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Chapter 9: UKRAINE

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NCSEER NOTE

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

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

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

Chapter 3: European Russia. (Kochurov)

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

Chapter 5: The Russian Far East. (Strand)

Chapter 6: Estonia. (Soot)

Chapter 7: Latvia. (Dreifelds)

Chapter 8: Lithuania. (Kritkauskys)

Chapter 9: Ukraine. (Stebelsky)

Chapter 10: Environmental Management in Ukraine. (Freeman)

Chapter 11: Belarus. (Cherp & Kovaleva)

Chapter 12: Moldova. (Dinu & Rowntree)

Chapter 13: Georgia. (Richards)

Chapter 14: Armenia. (Valesyan)

Chapter 15: Azerbaijan. (Wolfson & Daniell)

Chapter 16: Kazakhstan. (Smith)

Chapter 17: Turkmenistan. (Micklin)

Chapter 18: Uzbekistan. (Lubin)

Chapter 19: Kyrgyzstan. (Braden)

Chapter 20: Tajikistan. (Eicher)

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

Environmental Resources and Constraints
in the Former Soviet Republics

Ukraine

Ihor Stebelsky

Executive Summary

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

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

Particular attention is directed to the problems that have resulted from the 1986 Chernobyl explosion, as well as to problems resulting from agriculture, air pollution, contaminated water supplies, and deterioration of the Black and Azov seas. A map of the environmentally polluted regions of Ukraine is included.

The main conclusions of the chapter are that environmental problems in Ukraine are presently very serious, and that the poor state of the Ukrainian economy at present will not permit adequate funding for environmental improvement. A resolution of current political differences with Russia, especially those involving Crimea, is urgently needed. However, Ukraine is rich in natural resources, and is well situated to become strategically integrated into the greater European economy if it can resolve its internal economic difficulties.

Philip R. Pryde, June 6, 1994

Chapter 9. UKRAINE

Ihor Stebelsky

Among the republics of the former Soviet Union, Ukraine had the second largest population and economic importance; and, in reflection of this, it is discussed in two chapters. Chapter 9 will discuss the physical and historical background of the country, and outline its main environmental problems. Chapter 10 will examine the various laws and institutions that have been developed to address these environmental concerns, as well as some of their shortcomings.

Located north of the Black Sea, Ukraine is the second largest country in area in Europe and, after Russia and Kazakhstan, the third largest in the former Soviet Union. In population, it was the second largest republic in the former USSR, but in Europe it ranks sixth after Russia, Germany, Italy, United Kingdom and France. It shares a boundary with Russia to the east and northeast, with Belarus to the north, and in the west, from north to south, lie Poland, Slovakia, Hungary, Romania and Moldova. As a former Soviet republic, Ukraine is a member of the Commonwealth of Independent States (CIS), and has been a member of the United Nations since 1945. Since the demise of the USSR, it has transformed its role in the United Nations and other international bodies from reflecting Soviet policies to an independent position. Its government is seeking peaceful resolutions to regional tensions at home and abroad. Pressured by the reformist opposition, the presidency is pursuing economic reforms, but the process is hampered by a majority of the legislators and most of the administrators, carry-overs from the old regime who are reluctant to relinquish their former Communist bureaucratic power.

Ethnicity and History

Ukraine is inhabited mostly by ethnic Ukrainians. According to the January 12, 1989 Soviet census, of the 51.7 million inhabitants of Ukraine, 37.4 million (72.3 percent) were ethnically Ukrainian; the others comprised a large variety of minorities. Russians (11.4 million, or 22.1 percent) were by far the largest minority group. Jews and Poles, formerly much more numerous than at present, numbered about 0.5 and 0.2 million (0.9 and 0.4 percent), respectively (Table 9.1). Conversely, 6.8 million Ukrainians lived in the rest of the former Soviet Union, mostly in Russia (4.4 million), Kazakhstan (0.9 million), Moldova (0.6 million), Belarus (0.3 million), and Central Asia. Ukrainians are also found in large numbers in Poland (presently about 400 thousand), Slovakia (about 150 thousand) and Romania

Table 9.1 Ethnic Minorities in Ukraine

	Persons (thousands)	Percent
Ukrainians	37,400	72.34
Russians	11,400	22.05
Jews	486.3	.94
Belorussians	440.0	.85
Moldavians	324.5	.63
Bulgarians	233.8	.45
Poles	219.2	.43
Hungarians	163.1	.32
Romanians	134.8	.26
Greeks	98.6	.19
Volga Tatars	86.9	.17
Armenians	54.2	.11
Gypsies	47.9	.09
Crimean Tatars	46.8	.09
Germans	37.8	.07
Azeris	37.0	.07
Gagauz	32.0	.06
Other	461.0	.90
TOTAL	51,704	100.0

(over 250 thousand). There are also about 755 thousand in Canada, probably 1 million or more in the U.S., up to 400 thousand in Brazil, up to 250 thousand in Argentina, and smaller numbers in western Europe and Australia.

