

Country Pasture/Forage Resource Profiles

UKRAINE



by
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1. INTRODUCTION

With a population of 49 700 000 (according to the World Factbook the 2006 population was estimated at 46 710 816 with a growth rate of -0.6%), Ukraine covers an area of 604 000 km². It is in the south-east of the Eastern European plain between longitudes 22°08' and 40°13' east and latitudes 44°22' and 52°18' north. Its greatest distance from west to east is 1 316 km, from north to south – 893 km. It borders Belarus to the north, Russia in the east and south-east; Moldova and Romania in the south-west; with Hungary, Slovakia and Poland in the west. In the south it has outlets to the Azov and the Black Sea. The length of seaboard is about 1 580 km.

From a total land area of 604 000 km² of land, the utilized agricultural area is 418 000 km² (i.e. 69% of the total). Arable land occupies 326 700 km² (54% of the total), natural haymaking and pastures – 78 400 km² (13%), orchards, berry-fields, vineyards and other long-term plantations – 22 500 km² (4%). Forests cover 94 000 km² (15.6% of the total land area). The greatest areas of forest are in the northern flat part of Ukraine and in mountain regions of the Carpathians and the Crimea (forest covers 27% of these regions). The forests yield about 9 000 000 m³ of wood or 22–25% of national requirements. The forests play a considerable role in soil and water conservation, as well as areas for recreation.

In the former Soviet Union the agricultural enterprises were mainly collective and state farms. In 1980 there were 9 067, of which collective farms – 6 963 and state farms – 2 104. The process of conversion of collective and state farms took place in the following years. The size of farms varied depending on specialization and territorial location; the average size of collective farms was 5 158 hectares, state farms – 5 671 ha (in Polissia : 2–4, Forest-steppe : 3–6, in Steppe : 6–10 thousand ha) (Urogaj, 1979).

Collective and the state farms undertook more than 90% of crop production and 70% of cattle-raising (66–69% of meat, 73% of milk, 96–97% of wool). The remaining production was from individual farms.

Occupying 2.7% of land area of the former Soviet Union and 16% of its cultivated area, Ukraine produced in 1970 (as a percentage of total production) 20% of the grain, 59% of the sugar beet, 62% of the beet sugar, 44% of the sunflower seeds, 21% of the potatoes, 22% of the milk and 22% of meat of every kind. As to grain production, according to FAO estimates, Ukraine was in first position in Europe and in fourth position (behind USA, China and Canada) in the world. Ukraine in 1990 produced 51 000 000 tonnes of grain, or 1 ton per capita. Over 40% of the sown area and gross harvest of grain were winter wheat. The same level was anticipated in the future (Ministry of Agrarian Policy, 2000). However, intensification of agriculture with a high ratio of ploughed land (54% of the entire territory or 82% of all cultivated area) caused serious erosion and deterioration of the potable water quality. Annual losses of soil reached some 600 000 000 tonnes, including 20–30 000 000 tonnes of humus. Calculations show that ecological and economical losses caused by the erosion exceed US\$ 1.6 billions a year.

Coarse grain and pulse crops contributed 16.2% to the structure of grain planting in 1991–1995. Their percentage was reduced to 15.9% in 1996–1997. 11% are planned for 2002–2004.

The area of forage crops grew constantly from 6 000 000 ha in 1913 to 10–11 000 000 ha (32% of the total sown area) in 1965–1970; the area reached remained stable until quite recently. Most of this



Figure 1. Maps of Ukraine

area was maize intended for silage and green feed, annual and perennial grasses, root crops and fodder melon-watermelons. Perennial grasses have been gaining favour in recent years.

Ukraine became independent in 1991. Land reforms undertaken in 1992 provided free distribution of land to private citizens to carry on private infield farming. A new branch of economy for Ukraine – farming – had emerged. The number of farms has now reached 40 000, their average area being 22.6 ha. Now we have the process of farm strengthening through co-operation, formation of agrarian partnerships, as well as through lease of land plots (shares) in private ownership of people by members of some collective and budgetary enterprises. Nevertheless, the public production sector has been the largest up to 1999 and remains the largest now. It manages 87% of cultivated land. The structure of agricultural production of Ukraine is shown in Table 1.

Disruption of interindus-

trial links caused by the disintegration of the Soviet Union, sky-rocketing energy prices and technical facilities with high inflation rates and unbalanced economic mechanisms, including inadequate pricing, unfavourable credit and tax policies, high disparity of prices of food and industrial products (1:5), large debts in payments for work and low solvency of enterprises, slight upgrading of fixed assets and high depreciation of technical facilities - all this caused serious economical crises and recession in practically all branches of agriculture under a market economy.

Compared to 1990, application of mineral fertilizers in 1999, per hectare of sown area, was reduced by a factor of 7.8, and organic ones by a factor of 5. During the same period, the area of lime application on acid soils was reduced by a factor of 62 and gypsum treatment of saline soils was reduced by a factor of 179. Land cultivation techniques in recent years have violated good practice under conditions of extremely unfavourable balance of humus, phosphorus and potassium, resulting in an overall decline in the yield of crops and gross harvest of crop products (Tables 2 and 3).

