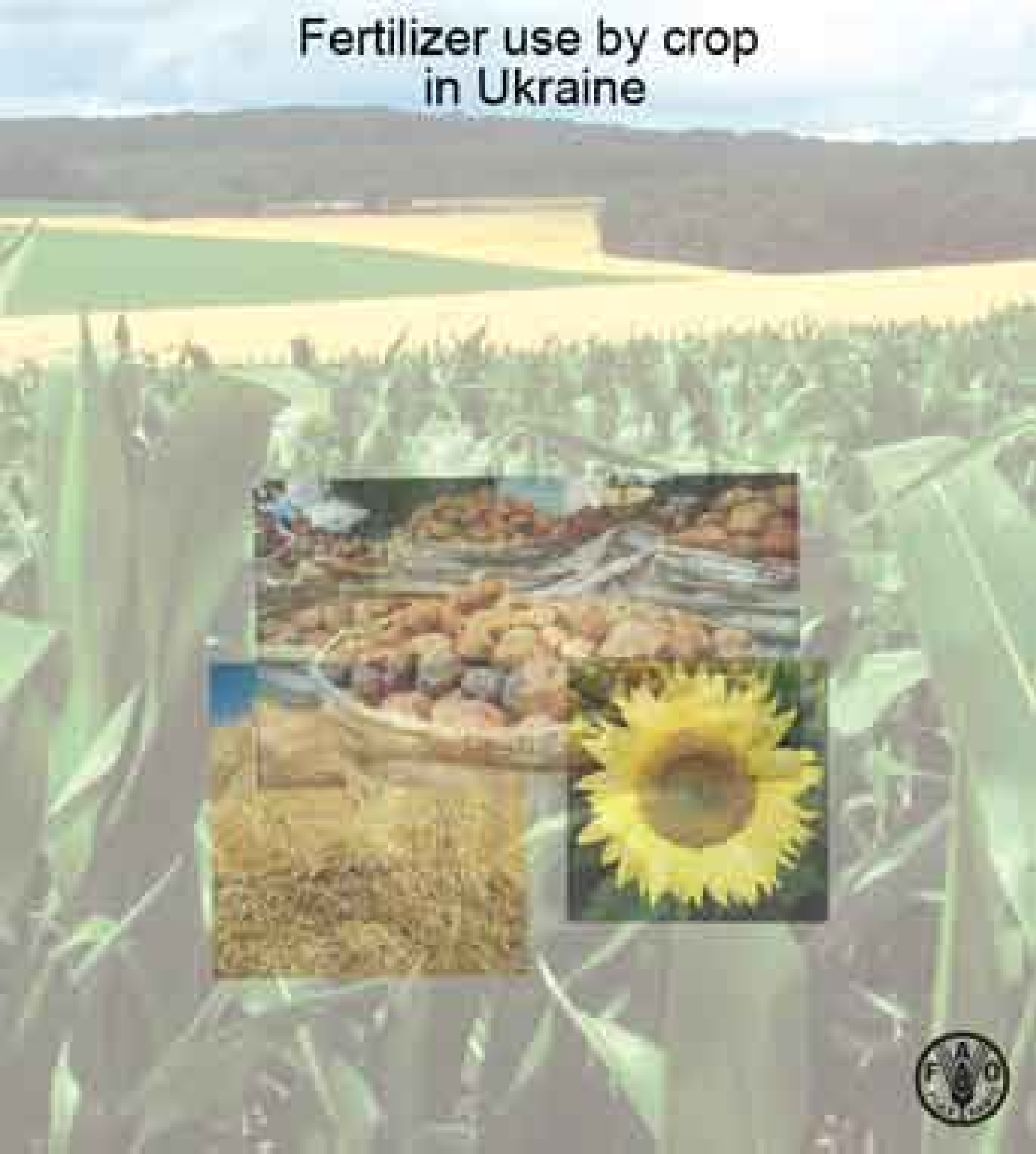
Fertilizer use by crop in Ukraine



Fertilizer use by crop in Ukraine

Land and Plant Nutrition Management Service
Land and Water Development Division

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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Preface

This study, commissioned by the Food and Agriculture Organization of the United Nations (FAO), is one of a series of publications on fertilizer use on crops in different countries.