Minorities settled in Ukraine mostly as a result of a long history of various empires implementing policies of colonization. The Polish-Lithuanian state (16th--17th centuries) encouraged the acquisition of lands by Polish nobility and small gentry, and the employment of skilled Jews (who had come from Germany, 13--14th centuries). The Turkic-speaking Muslim Crimean Tatars originated from the Mongol-Tatar invasion (13th century), as did the Turks who accepted Orthodox Christianity and became known as the Gagauz. Gypsies have long wandered through Ukraine. The thousands of Hungarians and Romanians are in general located along Ukraine's border with these two countries.

Under the Russian Empire (18th--19th centuries), the southern steppes of Ukraine were colonized in part by Russian peasantry and military, as well as by invited German (mostly Mennonite) colonists, and Bulgarian, Moldavian and Greek immigrants. Many of the Germans had immigrated to the west by the late 1920s or were removed in 1941 to Kazakhstan and Siberia. During the Soviet period, Ukraine received a large influx of Russian specialists and managers while losing its own to Russia and other republics. Along with the Russians also came Russian-speaking Belorussians, Volga Tatars, Azeris and others to fill managerial or worker positions in the industrial cities of Ukraine. Western Ukraine, when part of the inter-war Poland, had acquired a large influx of Polish colonists, most of whom were "patriated" after World War II to Poland.

The history of Ukraine extends back well over a millennium. By the 8th century, the city of Kiev had grown in economic and political importance to become the center of a new political power: Rus. The establishment of the Rus principality in Kiev in the 9th century began the process of replacing tribal loyalties with the broader Rus identity. This process was strengthened by Prince Vladimir's adoption (988) of Byzantine Christianity as a state religion and its propagation, in the Old Church Slavonic, among the Slavic tribes of the Dniπρο (Dnepr) River basin.

The subsequent Mongol-Tatar invasion (1237--1241) devastated the southeastern principalities, and brought about a political realignment. In the ensuing centuries, Muscovy arose as a protectorate of the Mongol-Tatars, while Lithuania, Poland and Hungary annexed the western principalities of Rus. The old Rus elites were absorbed into these kingdoms' Roman Catholic landed gentry, while the masses were subjected to serfdom.

Ukraine's struggle for independence gained momentum with the emergence of a new Cossack identity in the steppe frontier. Jealous of their freedom and proud of their Orthodox



Christianity, the Cossacks gathered beyond the Dnieper rapids where they organized a democratic-military order that fought both the marauding Tatars and Turks, and the haughty Roman Catholic Polish gentry. Their elected leader, Bohdan Khmelnytsky (1595-1657), led a military campaign against Poland which ended in the establishment of a short-lived Cossack state. The territory of this state became known as Ukraine (literally, the borderland). This Cossack state was partitioned and its hetmanates (territories governed by their own elected hetmans) eventually became restless protectorates of Poland and Muscovy. By 1795 most of Ukraine was absorbed into the Russian Empire, although the southwestern portion became part of the Austro-Hungarian Empire.

The identity of the people as Ukrainians emerged in conjunction with the name of their land, Ukraine, and became consolidated with their opposition to Muscovite expansionism. When Muscovy, transformed into the Russian Empire, subordinated the Hetmanate (late 18th century) into a province called "Little Russia", and bound the Cossacks in serfdom, the desire for freedom increased. In the 19th century, growing interest in folk culture, the development of a vernacular Ukrainian literature, and especially the poetry of the Ukrainian bard, Taras Shevchenko, gave rise to modern Ukrainian national consciousness. By the end of the 19th century, most of the so-called "Little Russians" of the Russian Empire and even the "Ruthenians" of Galicia in the Austro-Hungarian Empire considered themselves Ukrainian.

Following World War I, with the collapse of both the Russian autocracy and the Austro-Hungarian Empire, Ukraine engaged in a brief struggle for independence (1917--20), losing to the Red Army of Russia, which incorporated the larger part of it as the Ukrainian Soviet Socialist Republic within the USSR (1923). The western territories of Ukraine were absorbed by Poland, Czechoslovakia, and Romania. As a result of the Hitler-Stalin pact and the events of World War II, the Soviet Union extended its territory westward, annexing most of the earlier Ukrainian territories into the USSR, nearly all of which became part of the Soviet Ukrainian SSR, and now Ukraine. In 1954, Khrushchev transferred the Crimean peninsula from the Russian Republic back to Ukraine.

Physical Environment and Natural Constraints

Occupying the southern portion of the East European Plain, Ukraine consists mostly of lowlands and gently rolling uplands that seldom rise above 500 meters. Except for the coast of the Black Sea and the Sea of Azov, Ukraine does not have any obvious physical boundaries. There are two mountain systems, consisting of the Carpathian Range (rising to 1,700--2,000 m) in the west and the Crimean Range (1,000--1,500 m) in the south (Figure 9.1). The climate of Ukraine is temperate, cool and semi-continental. Temperatures increase from north

to south, with mean annual temperatures of about 6°C at the Russia-Ukraine border, about 10°C in Odessa, and about 12°C in Yalta. Continentality increases eastward with distance from the Atlantic Ocean, manifesting itself in colder winters, warmer summers, and thus increasing annual ranges in temperature. There is an increase in aridity from north to south, which presents the potential for dust storms. The mean January temperatures are nearly everywhere below freezing (-1 to -8°C). Only the southern coast of Crimea, sheltered by its mountains from the cold air masses in the north, remains free of frost. The mean July temperatures range from 24°C in the south to 19°C in the northwest, and to 16°C in the higher Carpathian Mountains.

