed by the government has declined and some laboratories can no longer evaluate the results collected by enterprises. Meanwhile, the equipment and procedures used to monitor self emissions is just as antiquated as that used by government agencies.

Problems are no less acute when attention turns to methods and statistical procedures. For example, the data collected is seldom dispersed to other government bodies or even processed by the collector. The use of MPCs and dispersion models introduced during the Soviet era is still common practice, but these tools are not appropriate today. Collection procedures have also become haphazard, jeopardizing the spatial and temporal comparability of results, even between different regions in the same country.

Not surprisingly, current programs are riddled with data gaps. Quality is not monitored in some cities where a large portion of the population depends on untreated drinking water. Most of the data being collected apparently refers to point sources of pollution while little information exists on pollution from diffuse sources. Only a limited amount of data is compiled on waste-water discharges (either by emitters or the government) and concerns about the accuracy and reliability of the available statistics apply to all countries.

In general, none of the five countries have a statistical program that can support the work of policy makers or allow for the systematic analysis of water resources. An overall strategy for water statistics in each country is clearly needed, including the creation of information systems that will integrate all the disparate parts. This step, however, will not be effective unless it is accompanied by a series of other improvements, many of them at local and provincial level. The spatial coverage of monitoring operations is too limited and must be expanded, although the number of topics and indicators that are considered could be reduced in some instances. The quality of the data to be processed is also insufficient and improvements in statistical methods will be essential.

D. Transborder Issues

Several thousand rivers run through two or more of the five countries included in this study. With such an intricate system, disagreements can be expected in times of scarcity, but the existing schemes of water allocation are a source of additional disputes. These agreements—which were drawn up in Soviet times—are not compatible with today's political and economic realities. During the Soviet period, intensive, large-scale farming operations were launched. They are supported by an extensive system of water infrastructure, including extensive irrigation facilities and a series of reservoirs and dams. Today, the water needs of agriculture account for 80-95 percent annual freshwater withdrawals in all countries but Mongolia (see Table 9). Little water remains to meet the requirements of emerging industries, to satisfy the demands of a population that is increasingly concerned with matters of health and sanitation, or to generate hydroelectric power.

Table 12. **An Evaluation of Water Monitoring Systems and Related Statistical Issues**

	Extent of Monitoring Operations	Methodological Weaknesses	Data Gaps
Kazakhstan	The measurement of surface-water pollution depends mainly on self-monitoring by water users. The government also takes occasional samples but the number of monitoring stations at its disposal has declined from 212 in 1990 to 96 in 2000.	Monitoring data (including that supplied by self-polluters) is used only to determine and evaluate point sources of pollution. It is not used systematically for analysis or planning and is not employed in connection with public supply systems. Permits for the discharge of pollutants are required for each point source. Determination of the dischargeable amounts is a function of the MPC. The enterprise's MEP is also derived from the MPC through the application of standardized distribution models. Both the MPCs and the models currently in use are based on old Soviet standards.[a] The country's water pollution index also makes use of MPCs. The lack of a more current set of benchmarks raises questions about the results.	The quality of drinking water is very poor in the coastal areas of the Caspian Sea. More than 500,000 people live in this region but there are no monitoring systems in the major cities. Almost 40 percent of the population in these areas uses untreated drinking water and there is a high risk of microbiological contamination.

continued ...

Table 12 (cont'd.)

	Extent of Monitoring Operations	Methodological Weaknesses	Data Gaps
Kyrgyzstan	In 1991, a network of about 180 stations was used to monitor the quality of surface water in rivers, lakes, and reservoirs. Capacity has been steadily reduced so that by 1999 monitoring was regularly conducted only on the Chu River. The quality and quantity of groundwater is monitored with a network of 800 observation points. Only 75 percent of these points were in operation in 1995 owing to a lack of funds and the number has fallen further since then. The performance of municipal waste-water treatment plants and large industrial enterprises is monitored. However, the laboratories that analyze these samples are able to verify just 20 of the country's 1,200 water standards. Emitters monitor their own discharges. The results are meant to be checked by a central inspection laboratory but this procedure has been interrupted owing to a lack of funds.	Little (if any) of the data obtained through monitoring is processed after collection. Apparently, none of this data is transmitted or exchanged between the institutions responsible for monitoring. Nor is the data used as a tool for decision-making purposes.	No data is collected on the pollution discharges of agriculture, neither from point sources (e.g., cattle breeding) nor from diffuse sources such as fertilizers and pesticides. There is very little information on waste-water discharges.
Mongolia	A network of 140 stations is apparently used to monitor the quality of surface water but no similar system exists to monitor groundwater.	The data obtained from monitoring does not appear to be processed or aggregated beyond the level of individual monitoring stations.	The limited amount of information that exists is insufficient to serve as a basis for assessing or tracking changes in water quality or quantity.

continued ...