The aim of the series is to examine the agro-ecological conditions, the structure of farming, cropping patterns, the availability and use of mineral and organic plant nutrients, the economics of fertilizers, research and advisory requirements and other factors that have led to present fertilizer usage. The reports examine, country by country, the factors that will or should determine the future development of plant nutrition.

During the past two decades, increasing attention has been paid to the adverse environmental impact of both the underuse and the overuse of plant nutrients. The efficient use of plant nutrients, whether from mineral fertilizers or from other sources, involves the shared responsibility of many segments of society, including international organizations, governments, the fertilizer industry, agricultural research and advisory bodies, traders and farmers. The publications in the series are addressed to all these parties.

Fertilizer use is not an end in itself. Rather it is a means of achieving increased food and fibre production. Increased agricultural production and food availability can, in turn, be seen as an objective for the agricultural sector in the context of contributing to the broader macroeconomic objectives of society. A review of the options available to policy makers is given in the FAO/IFA 1999 publication entitled *Fertilizer Strategies.*

The contents of the series of studies differ considerably from country to country, in view of their different structures, histories and food situation. But in each case the aim is to arrive at a better understanding of the nutrition of crops in the country concerned.

Acknowledgements

This study is based on the work of Dr. Zenon Hamkalo, Chief of the Department of Agro-ecology, Institute of Plant Cultivation, Obroshyno, Lviv, Ukraine.

The study benefited from the contributions of K. Isherwood (consultant FAO), J. Poulisse and T. van den Bergen (FAO).

The background photograph is from the FAO Mediabase (FAO/ 23197/O. Thuillier) as are the wheat (FAO/6153/F. Bots) and potato (FAO/ 23011/K. Iversen) photographs. The sunflower photograph is from EcoPort produced by the Novi Sad University, Serbia.

Abstract

The natural conditions in Ukraine are fundamentally favourable to agriculture. Over half the land area of the Ukraine, which is one of the largest countries in Europe, has fertile black earth soils. The climate is generally favourable for agriculture but with periodic drought and winterkill of crops. In the early 20th century, the Ukraine was a major supplier of wheat to the world market with a production comparable to that of the United States.

However, following the independence of Ukraine in 1991 there was a severe financial crisis in agriculture. Agricultural production fell, fertilizer use declined several-fold. The quality of the land deteriorated as the nutrient balances became negative and erosion and other forms of soil degradation occurred.

There are almost seventeen thousand large "agricultural enterprises" in the Ukraine, successors to the large state-owned and cooperative farms, and a large and increasing number of privately owned small and medium-sized farms. A progressive restructuring of the sector can be expected in future years.

During the years before the end of the Soviet period, there was a major campaign to increase wheat production using appropriate technologies, including fertilizer use. This resulted in a substantial increase in yields. Between the mid-1960s and the late 1980s, total annual nutrient consumption increased from 1.4 million tonnes to almost 5 million tonnes. Correspondingly, the average yield of winter wheat increased from 2.3 tonnes/ha to 4.7 tonnes/ha.

After 1991, state support to agriculture was greatly reduced. Farmers experienced a cost/price squeeze and had severe financial problems. The centrally planned system based on production targets was replaced by a market-oriented system, which required changes in many aspects of farm management. There was a particularly sharp fall in livestock numbers and the area of land devoted to forage crops declined by nearly 40 percent. Sunflower became the most profitable crop and the area of this crop increased substantially.

Fertilizer consumption fell seven-fold compared with 1990, with phosphate and potash use falling to very low levels. With the collapse of livestock production, the availability of cattle manure was greatly reduced, resulting in a deterioration of the humus balance in the soil. Wheat yields fell to little more than two tonnes/ha. A low point was reached in 1999, since when there has been a slow recovery.

Trial results demonstrate that the application of fertilizers provides an average response in the case of wheat of 4 to 7 kg grain per kg of nutrient supplied, which is viable but which is less than the response in most West European countries. This indicates a need for research findings to be put into practice.

Recommendations concerning the rates of use on the different crops have been developed and continue to be updated. Different institutes are developing methods for calculating the input/output balances of plant nutrients. A constraint is the availability of the required data, normally available only for the large farms.