From 1990 to 1999, cattle were reduced by a factor of 2.1, cows by a factor of 1.4; milk yield per cow fell by 1.7, and weight increments were reduced by 1.8. Beef production, as slaughter weight, was reduced from 84 to 44.5 kg per capita in 1995 already, while in 1999 the figure has dropped to 34 kg; milk per capita was reduced from 472.3 to 335.2 and 267.7 kg respectively. Sheep rearing is in a tight situation now as well. All this led to a steep reduction of gross agricultural production. From 1990 to 1999,

Table 1. Structure of agricultural production of Ukraine

	Years					
	1991	1995	1996	1997	1998	1999
Collective agricultural enterprises	9 043	9 716	10 252	10 261	10 465	10 465
Agricultural cooperative farms	308	341	348	335	357	362
Agricultural joint-stock companies	-	299	699	1 423	1 847	1 995
State agricultural enterprises	4 659	5 253	4 440	3 965	3 774	3 309
Farms	2 687	37 113	38 988	39 880	38 874	38 782
In total commodity producers	16 697	52 722	54 727	55 864	55 017	51 913

Source: Department of strategy and development of agrarian economy of the Ministry of Agrarian Policy of Ukraine database, 1999

Table 2. Productivity of basic crop agricultural enterprises, kg/ha

Crops	Years					
	1990	1995	1996	1997	1998	1999
Grain-crops (total)	3 510	2 430	1 950	2 430	2 060	1 930
Sugar-beet	27 600	20 300	17 900	17 300	16 800	14 800
Sunflower	1 570	1 430	1 050	1 150	940	1 000
Flax	640	500	330	290	360	270
Potatoes	1 130	5 500	10 400	6 700	9 200	5 700
Vegetables	15 700	8 300	6 900	8 100	9 000	8 200
Fruits & berries	4 000	1 070	1 740	2 390	770	330
Grapes	5 190	2 740	3 110	1 900	1 910	2 110
Melons and gourds	5 600	5 300	7 200	3 100	3 800	4 900

Source: Department of strategy and development of agrarian economy of the Ministry of Agrarian Policy of Ukraine database, 1999

Table 3. Crop production in all categories of enterprise ('000 tonnes)

Crops	Years					
	1990	1995	1996	1997	1998	1999
Grain-crops (total)	51 009	33 930	24 572	35 471	26 471	24 581
Sugar-beet (factory)	44 265	29 650	33 009	17 663	15 523	14 064
Sunflower (processed)	2 571	3 860	2 123	2 308	2 266	2 794
Flax (lint)	108.1	48.7	17.8	9.32	9.34	5.57
Potatoes	16 732	14 729	18 410	16 701	15 405	12 723
Vegetables	6 666	5 880	5 070	5 168	5 492	5 324
Fruit & berries	2 905	1 897	1 924	2 794	1 178	766
Grapes	836	457	498	319	270	306
Melons and gourds	792	497	362	280	261	476

Source: Department of strategy and development of agrarian economy of the Ministry of Agrarian Policy of Ukraine database, 1999

this criterion was reduced by 48.5% for all categories of enterprises; reduction in plant growing was 52.9%, in cattle breeding 44.2% (Figure 2).

Decrease in farm production under crisis conditions was considerably smaller compared to public enterprises (Figure 3): gross production was reduced by 0.9%, cattle-breeding by 11%, while crop production even increased by 12.8% which shows their better profitability.

Collective and public agricultural enterprises only retained quite good production indices during this period where their managers put general economic interests above personal ones. Export totals were reduced for many kinds of agricultural commodities, except for wheat, oats and rye grain (Shpitschak, 2000).

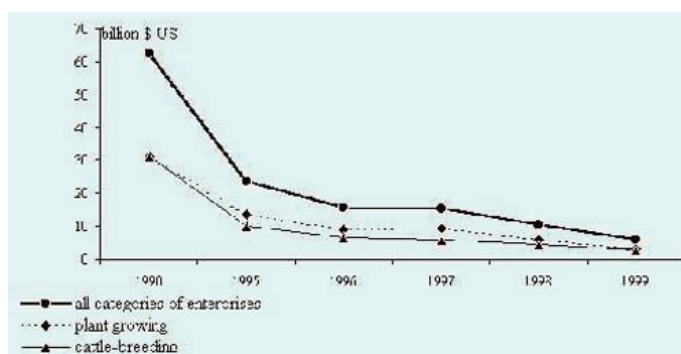


Figure 2. Dynamics of gross agricultural production

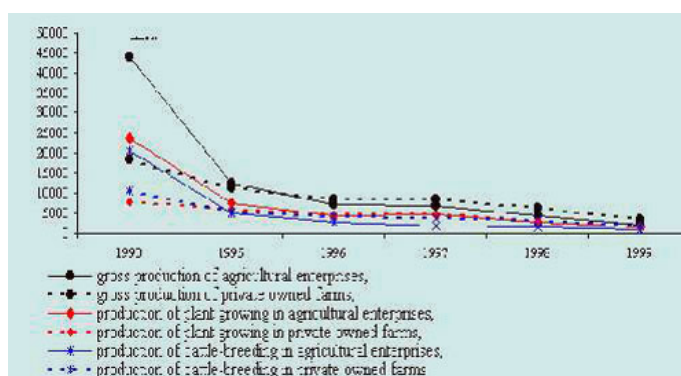


Figure 2. Dynamics of gross agricultural production in various categories

2. SOILS AND TOPOGRAPHY

Major topographical features Plains occupy over 90% of Ukraine. However it has the Crimean Mountains in the south and the Carpathians in the west. The highest elevations of its plains are 300–473 m above the sea, while those in the highlands reach heights of 1 542 m (Mt. Roman-Kosh in the Crimean Mountains) and 2 061 m (Mt. Goverla in the Carpathians). The high part of the flatland is in the central and southern areas of the country; it spreads from the west to south-west and occupies Podolskaia, Prydneprovskaia, Pryazovskaia and the Donetskaia high grounds. The lowest elevations can be found in the south, in Prychernomorie lowlands (38–67 m), in the centre – Prydneprovskaia lowland (65 m) and on the northern territories of Ukraine referred to as the Poltava plain and Polissia lowland. Soil cover of the latter region is the least well drained and may be characterised by a high percentage of swampy land. 32 000 km² (66%) of swamps have been drained and brought into agricultural production. It is planned to increase the drained swamp area up to 38 000 km² in the future (Kovalenko, 1998). Large stocks of peat are available.