Precipitation in Ukraine decreases from about 800 mm in the west to about 450 mm in the east and 300 mm or less along the coast of the Black Sea Lowland, but can be as high as 1200 mm in the Carpathian Mountains. The monthly maximums occur either in June or July. Whereas in western Ukraine winter precipitation is substantial, in eastern Ukraine frequent high pressure blocks the eastward flow of maritime air masses and results in meager snow cover, especially in the south. In the spring and summer, the occasional invasion of continental tropical air from Central Asia may be accompanied by a hot, drying wind which can wilt crops in a matter of hours and in severe cases lead to dust storms.

Variations in climate and topography have resulted in a natural zonation of soils and vegetation. In the north, the glaciated and poorly drained lowland, known as Polissia, comprises a mosaic of forested or swampy ecosystems, best left in a natural state.

South of Polissia is the forest-steppe zone, which is characterized by thick, rich soils. In the cooler, more humid areas, gray forest soils support deciduous forests. Further south are found the fertile chernozem soils, which originally supported a brightly-flowering meadow steppe and forested steppe. Much of the forest and nearly all of the steppe have been transformed into cultivated land, which has produced much food but also resulted in biotic depletions, erosion, and water pollution.

South of the forest-steppe is the steppe. This broad grassland zone, which extends south to the Black Sea, may be subdivided into several subzones of increasing aridity. The northern subzone is characterized by rich, prairie chernozems, which are now largely in agriculture. South of this is a drier belt of southern chernozems with increasing accumulations of salts; the natural vegetation here was narrow-leaved fescue and feather grass steppe. Along the Black and Azov Seas, and in the Crimean Lowland, are chestnut soils with considerable salt accumulations, overlain by a dry grassy steppe.

In the mountain province there is altitudinal zonation of soils and vegetation. The Carpathian Mountains have deciduous and mixed forests typical of the central European forest

belt. At higher elevations, the forests include more beech, silver fir and spruce; the highest elevations support Alpine meadows.

The Crimean Mountains are characterized by oak, beech, hornbeam, and various pines. The highest elevations support pastures of low, thick grass. The southern slopes, at lower elevations, support a Mediterranean type of vegetation, including oak, juniper, cypress, magnolia, stone pine, olive and myrtle trees. To preserve portions of these diverse natural communities, a network of mostly small nature preserves, plus three national parks, has been created. These are presented in Table 9.2. Additional information on them is presented in Chapter 10.

Ukraine has few physical constraints to development. Except for the mountainous zones in the Carpathians and Crimea, where seismic activity is common, the East European platform to the northeast is geologically stable. Areas that may hinder agricultural development such as marshes or steep, mountainous slopes, are small. Somewhat larger areas of podzolic soils, though not inherently fertile, may be improved for agricultural production. Perhaps more limiting to agriculture are the areas of the southern steppe that contain saline chestnut soils.

The greatest natural limitation to agriculture in Ukraine is the dry climate of the steppe. Here, in this warmest part of Ukraine, drought may occur not only as a prolonged period without rain, but can result from the sukhovij (a hot, desiccating wind that occurs on the average 24–30 days/year). The more intense ones can cause damage to crops within hours. Strong easterly winds may cause dust storms (3–8 days/year), removing the fine particles of dry topsoil and transporting it great distances, or building up dunes of coarse materials that cover up and suffocate young crops (see Figure 16.2).

Other weather hazards common to agriculture include early and late frosts, winter kills of winter wheat, and, in the summer, thunderstorms with torrential downpours and damaging hail. Thunderstorms are common in the steppe and forest-steppe (25–30 days/year), and in the Carpathians (up to 40 days/year) where they can produce damaging floods.

The greatest emerging physical constraint for agriculture, industry and municipal needs is the growing shortage of water. Both surface waters and groundwater depend on precipitation, most of which evaporates or infiltrates into the ground. Surface runoff in Ukraine is scanty. Only the Dnipro (Dnieper) River, with an average annual discharge of 40 km³/yr, is suitable for multipurpose river basin development. The Dnister (Dnestr) River, by contrast, discharges only 7–8 km³/yr, and the fluctuating flow is unreliable for navigation or power. Even less useful is the Donets (a tributary of the Don River), which releases a mere 4–5 km³/yr.