There is a strong fertilizer manufacturing industry in the Ukraine and an adequate supply of raw materials. With the collapse of the domestic market for fertilizers, manufacturers had to turn to the export market. Ukraine became a major exporter of nitrogen fertilizers, especially of ammonium nitrate and urea.

There is still considerable state intervention in the provision of agricultural services and inputs. The farm cost of fertilizers is subsidized and manufacturers are encouraged to supply stipulated quantities at preferential prices. The distribution system is controlled.

Abbreviations and symbols

SCS	State Committee of Statistics
Rus	Russian language
UAH	hryvnia (Ukrainian currency)
Ukr	Ukrainian language

AN	Ammonium nitrate
AS	Ammonium sulphate
DAP	Diammonium phosphate
MAP	Monoammonium phosphate
NPK	Compound fertilizers containing nitrogen, phosphate and potash
UAN	Urea ammonium nitrate

N	Nitrogen
P_2O_5 or P	Phosphate*
K_2O or K	Potash*

* Phosphate and potash may be expressed as their elemental forms P and K or as their oxide forms P_2O_5 and K_2O. Nitrogen is expressed as N. In this study, phosphate and potash are expressed in their oxide forms.

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Chapter 1
Introduction

Ukraine has substantial potential for the development of its agriculture. Agriculture could become a highly effective, export-competitive sector of the economy, while ensuring national food security. Over half of the total land area is arable land. Approximately one third of the soils of Ukraine are fertile black soils. There are 0.68 ha of arable land per person in Ukraine, compared with about 0.25 ha per person in Europe.

Ukraine occupies an area of 603 670 km^2 and is one of the largest European countries. Its area is larger than that of France (544 000 km^2), Spain (505 000 km^2), Sweden (450 000 km^2) and Poland (312 700 km^2). It is located in the central part of Europe, occupying the southwestern and southern parts of the East European Plain (more than 94 percent of the area). The country extends 1 316 km from west to east and almost 900 km from north to south. Ukraine has borders with Poland, Slovakia, Hungary, Romania, Moldova, Russia, and Belarus.

AGRICULTURAL STRUCTURE

Following the end of the Soviet period, the private ownership of land has been permitted and conditions favouring private enterprise have been introduced. This has resulted in a significant growth of the private sector in total agricultural production. The process is accelerating, the private ownership of agricultural land having increased 1.5 fold since 2000, reaching 12.8 million ha by early 2004, up 17 percent compared with 2003.

By 1 January 2004, privately owned land devoted to agriculture, vegetable growing, meadows and pasture etc. amounted to 6.6 million ha (15.7 percent of the total agricultural area), 5.5 percent more than in 2000. According to the State Committee of Statistic (SCS), there are now approximately 60 000 agricultural units, totaling 23.6 million ha, including 16 900 agricultural enterprises, the successors of the large state-owned and cooperative farms. Some ten percent of farms have areas up to 100 ha, 18 percent from 100 ha to 500 ha, 21 percent from 1 000 ha to 2 000 ha,

11 percent from 2 000 ha to 3 000 ha and 11 percent over 3 000 ha. The land plots of the agricultural enterprises exceed 1 200 ha.

In early 2004, there were over 43 000 privately owned farms in Ukraine, with a land area totaling 3.1 million ha (2.9 million ha of arable land). The average land area of these farms increased by 6 ha over 2003, to reach 72 ha.

In 2003, 3.9 million persons were engaged in agricultural activities, a decrease of 3.9 percent from 2002, 1.6 million persons, 42.7 percent of the total, being engaged in family farming.

LAND DEVELOPMENT

Agricultural land accounts for 70 percent of the total area of the country, amounting to about 42.4 million ha (about 1.2 ha per one inhabitant). This is twice the domestic requirement. Arable land at the beginning of 2004 amounted to 32.5 million ha or 53.8 percent of the total area. For comparison, in the USA arable land accounts for 16.9 percent of the total, in England for 29.6 percent, France 32 percent and Germany to 32.3 percent. In order to satisfy basic domestic food requirements, 11.7 million ha arable land are required, 17.7 million ha for the maintenance of reasonable norms of consumption. Allowing for exports, 22.6 million ha are needed.