Table 12 (cont'd.)

	Extent of Monitoring Operations	Methodological Weaknesses	Data Gaps
	Polluters are required to monitor their own discharges, although a lack of equipment and training renders the results of limited value.		
Uzbekistan	The national monitoring system provides information on trends in water quality and quantity in two river basins (the Amu-Darya and Syr-Darya) and their tributaries. Many stations, however, do not supply data on a regular basis and others are simply not operated. The equipment is obsolete and poorly maintained and there are no automatic monitoring devices to check quality 24 hours a day. The quality of drinking water is monitoring by both the government and vodocanal services. Many stations and laboratories are not equipped with modern analytical devices and cannot analyze microbiological components.	The results of monitoring activities do little to resolve many trans-border issues. Differences in monitoring activities in all the riparian countries—not only in Uzbekistan but also in Kazakhstan, Kyrgyzstan, and Tajikistan—differ markedly in terms of methodologies and equipment used. These discrepancies cast doubt on the reliability of the data and their comparisons. The country has no specific water quality standards for collector water and drainage water from irrigated land. However, this type of water is estimated to account for more than 75 percent of all discharged waste water. National standards do not agree with those adopted by the EU or WHO and some water-quality standards are less strict than those recommended by WHO. Many published estimates are simply arithmetic averages.	Published data does not include information on the quality of water taken from natural watercourses or on pollutants discharged into natural watercourses and reservoirs during different seasons of the year. Much of the data obtained through monitoring cannot be regarded as reliable.

Note: [a] The approaches employed by the other countries in this table are similar, though the descriptions of methods are less complete.

Sources: Kazakhstan Agency on Statistics (2001); Kyrgyz Republic National Statistical Committee (2001); State Committee on Statistics of the Republic of Tajikistan (2001); State Department of Statistics (2002); ECE (2000a, 2000b, and 2001); World Bank (2000).

The present debate centers on the Aral Sea Basin, an area of approximately 1.5 million square kilometers. The major tributaries are the Syr Darya and the Amu Darya rivers, which begin in Kyrgyzstan and Afghanistan respectively. The agreement on water sharing in the Basin pits the countries that are upstream (Kyrgyzstan and Tajikistan) against those located downstream (Kazakhstan, Turkmenistan, and Uzbekistan).[14] The upstream countries are poor in energy resources and wish to use their water for hydroelectricity generation when heating needs are greatest. As a result, the two countries prefer to release water through their dams in the winter. In contrast, the downstream countries require huge amounts of water for irrigation during the vegetation period in the summer.

Another contentious issue is the quality of water once it reaches the downstream countries. In the mountainous areas upstream, the water is virtually free from pollution. But in the middle and lower reaches of the Aral Basin, both the Amu-Darya and the Syr-Darya are heavily polluted, breaching MACs for hardness, sulfates, chlorides, phenol, and silicon. The rivers are also heavily mineralized in this stretch, with a salt content ranging from 1-2 grams per liter. A third source of dispute is that the water agreements assign responsibility for maintaining the reservoirs and dams to the country where these facilities are located. The upstream countries (mainly Kyrgyzstan) bear almost all this financial burden and argue that the agreements do not provide fair compensation from the water users located downstream.