Table 9.2: Preserved Areas in Ukraine

Type of Preserve (a)	Number	Total area(b)	Average size (b)	% of Republic (d)
Zapovidniki (nature reserve) (c)	12	1441.31	120.11	0.24
Above, that are Biosphere Reserve:	2	1206.55	603.28	0.20
National Parks (c)	3	1235.03	664.02	0.20
Zakazniki (c)	1103	4249.00	3.85	0.70
Total (c)	1118	6925.34	6.19	1.15

Zapovidniki (date created)	Hectares
Askaniya-Nova (1921; 1874)	11054
Chernomorskiy (1927)	57048
Dunaiskiye Plavni (1981; 1973)	14851
Kanev (1968; 1931)	1035
Karadag (1979)	1370
Karpatskiy (1968)	18544
Lugansk (1968)	1580
Mys Mart'yan (1973)	240
Poleskiy (1968)	20104
Rastoch'ye (1984)	2080
Ukrainskiy Stepnoy (1961; 1926)	1634
Yaltinskiy (1973)	14591
Total	144131

National Parks	Hectares
Karpatskiy (1980)	50303
Shatskiy (1983)	32800
Sinevir (1989)	40400
Total	123503

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

(b) In square kilometers.

(c) Data are for 1990; new nature reserves and national parks have been created since 1991.

(d) Area of Ukraine is 603,700 sq. kilometers.

Sources: Pryde (1991); Okhrana ... (1991).

Natural Resources

Ukraine has a wealth of natural resources. Runova (1986) estimated that Ukraine, with an area only 2.7 percent of the former USSR, accounted for 13.1 percent of its combined mineral, hydroelectric, forest and agricultural land resources, including 18.2 percent of the agricultural land and 8.6 percent of the mineral resources. If the quality of Ukraine's resources is taken into account, then their true value becomes even greater. Thus Ukraine produced, in the 1980s, over 22 percent of the value of agricultural production and generated over 17 percent of the electrical power in the former USSR.

Ukraine's fossil fuel resources have been significantly depleted. Only the coal deposits, especially the coking coals of the Donets Basin, are still rated exceptionally significant, accounting for more than 25 percent of the former USSR total. Even so, the most easily minable seams have been exhausted. The production of natural gas in Ukraine accounted for about 33 percent of the Soviet output in 1964 but dropped to 4 percent by 1989, while petroleum declined from 2.6 to 0.9 percent. There are abundant quantities of low pressure natural gas in Ukraine, but technologies are not yet available to harness it. For the nuclear power industry, Ukraine possesses very large graphite deposits (about 50 percent of the former Soviet total) and substantial uranium deposits. As graphite-moderated reactors are now considered unsafe, the future of this industry is questionable.

Ukraine has some of the richest deposits of iron ore (31 percent of the former Soviet total) and even larger deposits of the alloying metal manganese (70 percent). It also has rich deposits of mercury, as well as some titanium, bauxite, alunite, chromite, nickel, lead, zinc, copper, and gold. For the chemical industry, Ukraine possesses about 10 percent of the former USSR's common salts, 5.3 percent of the potash, and large deposits of magnesium salts and phosphorites. Ukraine is especially well endowed with kaolin clay, refractory clays, and limestones, and has quartzite sands for glass-making, quality granites, and a variety of precious stones. Mineral waters are found in the Carpathians, and also in Crimea, where they combine with a coastal setting and a mild climate for outstanding resort and recreational opportunities.

Most of Ukraine has been cleared of its natural vegetation for agriculture, but forests still occupy 8.6 million ha (over 14 percent of the area), largely due to an active reforestation program. Ukrainian forests are particularly valuable because of their relatively fast growth, and because of the presence of hardwoods (15 percent of the oak, 20 percent of the beech and 10 of the ash stands in the former USSR). Conifers (pine, fir, and spruce), however, represent 54 percent of Ukraine's forest fund. Almost 40 percent of Ukraine's forest fund is in deciduous hardwoods (oak, beech, and hornbeam). Only 7 percent is occupied by softwood deciduous species, such as birch, aspen, alder, linden and poplar.

Agricultural land occupies over 41.8 million ha, or about 70 percent of the total land area of Ukraine. Of the land used for agricultural purposes, 81.7 percent is plowed and 15.8 percent is in hayfields and pasture.

The quality of Ukraine's agricultural resources may be appreciated in terms of the republic's contribution to the former USSR's total: 7.5 percent of the agricultural land, but 15.0 percent of the land in crops, 22.6 percent of the total value of agricultural production, 25.9 percent of all vegetables, 26.0 percent of all grains, 26.7 percent of potatoes, 32.2 percent of flax fibre, 40.8 percent of sunflower seeds, and 53.3 percent of sugar beets. The feed base supports a large share of the former USSR's farm animals, such as cattle (21.3 percent), pigs (25.3 percent), and fowl (21.0 percent). As a result, Ukraine contributed about 22.0 percent of the USSR's meat, 22.5 percent of the milk, and 20.5 percent of the eggs.