In some regions the proportion of arable land reaches 90 percent (Table 1). The proportion is highest in the Forest-Steppe zone (85.4 percent) and lowest in Polissya (68.9 percent). The remaining areas are under perennial crops (2.7 percent), meadows (5.1 percent) and pasture (11.4 percent), (Land Resources of Ukraine, 1998).

AGRO-ECOLOGICAL ZONES

Because of its vast territory and climate, the geomorphology and the soils in Ukraine are very varied. From North to South, the territory is divided into three large natural zones: a mixed-forest zone, a forest-steppe zone and a steppe zone. In addition to these three natural zones, there are two mountain regions in Ukraine, the Carpathians and the Crimean Mountains (Chepkov *et al.,* 1982). The dominant soil map of Ukraine map of the Ukraine (Figure 1) was prepared on a scale of 1: 5 million.

TABLE 1
Arable land in regions of the Ukraine

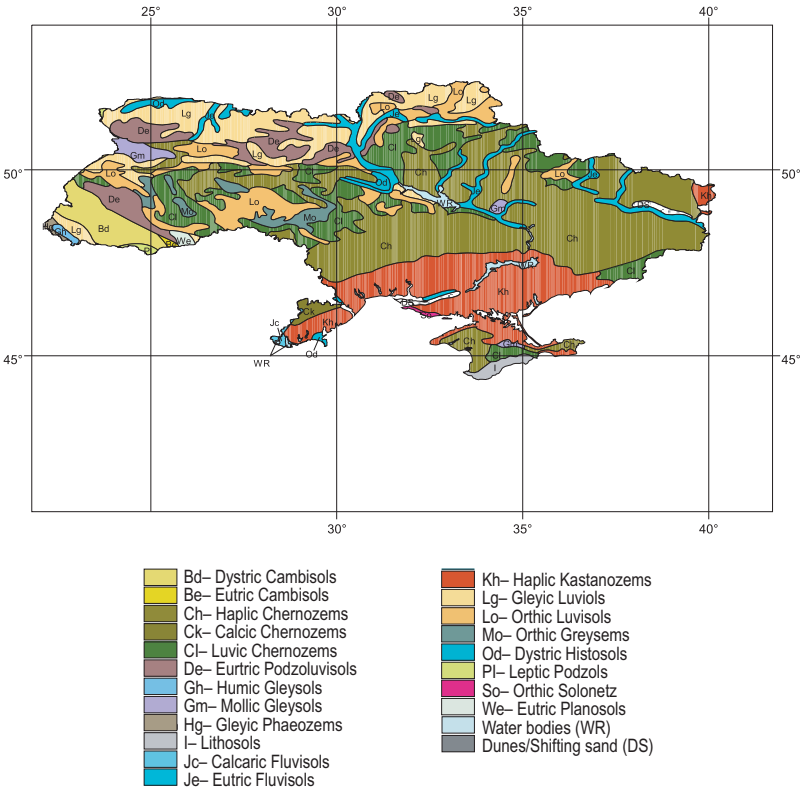
Administrative districts and regions	Arable land (%)	Administrative districts and regions	Arable land (%)
Autonomous Republic of Crimea	62.8	Luhanska	53.3
Cherkaska	65.8	Lvivska	40.2
Chernihivska	48.5	Mykolayivska	73
Chernivetska	43.1	Odeska	66.5
Dnipropetrovska	70	Poltavska	67.1
Donetska	63.9	Rivnenska	33.6
Ivano-Frankivska	30.1	Sumska	56.7
Kharkivska	63.5	Ternopilska	65.4
Khersonska	72.9	Vinnytska	67
Khmelnytska	62.8	Volynska	34.8
Kirovohradska	74.8	Zakarpatska	15.9
Kyiv	-	Zaporizka	75.4
Kyyivska	53.3	Zhytomyrska	41.6

CLIMATIC RESOURCES

Almost all of the territory of the Ukraine lies within the temperate climatic zone, with the exception of the Crimean South Coast, which belongs to the sub-Mediterranean zone and shows some subtropical climatic features. The average temperatures of January vary from -8 degrees Centigrade in the northeastern part to +2 or +4 degrees Centigrade in the southern part (the South Coast of Crimea). The average July temperature varies in these regions from +18 to 19 to +23 to 24 degrees Centigrade respectively. The annual precipitation in the northwestern plains is about 600 to 700 mm; the southeastern steppe regions receive as little as 300 mm of rainfall a year. Yet, in the mountains there are regions in which the annual rainfall goes up to 1 000 to 1 200 mm (the Crimea) or 1 600 mm (the Carpathians).