Finally, the plight of the Aral Sea and the surrounding coastal areas can be largely attributed to the ambitious schemes for irrigation and farming that were introduced after 1960, along with the supporting transborder agreements for water allocation. The ECE describes the Aral Sea crisis as “one of the biggest environmental and human catastrophes in recorded history”, affecting about 35 million people living in the Basin (see ECE 2001, chapter 4). In order to produce cash crops such as cotton and rice, massive irrigation systems were constructed. Since 1960, the total irrigated area in the Aral Sea Basin has increased from 3 million to 8 million hectares and the use of mineral fertilizers has risen between three fold 3 and six fold. Meanwhile, a series of canals and dams was built which greatly reduce the two rivers’ discharges into the Aral Sea. Before 1960, average annual discharges varied between 50 to 60 km^3. The volume of discharges fell to 20-30 km^3 a year during 1960-1980 and averaged only 5 km^3 water per year in the 1990s. There have also been years in which practically no water has reached the Aral Sea.

The severity of problems involving both the quantity and quality of water in the Aral Sea Basin cannot be overemphasized. Disagreements between the neighboring countries have become more frequent and acrimonious since the break-up of the Soviet Union. Numerous regional agreements on transboundary watercourses are in place, but their focus is on the quantity of water available and the amounts allocated to each country. Much less effort has been devoted to the

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[14] Turkmenistan is supplied with water from the two rivers by the Kara Kum Canal. The Canal is 1,200 kilometers long and delivers 10 cubic kilometres of fresh water each year.

negotiation of agreements on the water quality of shared watercourses. Nor have there been many attempts to introduce policies to encourage water conservation, although there is much scope for improvement and the move could significantly reduce tensions.

Curiously, the potential contribution of statisticians to this debate is largely absent. The amount of available relevant data is extremely limited and subject to all the qualifications noted previously in this section. One of the main reasons for the lack of empirical evidence is that governments have apparently been unable to agree on a system of joint monitoring, the need for joint control over polluting activities, or even a common statistical methodology for determining the natural background concentration of pollutants in watercourses that cross national boundaries.[15] The information to be derived from such activities would be essential in developing an overall strategy for management of transboundary watercourses.

IV. HIGHLIGHTS AND CONCLUSIONS

Central Asia's economic misfortunes have had a dramatic impact on the region's environment and seriously undermined its statistical capabilities. The five countries included in this study have only recently emerged from one of the most serious economic depressions in modern times. Even today, the gross domestic product (GDP) in the worst-hit economies is still 30-40 percent below levels recorded in 1990.

Data on air pollution in the region reveals a mixed set of long-term trends. The volume of aerial emissions fell in the first half of the 1990s in all countries and in many of the region's larger cities. In later years, the level has stabilized or risen slightly. These trends closely track changes in the macroeconomic situation. The recent increase in air emissions is not pronounced, but the upward trend has some worrying implications. In other parts of the world, for example, long-term changes in economic structure have usually led to a fall in aerial emissions as new and cleaner types of industries have displaced older, dirtier operations. The economies of Central Asia have undergone some drastic structural changes since 1990, but the indicators examined in this paper reveal no similar pattern of adjustment in patterns of air pollution.

There are several pieces of evidence that support this conclusion. First, there has been no change in the relative importance of specific pollutants over time. Such a result would be expected as economies modernize and the composition of output evolves. In Central Asia, however, the materials that account for the bulk of aerial emission today are the same as in the late 1980s. Second, the data do not suggest any change in the historical relationship between rates of economic growth and emission levels. This result differs from the experience of other countries, including

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[15] A number of regional groups, committees and funds are working to improve the Aral Sea Basin's environment. Their goals include: rehabilitation of disaster zones, improvements in the management of scarce water resources, and contributions to related activities involving planning and implementation of new programs. Much of this work, however, must be carried on without an adequate statistical base.

most of ex-Soviet economies in East and Central Europe. In those countries, the OECD observed a "decoupling" between the two variables in the years since independence.[16]

Data on the spatial distribution of air pollution indicates some reduction in the volume of aerial emissions since 1990. Indexes of air quality in almost all major cities and provinces (oblasts) suggest that the air is somewhat cleaner than it was ten years ago. Emission levels, however, are still well above permissible limits in many cases. In fact, the air pollution indexes for some cities have consistently exceeded the acceptable maximum during the past decade, even though pollution levels have gradually been falling.