The river network comprises over 22 000 rivers with a total length of up to 170 000 km. The Dnieper, the largest – its basin covers 40% of the Ukraine – crosses the country from north to south and flows to the Black Sea, being the largest navigable artery of the country. There are many lakes, reservoirs and ponds.

Major soil types The soil cover of Ukraine is diversified and tends to occur in latitudinal zones across the country (Figure 4).

The north-west has a wide belt of soddy (dern or dernovo)- podzolic soils with mainly light texture on sand-clay strata. These soils form some 70% of the total cover, are characterised by low humus content, increased acidity and therefore need application of mineral fertilizers and organic manures, as well as lime to yield a rich harvest. Thirty% of the territory is occupied with sod (dern), meadow, meadow-bog and peat-bog soils with slight soddy (dernor dernovo) sands on elevated pine-clad terraces. Over 600 000 hectares (60%) of Ukrainian peat lands are concentrated here.

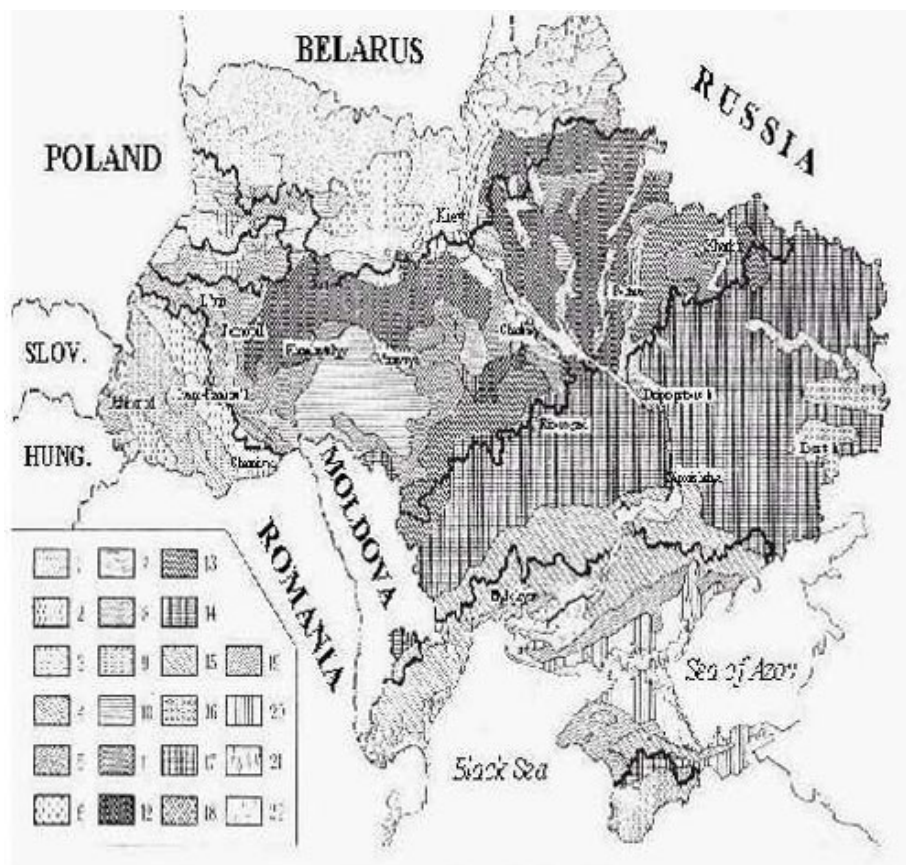


Figure 4. Soil map of Ukraine

- | | |
|--|---|
| 1 - soddy weakly podzolic sandy soils (dern weakly podzolic sandy soils); | 11 - podzolized chernozems (podzolic chernozems); |
| 2 - soddy medium-podzolic sandy loam soils (dern medium-podzolic sandy loam soils); | 12 - low in humus deep chernozems (deep low in humus chernozems); |
| 3 - soddy podzolic soil in the complex with rendzina (dern podzolic soil in the complex with humus carbonate soils); | 13 - medium in humus deep chernozems; |
| 4 - mountain podzol and meadow gravelic soils (mountain podzolic soil and meadow gravelic soils); | 14 - common chernozems; |
| 5 - soddy podzolic and soddy gley soils (dern podzolic and soddy gley soils); | 15 - southern chernozems; |
| 6 - meadow soils; | 16 - chernozems on firm noncalcareous rocks, partly gravelic; |
| 7 - bog(gy) soils and peatlands (moor soils and peat soils); | 17 - chernozems on firm calcareous rocks, partly gravelic; |
| 8 - chernozem-like meadow solonetz(ic) soils; | 18 - sandy chernozems (chernozem(ic) sandy soils); |
| 9 - brown mountain forest and soddy (or dern) brown mountain forest gravelic soils; | 19 - dark chestnut soils; |
| 10 - grey forest soils; | 20 - chestnut soils in the complex with solonetzes |
| | 21 - meadow solonchak soils (meadow solonchakous soils); |
| | 22 - blown sands (friable sands; unfixed sands) |

A wide belt of grey forest soils, as well as podzol and typical chernozems with a 1.2–1.5 m thick humus bed, running from south-west to northeast, is located somewhat to the south. These soils are formed on loess strata. In addition to these, small areas are occupied with bog, meadow and meadow-chernozem soils, often of solonetz type.