The climates in Ukraine vary considerably according to the region. For example, it is possible to grow sub-tropical crops in the Crimea but in general all the territory of Ukraine is suitable for growing all crops of temperate zones. In order to produce good harvests in the South of Ukraine it is necessary to irrigate because the annual rainfall is rather low and droughts may occur.

FIGURE 1
Dominant soil map of Ukraine



Orignal scale: 1:5 million.
Source: DSMW-FAO-UNESCO.

SOIL COVER

Within the territory of Ukraine there is a Mixed Forests zone (Polissya) where Albeluvisols dominate (Table 2), a Forest-Steppe zone with broad-leaved forests and Phaeozems, Chernic Chernozems and Luvic Chernozems soils and a Steppe zone with sub-zones where the following soils can be found: Chernic Chernozems formed under mixed fodder, sheep's fescue (*Festuca ovina L.)* and European needlegrass and Luvic

TABLE 2
Soil-climatic zones of the Ukraine

Soil-climatic zone	Soil name in the nomenclature of the World Reference Base for soil resources (1998)
Polissya	Albeluvisols, Arenosols, Histic Fluvisols
Forest-Steppe	Chernic Chernozems and Luvic Chernozems, Phaeozems
Steppe	Chernic Chernozems, Calcic Chernozems, Kastanozems
The Carpathian Mountains	Dystric Cambisols
The Crimean Mountains	Eutric Cambisols, Calcaric Cambisols

Source: Grin and Krupskiy, 1969.

Kastanozems formed under worm-wood, sheep's fescue and European needlegrass.

The major representatives of the large soil groups in Ukraine include, in order of importance, the Chernozems and their related chestnut soils (Kastanozems), the various podzolized Chernozems of the Forest-Steppe and the podzols of the forest. Chernozems occupy 41 percent of Ukraine's surface and even more of its agricultural land (54 percent) and arable land (58 percent) (Encyclopedia of Ukraine).

Chestnut soils, related to the Chernozems, occupy only 3.3 percent of the area and 3.4 percent of the agricultural land but account for 3.9 percent of the arable land. The presence of sodium cations in the chestnut soils causes a gradual change into salinized chestnut soils (Luvic Kastanozems) and Solonetz soils.

Solonetz soils have a low content both of humus (1 to 3 percent) and of available plant nutrients. In Solonetz soils the salts are leached to a certain depth, which allows a broader range of plants to grow. Solonchaks, by contrast, are salinized up to the surface, and only salt-tolerant species of plants (halophytes) can survive. The process of salinization can be reversed only by expensive ameliorative measures, such as subsurface drainage, deep ploughing, the application of gypsum or other agronomic techniques.

The podzolized soils (Albeluvisols) of the Forest-Steppe developed with the encroachment of deciduous forest into the domain of the Steppe. One-third of the soils in the Forest-Steppe are podzolized; their area represents 12 percent of the area of Ukraine but 18 percent of its agricultural land and 21 percent of its arable land.

Degraded Chernozems still retain the Chernozem characteristics. Inherent soil fertility is diminished as a result but can be enhanced with the application of mineral fertilizers and manure.

Podzolized Chernozems are more severely leached than degraded Chernozems, as is apparent from the presence of a narrow leached zone at the bottom of the topsoil layer. Grey forest soils, by contrast, have a thinner (20 cm) dark grey layer of topsoil with a lower (1.5 to 3.5 percent) concentration of humus.

Podzols of the forest and associated soils are found in northern and northwestern Ukraine. The podzols occupy about 13.5 percent of the area of Ukraine; another one percent, the remaining part of the region, consists of alluvial and organic soils. Known for their infertility, the podzols account for only 7.8 percent of the agricultural land and 6.8 percent of the arable land of Ukraine.