The general impression that emerges from this review is that reductions in air pollution are predominately due to the economic contraction during the first half of the 1990s and the weakness of the recovery in subsequent years. Several reasons are offered for this rather discouraging conclusion. First, most of the enterprises that have continued to operate rely on obsolete production technologies and equipment that is poorly maintained. Second, a large number of households and industrial enterprises have reverted to the use of solid fuels of local origin with a high caloric value and sulfur content. Third, the air pollution abatement technologies found in many enterprises are antiquated and inefficient or are not used at all. Finally, new investment remains at a very low level throughout the region. The shortage of capital denies enterprises access to new production technologies that are generally not only more efficient but also cleaner.

The economic depression may have temporarily halted the rise in aerial emissions, but at the same time it has weakened statisticians' ability to measure pollution and track changes in air quality. Some of the more important shortcomings that are noted in this paper are the following:

(i) The number of stations used to monitor air quality has been significantly reduced, and in some countries now represents no more than a token effort. In several instances, countries have also been forced to discontinue parts of their monitoring programs and to reduce the number of observations per station.

(ii) The sampling procedures used in several countries are questionable. Only a few observations may be used to compute annual values and primary data from stations operating in widely disparate conditions is sometimes combined.

(iii) None of the five countries are able to collect sufficient data on mobile sources of pollution.

(iv) The legal framework for the statistical programs is inherited from the Soviet era. Standards and emission limits are determined on the basis of Soviet methods that are out of data and do not reflect current technologies.

(v) The number of pollutants that are officially included in some monitoring programs is too large. With such limited facilities, it is possible to monitor only a few pollutants and programs should be rationalized.

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[16] Decoupling is defined to occur when GDP is growing at a positive rate while the growth of the environmental variable (for example, the volume of emissions of a particular pollutant) increases at a slower pace or even declines.

Clearly, the quality and coverage of the region's air statistics is poor and has deteriorated further in recent years. Nor is the data sufficiently reliable or comprehensive to be of much use to policymakers. In some areas, the air quality already poses serious threats to public health and the situation could quickly deteriorate if the economic recovery in the region continues. In their present state, the statistical systems around the region are ill equipped to cope with this prospect.

There are clear differences in the long-term trends for air and water pollution in the region. While air pollution declined in the 1990s, problems relating to water resources are proving to be much more permanent—and probably more serious. Water quality is often unsuitable, either for human consumption or irrigation. Water shortages are equally acute, and made worse because the distribution of water resources in each country is highly uneven.

The statistics collected on water quality are not adequate to track long-term changes. Nor are they sufficiently comprehensive to measure variations in quality in large water bodies. However, the available piecemeal information gives no reasons for complacency. In some of the region's major river systems, the contamination of surface water along long stretches is found to be several hundred times greater than the permissible limits. In Kazakhstan and Uzbekistan, portions of several rivers are extremely polluted with mercury, oil, heavy metals, fluorine, pesticides, radioactive contamination, and other toxic substances. About two fifths of the population in Tajikistan presently relies on untreated water taken directly from rivers, canals and irrigation ditches. Groundwater is also heavily polluted in many locations (particularly in parts of Kazakhstan and Uzbekistan). As much as 40 percent of all fresh groundwater is unsuitable for drinking in some oblasts and the percentage has been rising since the mid-1990s. Meanwhile, the region's dependence on underground water sources is growing.

There is indirect evidence suggesting that the region pays a heavy price for the deterioration in water quality. For example, the incidence of water-borne diseases such as malaria, acute intestinal infection, and bacterial dysentery is on the rise in several countries. According to other data presented in this study, the health burden inflicted by water-related problems is several times greater than that attributed to air pollution for most countries in Central Asia.

One reason for the poor quality is that many water-treatment systems are near collapse. A significant number are no longer operational and others cannot meet government standards. The problem is largely due to a lack of funds. In the worst case, water treatment systems have apparently received no funds for maintenance or repair in more than ten years. The situation is no better for sewage systems is certain countries.

Problems of water supply are closely linked to regional agreements on water allocation and are the focus of a continuing dispute between neighboring countries. These schemes for water allocation—which were drawn up in Soviet times—are no longer compatible with today's political and economic realities. They were part of a grander plan that included large-scale farming operations, an extensive system of irrigation facilities, and a series of reservoirs and dams.