Industrial Development

Modern industrial development began in Ukraine during the 19th century and was based almost entirely on raw material extraction and primary processing. Capital raised by the local gentry was used to construct grist milling, sugar refining, and some food processing industries. French, British and Belgian capital was invested to mine the Donets Basin (Donbas) coking coal and Kryvyi Rih (Krivoy Rog) iron ore, smelt the iron ore, and build some heavy machinery in the southeastern part of Ukraine.¹ The Russian government funded the building of the railways. Ukraine's raw material resources and primary products were encouraged to move to manufacturing centers in central Russia (mainly Moscow and St. Petersburg), thus retarding the development of manufacturing industries, other than steel, in Ukraine. Even less industrialization occurred in western Ukraine under the Austro-Hungarian Empire. Here, the main industrial development involved lumbering and woodworking, and petroleum extraction in the Carpathian foothills funded by British capital.

After World War I, in Soviet Ukraine, a concerted effort was made to expand heavy industry. The fastest growth occurred in the development of steel production and heavy machine-building and metal-working. Despite Ukraine's more productive industries, a policy of developing new resources in the eastern regions of the USSR was initiated in the 1930s and acquired urgent strategic considerations just before and during World War II. As a result, the national share of Ukraine's industrial output began to decline in comparison to that of Russia. The industrial base, of course, was largely destroyed during the war.

Following World War II, Ukrainian industrial capacities were quickly rebuilt. The industries that developed rapidly during this period included basic chemicals (chemical fertilizers, sulfuric acid, cellulose), tractors and automobiles, aircraft and electronic instrument

making. The steel industry, destroyed during the war, was rebuilt and expanded. The post-war industrial expansion caused many cities to increase rapidly in size (see Appendix 9.1). In the 1980s a policy emerged to develop energy and water-saving industries and processes, reflecting resource scarcities that are impacting certain industries, cities, or entire regions of Ukraine.

The generation of electricity is indicative of the emerging constraints in energy resources. Electric power generation has increased forty times since World War II, to meet the growing industrial needs of Ukraine as well as some energy export.

At first, electricity was generated from coal-fired power stations. On the eve of World War II, the Dnipro (Dnepr) Hydro-Electric Power Station (Dniprohes), located near Zaporizhzhya, entered production, and from the 1950s to the 1970s additional dams were built on the Dnipro. However, the share of their contribution to Ukrainian electrical production declined (from 17 percent in 1950 to 4 percent in 1989), as most of the growth in electricity generation came from giant regional coal-fired stations, atomic power stations, and urban heat and power plants.

By the 1970s, the Soviet nuclear power generating program required the construction of several nuclear power plants in Ukraine, including the Chornobyl (Chernobyl), Rivne (Rovno), South Ukrainian, Zaporizhzhya (Zaporozhe), Khmelnytsky, and Crimea stations. In 1992, the potential generating capacity of the nuclear power stations in Ukraine stood at 14,880 megawatts, with sixteen reactors available for service (Table 9.3). However, several of them, including all the units at Chornobyl, were in 1992 either temporarily or permanently shut down.

There are a number of environmental implications from such a rapid build-up of electrical generating capacity. First, there is the problem of air pollution from coal-fired generating plants: the need for efficient scrubbers, the use of low-sulphur coal, or the replacement of coal with cleaner natural gas. Second, there is the problem of the exhaustion of cooling water resources in Ukraine. Third, in the aftermath of Chornobyl, there is the public fear that, because of shoddy workmanship in the original construction and inadequately trained personnel, another nuclear power plant accident is likely to happen (Marples, 1986).

Environmental Problems

The intensive utilization of land for agriculture and the heavy industrialization of Ukraine has brought about losses of plants and animals, degradation of the soil, and the pollution of air, water and land. Soviet government priorities of rapid development at minimum expenditure have tended to exacerbate pollution and industrial hazards.

Table 9.3 Nuclear Power Stations Operating in Ukraine
(as of July 1992)

Station	Reactor Type	Location	Number of Reactors	Capacity (megawatts)
Chornobyl	RBMK-1000	Prypyat	3	3,000
Rivne (Rovno)	VVER-440/1000	Kuznetsov	3*	1,880
South Ukraine	VVER-1000	Prybuzhzhya	3	3,000
Zaporizhya	VVER-1000	Energodar	5*	5,000
Khmelnysky	VVER-1000	Netyshyn	2*	2,000
TOTAL				14,880

* The Rivne, South Ukraine, and Khmelnytskyy complexes each have an additional 1000 MW reactor that has been completed but cannot be started up because of a moratorium on bringing new units online.

Sources: David Marples, 1992; and Post-Soviet Geography, Vol. 32, no. 4 (April 1991), pp. 285-289.

For over a century, erosion has been one of Ukraine's most serious environmental problems. The expansion of cultivation on sloping lands has accelerated water erosion, gullying, the disappearance of small streams, and the loss of the rich loess-based chernozems. The clearing of the steep slopes of the Carpathian and Crimean foothills has resulted in severe erosion and flooding. Continuous cultivation of the dry steppes has resulted in wind erosion, and neither the planting of windbreaks nor improved tilling methods has eliminated this problem. The ill-advised drainage of the sandy soils of Polissia (in northern Ukraine) has brought about desiccation and wind erosion.