Further to the south, encompassing a considerable part of the territory of Odessa, Kirovograd, Dnipropetrovsk, Zaporizhia, Donetsk and Lugansk regions, typical chernozems stretch, with the thickness of their humus bed up to 80–90 cm, formed on moist-loamy strata.

The southern part of Prychernomorie lowlands contains dry southern chernozems, which are replaced along the coastlines of the Black Sea and the Sea of Azov with a rather narrow strip of dark-chestnut and then chestnut soils combined with solonetz and soloth.

Carbonatic chernozems and brown forest (often with gravel) soils prevail in the Crimean Mountains, while the Carpathians are characterised with short-profile mountain-forest and sod-brown soils with low content of humus, leached and heavy acid soils (pH=3.6–5).

[Note: The classification applied in this paper is the Russian Soil Classification (Ivanova and Rozov, 1967) or a variant thereof. The terms *dern(ovo)* and *sod* are typically Russian and not easily translatable. *Dernovo* is used as “pseudo” in podzol-like soils. “*Sod*” refers to the topsoil horizon. Many of these soils correspond with the *Albeluvisols* (or *FAO Podzoluvisols*) which are characterized by a dark surface horizon, a bleached eluvial horizon and a horizon in which clay has accumulated. They are normally acid and sandy textured.

A soil map of the Ukraine is contained in the *FAO Land and Water Digital media series # 10 (Soil and Terrain Database, Land Degradation Status and Soil Vulnerability Assessment of Central and Eastern Europe.)* For details about this CD see http://www.fao.org/catalog/book_review/giii/x8322-e.htm

Another CD ROM with a smaller scale soil map for Ukraine but also including a book on “*Russian soils and their classification*” is contained in *FAO Digital Media Series #7 Soil and Physiographic Database for Northern Eurasia.* For details see < http://www.fao.org/catalog/book_review/giii/x3528-e.htm > and extracts of the book at the *iiasa* website. http://www.iiasa.ac.at/Research/FOR/papers/medea/3_soils.htm].

3. CLIMATE AND AGRO ECOLOGICAL ZONES

General climate - effects of topography. Nearly all of Ukraine is within the temperate zone. Only the southern coast of Crimea has sub-tropical features. Annual total solar radiation varies from 96 to 125 kcal/cm². The average annual air temperature increases from 5–6 °C in the north-east up to 9–11 °C in the south-west. Absolute values of temperature: minimum –34 to 37 °C of frost, maximum +36 to 38 °C above zero. On average on flat areas 300–700 mm of precipitation falls annually, in mountain regions up to 1 200 mm. The climate is generally favourable for most of the important crops, and on most of the territory allows two harvests per year.

Agro-ecological zones. There are three major agro-ecological zones: *Polissia* in the north (mixed forest zone, 19% of the entire Ukrainian territory), *Forest Steppe* to the south (33%) and *Steppe* in the south (40%).

Polissia is the least ploughed part of the territory, characterised by a diverse mosaic of natural complexes, with many hayfields and pastures (these account for 17.8% of agricultural holdings with 77.3% being natural pastures and 22.7% sown. The percentage of ploughed land here is 36.4% of the terrain or 65.8% of cultivated area. Conditions are suited to many cereals, pulse crops, potatoes, flax, forage crops and traditional development of beef-dairy cattle-raising. In recent years, small areas in the sown lands are often occupied with winter wheat, rye, spring barley, potato and perennial grasses. Potatoes are used for food and pig fattening, especially on private holdings.

Forest Steppe (the percentage of forest land of the *Forest-Steppe* territory is about 12%. The woody vegetation is represented by broad-leaved oak, oak-hornbeam, oak-maple-linden woods. In the river valleys pine and oak-pine woods occur) having fertile soils and favourable moisture conditions; is characterised by a higher percentage of ploughed land, reaching 58.9% of the terrain or 82% (and up to 88% in certain cases) of its cultivated lands. Conditions here are favourable for cereals, especially winter wheat and maize, peas, white beet, and potatoes. The moister northern and north-west areas suit perennial grasses. This zone may produce sugar beet with beef-dairy cattle raising and pig rearing. White beet and grain are the main commodity industries.

The *steppe* is also an intensively cultivated area; it has 62.3% of its area or 81.3% of cultivated lands ploughed. Main crops include winter wheat and sunflower, the latter being the most important oil plant in the country. Winter wheat growing area in 1991–1995 in this zone was 2 800 000 ha or 52% of all crops, the area sown to sunflower was 1 400 000 ha. The area of sunflower rose to 1 900 000 ha in 1998. This caused difficulties regarding the position of sunflower in crop succession and aggravated the problem related to protection of the crop against disease. Large areas (over 1 200 000 ha) are occupied by maize for green fodder and silage. Southern, droughty regions of the *Steppe*, apart from the above major agricultural crops, are suitable for viticulture. Animal industries include cattle and sheep rearing.