Since 1960, the total irrigated area in the Aral Sea Basin has increased from 3 million to 8 million hectares and the application of mineral fertilizers has risen between three and six fold. The consequences have been well documented in other studies. The Aral Sea crisis is estimated to affect about 35 million people living in the Basin. By the 1990s, the average annual volume of discharges into the Aral Sea had decreased to just 5 km^3, compared with 50-60 km^3 per year in the early 1960s. The long-term decline in discharges is a result of the huge amounts of withdrawals that occur as the rivers make their way to the Aral Sea. Almost all these withdrawals are to feed irrigation systems in the Aral Basin. In fact, agriculture now accounts for 80-95 percent annual freshwater withdrawals in all countries but Mongolia. Very little water remains for other users including industry, households, and hydroelectric power.

Issues pertaining to problems of water quality and supply must rank high on the policymakers' agenda. However, the statistical systems that are meant to supply these officials with the information required to properly managed water resources are woefully inadequate. Some of the more critical shortcomings include the following:

(i) Monitoring operations on long stretches of national water systems have been discontinued, groundwater is rarely monitored, and the frequency of sampling has been curtailed.

(ii) Countries still employ the same standards, dispersion models, and statistical methodologies that were used during the Soviet era. These tools are no longer appropriate and their use casts doubts on the reliability of the data.

(iii) Collection procedures have become haphazard, jeopardizing the spatial and temporal comparability of results, even between different regions in the same country.

(iv) A significant portion of the data that is still being collected by monitoring stations is neither processed nor exchanged with other institutions. This information is rarely for decision-making purposes.

(v) Existing regional agreements on transboundary watercourses focus almost exclusively on water supplies and the amounts allocated to each country. Cooperation on matters relating to the quality of water in shared watercourses has made little progress. Governments have apparently been unable to agree on the need for joint monitoring of shared watercourses, the importance of joint control over polluting activities, or even a common methodology for determining the natural background concentration of pollutants in watercourses crossing national boundaries.

(vi) There have been few attempts to introduce policies that encourage water conservation, although there is much scope for improvement here. Existing procedures for inspection and enforcement would not be equal to this task in any case.

(vii) The division of labor between institutions working in the field of water resources is unnecessarily complex with overlapping responsibilities. These circumstances make it difficult to formulate an efficient statistical strategy and hinder the development of comprehensive information systems to serve the needs of regulators and policymakers.

In conclusion, water shortages and problems of water quality have reached a very serious state for most of the countries in this study. At the same time, the region's statistical systems are in disrepair and generally unable to produce the information that policymakers need if they are to address these problems. Without remedial action, water problems will worsen, jeopardizing public health and undermining the region's incipient economic recovery.

Appendix

Table A1. **Air Emissions by Province in Kazakhstan, 1990-2000**[a]
(in thousands of tons)

	1990	1995	1997	1998	1999	2000
Total	4677	3097	2969	2328	2309	2429
Akmolinskaya	205.0	136.2	67.3	34.5	59.8	41
Aktubinskaya	186.7	62.3	41.7	46.7	23.2	31.4
Almatinskaya	138.4	95.0	77.1	72.3	58.6	63.1
Vostochno-Kazakhstankaya	345.5	205.3	190.5	164.4	177.9	243.8
Karagandinskaya	1686.8	1089.2	950.9	1009.2	1049.5	1108.1
Kostanaiskaya	203	197.5	89.2	88.1	54.7	109.5
Mangistauskaya	202.8	90.5	59.6	71.0	51.0	59.4
Pavlodarskaya	975.5	763.0	514.8	440.1	435.2	433.7
Severo-Kazakhstankaya	211.1	231.7	87.7	82.2	60.4	53.3
Astana City	…	…	…	41.5	45.8	46.3
Almaty City	39.0	19.2	13.4	16.2	13.1	13.0

Notes: [a] Data refer only to emissions by stationary sources. Table includes data for selected cities only.
Source: Kazakhstan Agency on Statistics (2001).