Irrigation in the dry steppe, by contrast, has resulted in waterlogging, soil salination, and the degradation of the fertile chernozems. Agricultural chemicals have contaminated soils with pesticide residues and polluted both surface and groundwater with nitrates and other chemicals. This condition is particularly acute in the southern steppes, where the heavy use of chemicals has resulted in the 1980s in some of the highest rates of morbidity and mortality in Ukraine (Dorohuntsov, 1991). Chemical pollution has been intensified by the limited assortment of herbicides and pesticides available, their improper application, inadequate use of biological methods of pest control, and imbalanced application of mineral fertilizers.

Mining and primary processing have had a severe impact on land, water and air quality. In the Donets-Dnipro industrial region, some 250,000 ha of land have been disturbed by the mining of coal, iron ore, manganese and other minerals. Another 5,000 ha of land are lost annually to industrial waste storage and the disposal of slag (Zastavnyi, 1990, p. 212). Mercury is one of the most highly toxic of all minerals, and the former Soviet Union's second largest mercury mines were located at Nikitovka, north of Horlivka. This is in one of the most highly polluted regions of Ukraine.

Smelting, thermal-electric power generation and chemical production have led to severe air pollution, including high emissions of oxides of nitrogen and sulphur, which have resulted in acid precipitation. Smelting, in particular, has contributed to heavy metal contamination of the areas surrounding several metallurgical cities. Automobiles, fueled by leaded gasoline and devoid of pollution control equipment, are major sources of air pollution in otherwise less industrialized cities, such as Kyiv (Kiev), Lviv (Lvov), Vinnytsya (Vinnitsa), or Yalta. Such cities as Dniprodzerzhynsk, Donetsk, Mariupol, Zaporizhzhya (Zaporozhe), Dnipropetrovsk, Kryvyi Rih (Krivoy Rog), Kyiv, Odesa (Odessa), Alchevsk (formerly Kommunarisk), Makiyivka, and others were listed in environmental documents in 1989 as particularly polluted (Pryde, 1991, ch. 2; *Okhrana...*, 1991, pp. 43-45). The cities with the most serious problems are shown in Table 9.4.

Table 9.4 Most Polluted Ukrainian Cities

City (Russian spelling/name)	Air pollutants (1000 tons) (a)		
	1985	1987	1990
1. Kryvyy Rih (Krivoy Rog)	1314.2	1290.0	1041.7
2. Mariupol' (Zhdanov)	814.3	785.8	610.2
3. Makiyivka (Makeyevka)	375.0	318.8	305.2
4. Dniprodzerzhynsk (Dneprodzerzhinsk)	370.4	337.0	268.2
5. Dnipropetrovsk (Dnepropetrovsk)	354.3	321.2	254.1
6. Zaporizhzhya (Zaporozhe)	302.1	286.9	246.4
7. Alchevs'k (Kommunarsk)	369.1	251.4	187.8
8. Donetsk	208.1	192.8	171.0
9. Kremenchuk (Kremenchug)	174.9	194.2	151.4
10. Lysychansk (Lisichansk)	120.5	132.2	129.1
11. Yenakiyev (Yenakievo)	136.5	120.8	125.4
12. Odesa (Odessa)	124.5	105.6	80.6
13. Kyiv (Kiev)	99.2	93.7	54.7
14. Cherkasy (Cherkassy)	64.4	62.4	31.5

(a) From stationary sources only

Source: Okhrana okruzhayushchey ... (1991), pp. 43-45.

Note: Some major cities and important industrial centers, such as Kharkiv, Lviv, Luhansk, Kramatorsk, and Stakhanov, were not included in the list.

To reduce emissions from coal-burning power plants, the United States is currently assisting Ukraine with a process called "reburning." This technology, initially applied at the Ladyzhin power plant, is designed to reduce the output of oxides of nitrogen.

Water pollution is equally a serious problem. Many large industrial enterprises and some municipalities have failed to treat some of their effluent, leading to the pollution of surface water with oxygen-depleting organic matter, phosphates, nitrates, cyanides, ammonia, phenols, PCBs and heavy metals. This has impacted not only potable water supplies, but also river and coastal fisheries, and the safety of water for swimming. Rivers flowing through heavily industrialized areas, such as the Donets, have become open sewers. Pollution of the Donets River contaminated the drinking water of Kharkiv (Kharkov) for years. Coastal resorts, concentrated in Crimea and along the Black Sea and Azov Sea littoral, have been affected by beach closures. Even groundwater, the main source of drinking water in southern Ukraine, is being threatened by critical levels of fertilizer, herbicide and pesticide pollution. Kyiv's water supply may have been contaminated by fallout from Chernobyl. Cholera and cancer rates were unusually high in the Odesa region in the 1970s and 1980s (Feshbach and Friendly, 1992, pp. 124-5).

Pollution of the Black and Azov Seas is another growing problem. The Black Sea is polluted from chemicals flowing down the rivers that feed into it, from cities along its coast, and from boats that traverse it. As a result, toxic hydrogen sulfide levels are building up in the Sea, and beaches near Mariupol, Odesa, and elsewhere have to be periodically closed. Oxygen supplies, necessary for fish life and confined to the upper 100 meters of the Sea, are being depleted.