The piedmont and highland areas of the Crimea are where viticulture and horticulture are developed, where essential oil crops (*Rosmarinus officinalis* L., *Salvia sclarea* L., *Lavandula angustifolia* Mill., *Rosa* sort Krimskaja red) and tobacco are grown. *Olea europaea* L. is cultivated in the South of the Crimea. Highland hayfields and pastures promote development of cattle and sheep rearing. Sheep are also important on abundant natural pastures in the highlands of the Carpathians.

4. RUMINANT LIVESTOCK PRODUCTION SYSTEMS

Cattle numbers and production. Over 20% of all Union cattle were in Ukraine before 1990. Imperfect economic mechanisms, liberalisation of prices resulting in the rates of price growth of industrial commodities exceeding these of livestock products by 5.6 times in 1997 already [Zubets, 1999], and traditional application of energy-consuming technologies in fodder production has turned cattle-raising into an unprofitable branch of agriculture in recent years (Table 4). Capacity rates in the beef and dairy industry were reduced to 15–40%. Numbers of cattle for the years 2000–2005 were: 2000 – 10.6 M; 2001 – 9.4 M; 2003 – 9.1 M; 2004 – 7.7 M and 2005 – 7.0 M.

Dairy cattle Changes in the number of dairy cattle are shown in Table 5. According to FAOSTAT (2006) the number of dairy animals had fallen to 4.4 M by 2005 and milk production was some 13.5 M metric tons.

The breeds of cows kept are: Red Steppe, Simmental, Black Speckled, Brown Carpathians, White Head, Ukrainian, Lebedynskaia, Red Polish, Pinzgau, Grey Ukrainian and others. The first three breeds constitute over 90% of the livestock.

To improve the genetic potential of dairy cows, they were crossed with Holsteins in recent years. Under the conditions of our farms, these half-breeds have higher milk yield and consume less fodder, thus promoting reduction of the prime cost of cattle-breeding products and improvement of dairy cattle breeding efficiency (Katsi *et al.*, 2000).

Dairy cattle in large agricultural enterprises are managed in standard (mainly two-row and four-row) cattle houses for 200 head with mechanised manure removal and feed cups leading from the central passage. Farms have

Table 4. Number of cattle and indexes of efficiency

	Years					
	1990	1995	1996	1997	1998	1999
Number of cattle ('000 head)						
All categories of enterprise	24 623.4	17 557.2	15 313.2	12 758.5	11 721.6	10 626.5
Agricultural enterprises	21 083.1	13 674.4	11 545.3	8 967.1	7 849.5	6 681.4
Private farms	3 540.3	3 882.9	3 767.9	3 791.4	3 872.1	3 845.1
Livestock in private farms,% of total	14.4	22.1	24.6	29.1	33.0	37.1
Efficiency of cattle in agricultural enterprises						
Average milk yield per cow in year, kg	2 941	1 908	1 706	1 389	1 646	1 719
Daily butterfat yield, g.	431	259	237	213	267	258
Profitability of agricultural enterprises,%						
Milk and dairy production	32.2	-23.2	-44.0	-53.7	-46.7	-36.6
Beef production	20.0	-19.8	-43.1	-61.5	-59.3	-57.9

Source: Department of strategy and development of agrarian economy of the Ministry of Agrarian Policy of Ukraine database, 1999

Table 5. Dynamics of number of dairy cows and milk production in all categories of enterprises

	Years					
	1990	1995	1996	1997	1998	1999
Total number of dairy cows ('000 head)						
All categories of enterprise	8 378.2	7 531.3	6 971.9	6 264.8	5 840.8	5 431.0
Agricultural enterprises	6 191.5	4 578.7	4 039.2	3 327.0	2 886.9	2 465.0
Private farms	2 186.7	2 952.6	2 932.7	2 937.8	2 953.9	2 966.0
Amount of cows in private farms,% of total	26.1	39.2	42.1	46.9	50.6	54.6
Milk production ('000 tonnes)						
All categories of enterprise	21 508.3	17 274.3	15 821.2	13 767.6	13 552.7	13 362.2
Agricultural enterprises	18 634.1	9 401.5	7 614.3	5 389.0	5 205.3	4 680.9
Private farms	5 874.2	7 872.8	8 206.9	8 378.6	8 547.4	8 681.3
Milk production in private farms,% of total	24.0	45.6	51.9	60.9	62.2	65.0
Milk production per capita, kg						
All categories of enterprise	472.3	335.2	309.5	271.6	273.4	267.7

Source: Department of strategy and development of agrarian economy of the Ministry of Agrarian Policy of Ukraine database, 1999

electrical milking machines, with central milk ducts and tanks for milk cooling. However, many cattle-breeding premises are empty in recent years because of a steep reduction of livestock in the public sector. The rest of the livestock has poor fodder supplies; the fodder mainly consists of silage supplemented with hay, straw, fodder root crops and grain forage. A conventional cow was provided in 1999 with 23.5 fodder units (in Ukraine the nutritive value of forages is determined by oat fodder units. One fodder unit is equated to 1 kg of oats of average quality. One fodder unit is equal to 0.6 of the Kellner's starch equivalent or to 0.8 of the Scandinavian fodder barley unit. 1 FU = 11.5 megajoules or 144 kilocalories) or 55.3% of animal needs in forages. Today we have a task to raise more stock to fill the byres. But, due to late reform of the public sector and restricted financing, little progress is seen as yet.