Bog soils (Histic Fluvisols), formed under poor drainage conditions, are representative of the hydromorphic suborder of the intrazonal soils. In Ukraine bog soils are abundant in the wet regions of Polissya (the Prypiat River Basin), in Chernihiv Polissya, and the Forest-Steppe. Because of their high organic content, bog soils can be agriculturally productive, but first they must be drained and then treated with fertilizer. Bog soils occupy about 5.5 percent of the area of Ukraine and 4.5 percent of its agricultural land but only 0.24 percent of the arable land.

Meadow soils (Umbric Gleysols, Dystric Fluvisols and Eutric Fluvisols) are formed on the floodplains of streams and rivers where occasional floods and imperfect drainage provide for increased moisture. Excluding the Solonetz, meadow soils occupy 4.3 percent of the area of Ukraine and 4.4 percent of its agricultural land but only 2.1 percent of the arable land.

STATUS OF SOILS AND THEIR FERTILITY

Depth of soil humus layer

The depth of the humus layer of the soils of Ukraine varies from 15 to 150 cm and sometimes even more. Soddy podzolic non-gleyed sandy and loamy sandy soils (Eutric Podzoluvisols), dominant in Polissya, are notable for a weak humus layer (17–24 cm). An increase in the depth of this layer from 7 to 26–31 cm accompanies the appearance of signs of gleyzation. A finer texture results in the humus layer depth increasing

to 35–45 cm and for gleyic soils to 35–50 cm. The soddy process of soil formation also increases the humus profile depth, which is 66–70 cm in dark grey podzolized soils and Chernozem podzolized soils. The Forest-Steppe zone is mainly occupied by typical Chernozems. The humus layer has a depth of 71–120 cm. In the Steppe and Dry Steppe the soils with a humus layer of 41–70 cm prevail: ordinary Chernozems and southern (dark) chestnut soils (Haplic Kastanozems), (Medvedev, 1997).

The soils of the Ukraine have a humus layer of 71–120 cm on one third of their area. Soils with depths of 41–70 cm and 26–40 cm have roughly the same area (Medvedev, Laktionova and Kanash, 2003).

Soil acidity

In the case of the soils of the Steppe and Dry Steppe zones, the pH is within the range of 6.0 to 7.0. In the other zones the pH values vary according to the region. The pH value of the Precarpathian and Transcarpathian soils fluctuates within the range of 4.4 to 4.7. These same pH values are found elsewhere only in the most leached soils of Polissya. In the mountainous soils of the Carpathians the pH is even lower, at 4.3. In Polissya, most of the soils have a pH level of 4.8 to 5.1 and 5.2 to 5.5. There are small regions of podzolized Forest-Steppe soils on loess rocks with a pH of 5.5 to 5.9. Soils with carbonate rocks emerging on the surface have a pH of 6.0 to 6.6 and more than 6.6. As a whole in Ukraine in most cases the soils have high acidity (Table 3).

Phosphorus

According to the results of the sixth agrochemical survey of Ukrainian soils, most have a low and average content of phosphorus (Table 4). Even fertile black earth soils often showed content of available phosphorus that is insufficient to produce high yields.

TABLE 3
Soil pH in the agro-ecological zones in the Ukraine

Zone	Area of soil groups by pH, %				
pH	<4.5	4.5-5.0	5.1-5.5	6.0-7.5	>7.5
Polissya	4.1	10.0	17.5	66.0	2.4
Forest-Steppe	0.8	5.5	17.0	75.0	1.7
Ukraine	1.8	6.7	17.2	72.4	1.9

TABLE 4
Content of available phosphate in Ukrainian soils

Zone	Distribution of soils by phosphate content, percent			
	Low	Average	Fairly high	High
Polissya	17.9	26.6	24.8	30.7
Lisosteppe	5.0	50.9	27.4	16.1
Steppe	7.9	44.8	29.5	17.8
Total Ukraine	**8.3**	**44.5**	**27.9**	**19.4**

Source: Sixth agrochemical survey, 1991-1995.