The shallow Sea of Azov is in even worse condition, and is often described as dying. Its once abundant fishery is almost gone. It suffers from pesticides and nutrients from farming operations, and from exceptionally high readings of such serious pollutants as mercury, ammonia, phenols, surfactants, and sulfur compounds. An introduced parasite has reportedly killed up to 80 percent of the plankton in the Sea (Mnatsakanian, 1992, p. 53).

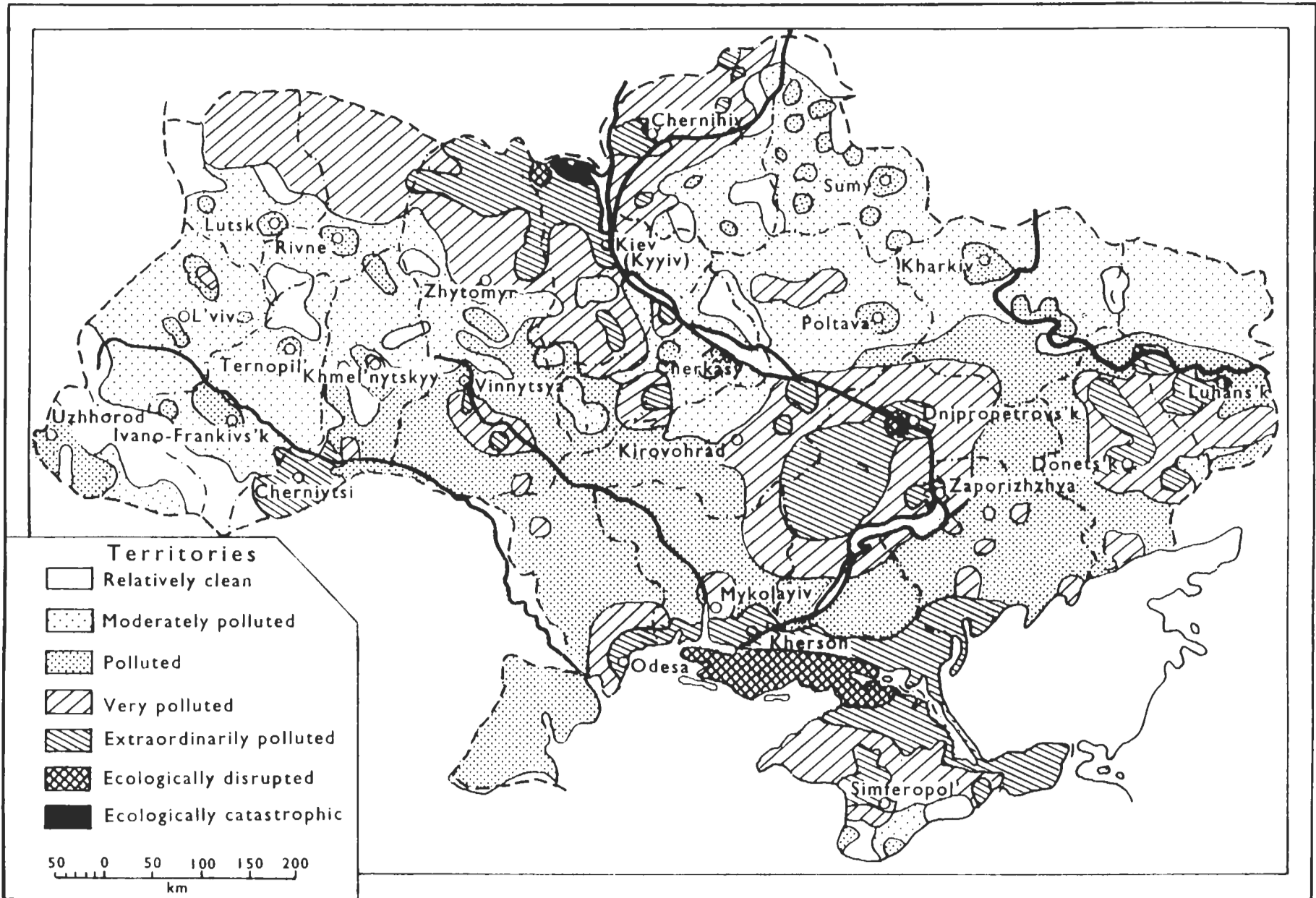
Perhaps the greatest environmental problem in Ukraine presently is the aftermath of the Chernobyl (Chernobyl) accident, the long-term exposure to radiation, and the hazard of a similar accident in the future. Although the official death toll from acute radiation exposure at the time of the accident stood at 31, the unofficial count of deaths (attributed mostly to work on radioactive cleanup) has ranged from 4,000 to 10,000 (Feshbach and Friendly, 1992, p. 146). Since the prevailing winds, at the time of the reactor fire, were from the southeast, the city of Kyiv (2.5 million people) was spared, and the heaviest radioactive fallout became concentrated mainly in areas north of the reactor. Within Ukraine, rain deposited hot spots of

radioactivity to the west in Polissia, to the Belarus border to the north, and in scattered locations of central Ukraine to the south of Kyiv. Surveys indicate that the heaviest contamination with radioactive cesium occupies about 10,000 km², of which 7,000 km² is in Ukraine and the rest in Belarus. This zone contained 640 settlements with a population of about 250,000 (Zastavnyi, 1990, p. 225). To date, over 100,000 persons have had to be relocated out of the most highly contaminated regions of Ukraine. In the late 1980s, the undamaged reactors were put back into service, but in 1992 following independence, all units at the Chornobyl plant were shut down. However, the critical need for electrical energy caused the Ukrainian parliament in 1993 to order all available units back on line for the foreseeable future. Further, work on additional units at other nuclear power plant sites was reauthorized, after being stopped for several years.