Privately owned dairy cattle are mainly in small farms with one or two cows. Farming enterprises are mostly still developing and have negligible quantities of cattle to manage and milk by hand. However, private farms supplied 65% of gross milk production in 1999 (Table 5). Milk is mainly consumed by the producers, any excess is delivered to reception points in villages from where it goes to dairy enterprises. Some milk is sold directly by producers. Cows are mainly fed with hay (not always of high quality) in winter, with fodder beet and grain; in Polissia and northern Forest Steppe, fodder is partially supplemented with potato. Livestock in summer is managed in community herds on village grazing allotted to them from a special reserve fund. Livestock in a number of western regions are grazed individually on land shares allotted to individuals. The main drawback of private holdings and small enterprises with up to 15 head is in the prevailing low-productivity of manual labour, in mainly subsistence farms with low earnings; absence of machine milking, milk ducts, milk filtering and cooling which does not provide the quality needed to be competitive on EC markets (Kalintchik *et al.*, 2000).

To improve the supply of dairy products and to increase exports (mainly to Russia), it is planned to increase milk production in Ukraine for all kinds of farming up to 17 500 000 tonnes in 2005 that is 1.3 times the 1999 level (however, FAOSTAT (2006) figures suggest that production in 2005 had reached only 13.5 M tonnes and had not increased significantly since 1997); with further increase in the level up to 22 500 000 in 2010 and up to 24 500 000 in 2015 that is 1.8 times the 1999 level (Zubets, 1999). In this connection, the government provides a number of measures aimed at fodder base strengthening and at improvement of a system of services to be rendered to agrarian commodity producers in selection and reproduction of livestock, in veterinary services, in providing them with concessionary lending for the purchase of pedigree cattle, in partial reimbursement of services on artificial insemination (especially for private holdings and farms), in creating conditions for implementation of contemporary cattle management technologies [Decree of President of Ukraine "On measures aimed at stabilisation of conditions on the consumer's market and on development of cattle-breeding in 2001–2002" (Anon, 2001)].

Beef cattle Raising specialized beef breeds of cattle is new in Ukraine. It began in the nineteen seventies and progress was very slow. Demand for beef was mainly met by cross-bred and surplus dairy stock (crossing cows not suitable for dairy breeding with Simmental, Lebedynskaia, Brown Carpathians, Red Steppe, etc.). However, considerable curtailment of dairying in recent years led to a simultaneous decrease of top-crossed young intended for beef. Labour problems, as well as energy problems that emerged in the country, required development of a specialised beef cattle branch. It is assumed that such a branch will be less labour-intensive and will require less mechanisation for production, will need less energy, capital and materials. There is a great potential for application of economically favourable grazing technologies. Crop residues are used more efficiently, with significant reduction of cereals in the ration.

Development of beef cattle in Ukraine started from the importation of beef breeds. Now we use imported and domestic breeds and types of beef cattle raised in Ukraine (Table 6).

Over 330 farms are now raising beef in Ukraine; they manage 150 000 cattle, including 45 600 cows.

To meet the demand for meat, we must have one beef cow for each five dairy cows today, and two-three cows for each five dairy cows in the future. Taking into account diversity of natural climatic and ecological conditions, "The program of development of specialised beef cattle breeding branch" provides for 14 breeds of beef cattle at least. This has to provide stud breeders and farms where this or that breed is grown with a true incentive to improve the breeds as to their meat productivity, improved return from fodder, and beef quality.

Major ways of improving beef breeds are as follows:

- Intense multiplication of domestic beef breeds and types, as well as those from imported breeds;
- Use of top-crossed heifers of dairy and dual purpose breeds to cross with sires of beef breeds then rearing the offspring for beef. Such mixed foundation stock will become the base for formation of commercial herds of beef cattle with wide application of grazing for fattening;
- Wide use, by pedigree and reproductive farms, of embryo transplantation to obtain 10–12 high-quality calves a year, instead of one, from outstanding exclusive dams;

To provide the population with milk and beef, it was planned to have 11 400 000 head of cattle by 2005 (in the future, the livestock would be increased up to 15 000 000), including 5 400 000 head (42.5%) of beef breeds and 4 000 000 dairy cows [“The Programme of development of specialised beef cattle breeding branch in Ukraine for 1997–2005”]. Having achieved the aforesaid ratio between dairy and beef breeds, it was planned to obtain up to 48% of beef resources from the cattle of specialised beef breeds. According to prospects for development of cattle-breeding in Ukraine, developed by scientific institutions of Ukrainian Academy of Agrarian Science for 2005, 2010 and 2015, production of meat should be as per Table 7. FAOSTAT (2005) data indicate that actual values for the years 2000 and 2004 fall well short of the 2005 targets and cattle numbers had fallen to about 7.0M by 2005.