In most cases soddy podzolic, brown mountainous-forest soils have either a low or very low available P_2O_5 content. The poorly podzolized Forest-Steppe (dark grey, podzolized Chernozems) soils have a medium or high content and the light-grey and grey forest soils take an intermediate place. Almost everywhere Chernozems are characterized by relatively high and high content of available phosphorus. Chernic and Calcic Chernozems have almost the same phosphorous content; Haplic and Luvic Kastanozems are poorer in phosphorus. In general, the soils of the Ukraine have limited available phosphorus that is insufficient to produce high crop yields.

Potassium

The soils of the Ukraine are characterized by a large variation in the content of available potassium. Its content increases from the soddy podzolic soils of Polissya to the Chernic Chernozems, the latter having a high to a very high content. Data from the sixth agrochemical survey of Ukrainian soils indicate that the majority of the soils are characterized by a rather high (33.1 percent of the total area) to high potassium content (35.7 percent), see Table 5. The soils of the Steppe have the highest potassium content. The soils of the Forest-Steppe region and Woodlands have an average content (Table 6); the crops cultivated in these zones, such as potato, sugar beet and maize have the highest potassium requirement.

TABLE 5
Exchangeable potassium content in Ukrainian soils, 1966 to 1995

Years	Distribution of soils by potash content, percent			
	Low	Average	Fairly high	High
1966–1970	18.0	35.2	23.8	22.9
1986–1990	7.1	22.9	32.5	37.5
1991–1995	7.5	23.6	33.1	35.7

Source: Sixth agrochemical survey, 1991-1995.

Generally, Ukraine's soils are characterized by high natural fertility. There is a prevalence of varieties of black-earth soils, the most fertile being typical black-

TABLE 6
Exchangeable potassium content Ukraine soils, by region

Years	Content of K_2O, mg/100 g of soil			
	Steppe	Forest and steppe regions	Wood-lands	Ukraine
1986–1990	13.7	10.6	10.3	11.3
1991–1995	11.6	10.5	11.4	11.1

Source: Sixth agrochemical survey, 1991-1995.

earth, regular black-earth and southern black-earth soils. They account for 18.1 percent, 27.7 percent and 8.9 percent respectively of the total area of the country's farmland. Some ten percent of the farmland has sub-podzolic and black earth soils. Some six percent have black earth and turf soils on solid rock, black earth on loamy sand and sand rock, and meadow-black earth soils. Large areas are occupied by turf-sub-podzol (nearly 7 percent), sub-podzolic (5 percent) and grey-forest (6.7 percent) soils - these soils are characterized by relatively high natural fertility. Brown soils (some 9 percent), meadow soils (2 percent), turf soils (1.3 percent) and other soils also occur.

Soil degradation

Some qualitative characteristics of soils are shown in Table 7. General conclusions drawn at the Institute for Soil Science and Agro Chemistry Research testify that during recent decades the state of soils in Ukraine has deteriorated.

TABLE 7
Some qualitative properties of soils in regions of the Ukraine ('000 ha of agricultural land)

Oblasts	Total area	Salt	Solonetzic	Acid	High moisture	Water logged	Rocky	Eroded
AR Crimea	1 802	201	450	-	181	1	212.7	207
Cherkaska	1 457	7	5	691	22	15	-	362
Chernihivska	2 106	132	54	923	179	399	-	66
Chernivetska	474	-	-	190	28	16	16	201
Dnipropetrovska	2 512	130	77	-	69	33	0.3	997
Donetska	2 050	91	145	-	36	22	42.4	1 356
Ivano-Frankivska	635	-	-	413	40	25	54.8	136
Kharkivska	2 424	139	146	729	14	48	1	1 111
Khersonska	1 969	261	787	-	140	1	3	264
Khmelnytska	1 571	-	-	620	122	82	11	664
Kirovohradska	2 042	4	0.8	1018	4	8	1	1 029
Kyyivska	1 676	73	2	573	36	84	-	174
Luhanska	1 920	88	76	-	30	16	42	1 216
Lvivska	271	-	-	580	192	75	12	301
Mykolayivska	2 013	67	15	46	67	15	28	938
Odeska	2 593	73	68	6	78	15	15	1 241
Poltavska	2 186	248	310	56	24	46	-	356
Rivnenska	937	6	-	356	100	67	13	149
Sumska	1 709	113	71	691	21	90	-	305
Ternopilska	1 055	-	-	485	92	68	19	391
Vinnytska	2 019	-	-	1 164	106	76	2.2	744
Volynska	1 056	211	0.3	11	-	270	-	89
Zakarpatska	462	-	-	353	56	92	87.9	38
Zaporizka	2 248	76	38	-	87	26	2.6	693
Zhytomyrska	1 600	-	-	749	74	325	12.9	64
Total Ukraine	**41 786**	**1 919**	**2 247**	**10 449**	**1 795**	**1 948**	**575**	**13 089**

Source: Medvedev, Laktionova and Kanash, 2003.