At the time of the accident, the Soviet authorities treated the event with secrecy and callous indifference to public welfare. When the accident became known internationally, an administrative approach was taken to evacuate a 30 km radius zone. There was great reluctance to evacuate all areas severely affected by radiation, and even by 1990 a number of such areas outside the 30 km zone were not yet evacuated and their records of morbidity were suppressed. Food was not carefully screened for radioactivity and farming in contaminated areas was encouraged to continue. Radioactivity in the Prypiat (Pripyat) River, the Kyiv Reservoir on the Dnipro River (a source of drinking water for millions), and in the Dnipro River itself as it flows toward Kyiv, has been officially termed as being at "acceptable levels", but many informed people question this (Figure 9.2). The Prypiat River is so close to the reactor that contamination must have occurred, and the bottom sediments in the Kyiv reservoir are known to have elevated radiation levels.

Moreover, the natural areas of elevated background radiation in Ukraine, particularly in the Ukrainian crystalline shield, make even a small increase from radioactive fallout dangerous. Therefore, it is not surprising that the population mistrusts the official statements regarding the safety of nuclear reactors or the denials of health officials that increasing sicknesses are related to radiation. It didn't help that a fire forced a second unit to be closed at Chornobyl in 1991. In addition, in 1992 there were operating problems, which required unit closures, at the Khmelnytsky, South Ukraine, and Zaporizhzhya (Zaporozhe) power plants.

A map, prepared by the Geographical Branch of the Academy of Sciences of the Ukrainian SSR identifies the main areas of ecological disruption (Rudenko et al., 1990, p. 18). This map is reproduced as Figure 9.3. Ecological disasters ("catastrophes") are identified in the area of Chornobyl and in the irrigated zone of the southern steppe. Very severe ecological disruptions are evident beyond the immediate disaster zones in these two regions, and also in



MAP 9.3 POLLUTION OF THE ENVIRONMENT

resolving the internal economic problems, and the Ukrainian-Russian political issues, that now cloud the contemporary existence of this ancient nation-state.

¹ Throughout this chapter, the former English transliterations (from Russian) of Ukrainian place names are given in parentheses when they differ significantly from contemporary Ukrainian spellings. Some recent works persist in using the traditional "Kiev," rather than the Ukrainian spelling of "Kyiv."

Appendix 9.1. Ukraine's Largest Cities

City (Former Name)	Major Function(s) ¹	Population (1000s)		% Increase 1970-1989
		1970	1989	
Kyyiv (Kiev)	C,P,Ch	1632	2587	58
Kharkiv (Khar'kov)	C,Ch	1223	1611	32
Dnipropetrovsk	C,F,Ch	904	1179	30
Odesa (Odessa)	C,P,Ch	892	1115	25
Donetsk	C,F,Ch	879	1110	26
Zaporizhzhya (Zaporozh'ye)	C,F,Ch	658	884	34
L'viv (L'vov)	C,Ch	553	790	43
Kryvyy Rih (Krivoy Rog)	F	573	713	24
Mariupol' (Zhdanov)	F,P	417	517	24
Mykolayiv (Nikolayev)	C,P	362	503	39
Luhansk (Voroshilovgrad)	C	383	497	30
Makiyivka (Makeyevka)	F	429	430	1
Vinnytsya (Vinnitsa)	C,Ch	212	374	76
Sevastopol'	P	229	356	55
Kherson	C,P	261	355	36
Simferopol'	C	249	344	38
Horlivka (Gorlovka)	Ch	335	337	1
Poltava	C	220	315	43
Chernihiv (Chernigov)	C,Ch	159	296	86
Zhytomyr (Zhitomir)	C,Ch	161	292	81
Sumy	C,Ch	159	291	83
Cherkasy	C,Ch	158	290	84
Dniprodzerzhynsk	F,Ch	227	282	24
Kirovohrad (Kirovograd)	C	189	269	42
Chernivtsi (Chernovtsy)	C	187	257	37
Khmel'nytskyi	C	113	237	110
Kremenchuk (Kremenchug)	Ch	166	236	42
Rivne (Rovno)	C,Ch	116	228	96
Ivano-Frankovsk	C	105	214	104
Ternopil'	C	85	205	141

¹ C=Oblast Capital; F=Ferrous Metallurgy; P=Port; Ch=Chemical Industries

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