Sheep and goat production. Sheep rearing is commonest in the Steppe zone, where some 60% of all sheep are found. This branch is also developed considerably in the Carpathians. In general fine-wool breeds (*Praekos*) in Polissia and Forest Steppe, and *Askania* breed in the steppe regions of Southern Ukraine prevailed up to recent times. Of semi-fine-wool breeds, *Tsygaiskaia* breed is widespread in Donetsk, Crimea and Odessa regions. Of coarse-wool breeds, *Karakul* is the most important; these are kept in Poltava, partially in Odessa and Chernivtsi regions, while *Sokolskaia* is less popular and is kept in Poltava region. Semi-coarse-wool breeds are widespread in the Carpathians; their main use is production of mutton and wool. However, imperfect economic mechanisms and absence of state regulation of the production, import-export of wool, understatement of mutton potential in sheep rearing, taking place during the recent 5–7 years, resulted in a steep decline of the branch. Sheep in 1999 (as compared with

Table 6. Breed composition and number of beef cattle, 1 January, 1997

Breed	Total cattle, thousands	Including cows		Percentage
		head, thousands	%	
Native breeds				
Beef Ukrainian	62.0	19.8	31.9	40.0
Beef Volyn	39.0	10.0	25.6	25.1
Polissia type	6.5	2.1	32.3	4.2
Foreign breeds				
Aberdeen Angus	28.0	7.0	25.0	18.1
Hereford	1.2	0.4	33.3	0.7
Limousin	0.7	0.3	42.8	0.5
Sharoleskaia	0.7	0.3	42.8	0.5
Other breeds	5.6	1.7	30.5	3.6
Recent locally created breeds of beef cattle				
Znamenskaia	4.6	1.7	36.9	3.0
Southern	5.5	1.8	32.7	3.5
Beef Simmental	1.3	0.5	38.4	0.8

Source: The program of development of specialised beef cattle-breeding branch of Ukraine for 1997–2005 years. Min. of Agriculture of Ukraine and Ukrainian Academy of Agrarian Sciences, 1997).

Table 7. Meat production in all categories of enterprises, in thousand tonnes

	Years											
	1990	1995	1996	1997	1998	1999	2005	2010	2015	2000	2004	2005
	In fact						Prognosis			Actual*		
Live weight	6 428.2	3 581.0	3 551.2	2 975.8	2 653.3	2 646.6	4600	6300	7250	n.r.	n.r.	n.r.
Slaughter weight including:	4 357.8	2 293.7	2 112.7	1 874.9	1 706.4	1 695.3	3 030	4 170	4 760	1 662.8	1565.7	n.r.
Beef	1 985.4	1 185.9	1 047.8	929.6	793.3	791.2	1 250	1 900	2 100	754.3	613.8	556.0
Pork	1 576.3	806.9	789.3	710.0	668.2	656.3	1 200	1 500	1 800	675.9	558.8	510.0
Poultry	708.4	235.2	217.8	186.0	200.0	204.2	540	730	800	193.2	375.5	470.0
Meat production per capita, kg,												
Slaughter weight	84.0	44.5	41.3	37.0	33.9	34.0	61.4	85.0	97.1	n.r.	n.r.	n.r.

Source: Department of Strategy and Development of Agrarian Economy of the Ministry of Agrarian Policy of Ukraine database 1999; Zubets, 1999.

* Data from FAOSTAT, 2005/6

n.r.=no record

Table 8. Number of sheep and goats and production of wool in all categories of enterprises

	Years								
	1990	1995	1996	1997	1998	1999	2000	2004	2005
Number of sheep and goats ('000 head)									
All categories of enterprises	8 418.7	4 098.6	3 047.1	2 361.8	2 026.0	1 884.7	1 884.7*	1 859*	1 770*
Agricultural enterprises	7 165.5	2 403.6	1 539.7	958.0	660.2	552.1			
Private farms	1 253.2	1 695.0	1 507.1	1 403.8	1 365.8	1 332.6			
Amount in private farms,% of total	14.9	41.4	49.5	59.4	67.4	70.7			
Production of wool, in thousand tonnes									
All categories of enterprises	29 804	13 926	9 318	6 679	4 557	3 759	3 400*	3 100*	3 216*
Agricultural enterprises	26 466	9 665	5 595	3 723	2 289	1 682			
Private farms	3 338	4 261	3 723	2 956	2 668	2 077			
In private farms,% of total	11.2	30.6	40.0	44.3	49.8	55.3			
Average wool per sheep, kg	3.4	2.5	2.3	2.4	2.4	2.5			
Number of lambs per 100 dams, head	92	66	64	60	66	74			

Source: Department of Strategy and Development of Agrarian Economy of the Ministry of Agrarian Policy of Ukraine database, 1999; *from FAOSTAT (2006)

1990) were down from 8 400 000 to 1 900 000 head (or 1 198 400 according to FAOSTAT data, 2006, and the figure 1.9 M appears to refer to sheep and goats) or by the factor of 4.5, while average wool clip was reduced from 3.4 to 2.5 kg or by a factor of 1.4. Extremely large reductions of sheep (to one-thirteenth) took place in large collective agricultural enterprises (Table 8).

Exports of sheep and goat products almost stopped in 1999. Scientific-breeders continue work aimed at creation of breeds of dual purpose sheep. Goats are not common (some 4% of all livestock), 60% of them are in private holdings, and mainly for milk and meat. In 2004 Ukraine was importing considerable quantities of meat (eg. 297 301 tonnes of poultry meat) and dairy products (eg. 29 747 M tonnes of milk equivalent products).

Animal health. Epizootic conditions remain satisfactory. But known cases of tuberculosis and leucosis among cattle provide some threat, especially if seen against the background of financial difficulties in the conduct of anti-epizootic measures. To diagnose, treat and prevent the most dangerous infectious diseases of animals, Institutes and the Veterinary Medicine Department at the Ministry of Agrarian Policy of Ukraine have devised a number of important legislative-regulatory instruments governing activities of practising specialists in veterinary medicine. Unfavourable epizootic conditions in neighbouring countries are a much stronger threat. This can result in propagation of extremely dangerous infections - cow rabies, classical swine fever, rinderpest, pox and the like - caused by importation of animals and animal products from abroad. The government and State Veterinary Service take every effort to enhance control over the disease rate of animals and over observance of sanitary requirements in the course of herd formation and their management, over providing them with new efficient protective facilities. The decree of the President of Ukraine "On measures aimed at stabilisation of conditions on the consumer's market and on development of cattle-breeding in 2001–2005" (Anon., 2001) provides for allocation of finance from local budgets for veterinary activities, for support of selection programmes in stock raising, for purchase of pedigree (genetic) resources of agricultural animals.