Table A2. **Institutional Responsibilities for Environmental Policy and Environment Statistics**

	Institution	Functions/Responsibilities[a]
Kazakhstan	Ministry of Natural Resources and Environmental Protection	Approves permits and licenses for discharges of pollutants to water bodies, controls water use for special purposes, carries out other water-management tasks.
	Committee for Geology and Underground Resources Protection.	Supervises specific aspects of water management.
	Committee on Water Resources	Responsible for delivery of irrigation and rural drinking water, for aspects of water allocation and national polices on water quality and protection of water resources. Supervises the eight national River Basin Water Directorates. Regulates the use of surface water resources and represents the country in inter-governmental negotiations on water distribution and advises on water sharing from international river system.
	Committee on Geology and Underground Resources Protection	Responsibilities for managing groundwater resources are analogous to those of the Committee on Water Resources.
	Ministry of Agriculture	Responsible for the monitoring drainage, water logging and soil salinity conditions in several major irrigation projects in the south of the country.
	Ministry of Municipal Affairs	Supervises domestic water supply and waste-water treatment. At provincial and inter-provincial levels management of the main water supply network is the responsibility of the Committee on Water Resources.
	Kazhydromet	Occasionally measures surface water pollution, enforces process of self-monitoring by the water users.
	Ministry of Health, the State Committee on Emergency Situations, Agency for Control of Strategic Resources	These institutions carry out other water-management tasks.
	Municipal companies (vodokanal)	Where they exist, these companies are responsible for the supply of drinking water as well sewerage and waste-water treatment.

continued ...

Table A2 (cont'd.)

	Institution	Functions/Responsibilities[a]
Kyrgyzstan	Ministry of Agriculture and Water Resources (MAWR)	Responsible for water allocation, water accounting and permits for water use. Together with the local authorities, it is also responsible for construction and maintenance of infrastructure irrigation water, including reservoirs, dams and canals, and for delivering irrigation water. It monitors ground and surface water quantity and quality in irrigated areas, negotiates water allocations with neighbouring countries, and verifies that the actual water uptakes comply with the permits.
	Ministry of Environment Protection	In charge of protecting water quality; regulating the discharge of pollutants into water bodies and collecting fines for discharges. Supervises and checks the self-monitoring operations of firms discharging pollutants.
	Ministry of Emergencies and Civil Defense	Responsible for flood infrastructure.
	Ministry of Health	Controls the quality of tap water and water discharged from treatment facilities.
	State Agency for Meteorology (Hydromet), Ministry of Environmental Protection	Monitor surface water and quality.
	State Committee for Geology and Mineral Resources, Ministry of Environmental Protection	Monitors groundwater quality and quantity, explores and tests aquifers.
	Environmental Monitoring Department, Ministry of Environmental Protection	Monitors the purification performances of municipal waste-water treatment plants and major industrial enterprises.
	Central Inspection Laboratory, Ministry of Environment Protection	Verifies emission discharge reports produced by emitters.
	Ministry of Health	Monitors the quality of drinking water.
	Water Management Associations/ Interstate Council for Water Coordination	Responsible for ensuring compliance with water withdrawal limits and guaranteeing annual water supplies.

continued ...

Table A2 (cont'd.)

	Institution	Functions/Responsibilities[a]
Uzbekistan	Ministry of Agriculture and Water Management	Involved in water research, planning, development and distribution. Responsible for construction, operation and maintenance of the irrigation and drainage systems
	Agency of Municipal Services/ local authorities	Responsible for the infrastructure of municipal water supply and waste-water treatment.
	State Committee for Nature Protection	Responsible for monitoring compliance with standards for waste-water. Monitors water quality at major waterworks, control of permits for water use and sewage, responsible for ensuring that water discharges meet water quality standards (MACs).
	Main Administration on Protection and Wise Use of Land-Water Resources, State Committee for Nature Protection	Monitors and regulates industrial waste discharges.
	Main Administration on Hydrometeorology, Cabinet of Ministers	Monitors surface water, collects and analyses information and forecasts on the state of surface water.
	State Committee for Geology	Monitors changes in the condition of groundwater in the underground hydrosphere.
	Sanitary and Epidemiological Service of the Ministry of Health	Monitors drinking-water quality in cities and large settlements.

Notes: [a] Information on institutions and their responsibilities is only a partial list.
[b] Similar information is not available for Mongolia and Tajikistan.

Sources: Kazakhstan Agency on Statistics (2001); Kyrgyz Republic National Statistical Committee (2001); State Department of Statistics (2002); ECE (2000a, 2000b, and 2001).

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