Chapter 2
Crop production systems

CROPPING PATTERNS

The production of cereal and industrial crops tends to be the specialization of the "agricultural enterprises". Major cereal crops include winter wheat, spring barley and fodder maize. Winter wheat appears to be the main crop for both private farms and agricultural enterprises. However, the majority of the private farms have relatively small areas of winter wheat and other cereal crops, the average area sown to winter crops on these farms being 39.9 hectares. The largest areas sown to winter crops on private farms are on farms in Kherson and Donetsk oblasts, with 59.8 and 42.3 hectares respectively. The smallest (14.6 hectares) are on farms in Ivano-Frankivsk oblast (SCS, 2002-2004).

Industrial crops include sunflower, sugar beet and rape seed. Many surveyed farms in Kherson, Donetsk and Poltava oblasts specialized in the production of the first two crops. Donetsk oblast has a number of specialized agricultural producers with areas sown to sunflower reaching 1 200 hectares, while the average area under this crop in the sample was 268.7 hectares. The high profitability of this crop encourages many farmers to grow sunflower.

As most cereal and industrial crops are produced by agricultural enterprises, private farms tend to focus on growing fruit and vegetables. The principal reasons for specialization in vegetable growing are the numerous possibilities for selling the produce (either fresh or for processing) and the possibility of using manual labour instead of special equipment.

Yield is one of the key performance indicators. Yields of major agricultural crops vary both between regions and between the main categories of farms. Thus, in 2002 to 2004, in most oblasts, private farms tended to have higher yields of winter wheat than the agricultural enterprises.

In recent years, the traditional zonal pattern of growing major agricultural crops has changed. Thus, for example, sugar beet, a crop grown predominantly in the Forest-Steppe zone, has advanced further south and is now grown by Kherson farmers. However, the areas sown to these crops are not significant, and the yields are much lower than in the traditional production areas. For example, the yield of sugar beet on the surveyed farms of Kherson oblast was 5.8 tonnes/ha, while in Poltava oblast the figure was 29.4 tonnes/ha.

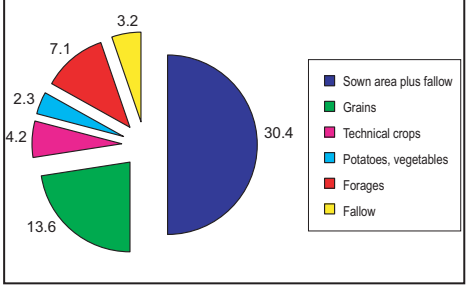
CROP PRODUCTION SYSTEMS

Crops

The use of agricultural land, which includes cultivated land (cereals, industrial crops, forages, potatoes and vegetables etc.), gardens, orchards, vineyards, and permanent meadows and pastures, has changed significantly since Ukraine declared independence from the Soviet Union in 1991. The areas devoted to the different crops are shown in Figure 2.

Between 1991 and 2000, the area sown to crops fell by about 5 percent, from 32.0 million hectares to 30.4 million. The area of almost every category of crop fell, except that of industrial crops, especially sunflowers. The area devoted to forage crops fell by nearly 40 percent, in line with a sharp fall in livestock numbers and hence the demand for feed. Winter wheat, spring barley, and maize are the country's main cereal crops. Sunflowers and sugar beet are the main industrial crops. The development of the production and yields of the main crops from 2000 to 2004, are shown in Table 8.

FIGURE 2
Land use (million ha)



Data source: SCS.

Wheat is grown throughout the country, but central and south-central Ukraine are the key production zones (Figures 3 and 4). About 95 percent of the wheat in Ukraine is winter wheat, planted in the autumn and harvested during July and August of the following year.