Starting from 2001, they plan to apply budgetary earnings, provided for epizootic events, to supporting the production of cattle-breeding and plant-growing products, towards agricultural producers, including support to personal holdings. It is planned to organise centres of veterinary services and artificial insemination of animals in each rural populated location.

5. THE PASTURE RESOURCE

Natural features of grassland and cultivation of fodder crops. The vast area of Ukraine, including several different natural-climatic zones, causes considerable diversity of grasslands as to their variety and composition of vegetation, and of their productivity. According to our estimates (personally Bogovin A.V.), resource potentialities of natural grassland are as follows (Table 9):

The largest areas of grasslands are in Polissia and the Carpathians (17.8%) with lesser areas in the Forest Steppe (10.3%) and in the Steppe (12.7%). In all zones, they are represented by continental meadows and flood lands. Meadow formations comprising *Elytrigia repens*, *Festuca pratensis*, *Phleum pratense*,

Alopecurus pratensis, *Poa pratensis*; *Festuca rubra* and *Calamagrostis epigeios* on sandy soils are prevailing in the vegetation cover of Polissia, northern and western Forest Steppe, while *Nardus stricta* etc are mostly spread on heavy acid soils and alpine meadows of the Carpathians. Natural fodder grasslands in the southern part of the Forest Steppe are represented by steppified meadows and meadow steppes with prevailing *Festuca rupicola* and *F. valesiaca*, *Stipa capillata*, *S. pennata*, *S. tirsia*, *Bromopsis inermis*, and *Poa angustifolia*. Real *tipchak* steppes are spread in the Steppe; they are represented in the northern part with *herbal-tipchak-stipa* formations (*Stipa lessingiana*, *S. zalesski*, *S. pulcherima*, *S. tirsia*, *Festuca valesiaca* and a few forbs), while southwards, on black earths, they are represented by *tipchak-stipa* species (*Stipa ucrainica*, *S. capillata*, *S. lessingiana*, *Festuca rupicola* and *Festuca* with small forb content). In Prysvashie, along the Black Sea and the Sea of Azov, on Solonetz Chestnut soils, they are represented with wormwood-poaceous steppes (*Artemisia santonica*, *A. taurica* and wormwood-*tipchak* formations). Grasslands within the Forest Steppe and on flood lands are saline; the same takes place in the Steppe on low ground. These have vegetation characterised by *Elytrigia pseudocaesia*, *Alopecurus arundinaceus*, *Poa angustifolia*, *Juncus gerardi*, *Eleocharis uniglumis*, *Puccinellia bilykiana*, *Puccinellia fominii*, while the littoral belt contains *Aeluropus littoralis* and *Juncus maritimus*. Plant formations in the Steppe, especially in its southern part, are low-yielding and often dry standing, so resulting in shortage of grass fodder on pastures. The deficiency is replenished by growing annual forages or irrigable pastures.

During the past 15 years, natural grassland with an area of some 3 000 000 hectares was replaced by sown pasture. The annual scope of work aimed at renovation of degraded plant formations was reduced by a factor of more than 2 (from 443 000 to 210 200 ha) in 1995 compared to 1990, while the reduction in 1998 was already characterised by a factor of 3.5.

Natural hayfields and pastures on large areas are preserved on alpine meadows of the Carpathians and in the Crimea, while within the plain parts of the country they are in long-term flood plains of large and medium rivers, on swamplands with poor sand soils or on ground cut by ravines and washes; in the south of the country they are preserved on grasslands with prevailing Solonetz-Solonchak complexes.

Pasture in the north of Ukraine (Polissia and northern Forest Steppe) for irrigation is usually made with leguminous-poaceous or poaceous (on the land plots with increased soil moisture) mixtures containing 3–5 species comprising *Phleum pratense*, *Festuca pratensis*, *Dactylis glomerata*, *Bromopsis inermis*, *Trifolium pratensis*, *T. repens* with inclusion of *Lolium multiflorum* in western regions of Ukraine and its hybrids with *Festuca orientalis*. Use of legumes in mixtures allows us to obtain high yield over several years without application of nitrogen fertilisers. *Dactylis glomerata* regrows 10–15 days earlier compared with *Festuca pratensis* and 25–35 days earlier if compared with *Phleum pratense*. Therefore, to avoid aging of the plant formation of *Dactylis glomerata*, it is sown on 25% of the area in pasture crop rotation.

Mixtures of *Medicago sativa* and *Bromopsis inermis* are the most popular in the southern Forest Steppe in waterless valleys, while those in the Steppe include *Medicago sativa*, *Onobrychis arenaria* or *O. vicifolia*, *Bromopsis inermis*, and *B. riparia*. Also, it is recommended to introduce *Agropyron pectinatum* or *A. desertorum*, *Psathyrostagys juncea*, *Elytrigia pseudocaesia*, *Roegneria trachycaulon*, which withstand dry conditions and soils salinisation. Here perennial mixtures, as a rule, are combined with planting of drought-resistant annual crops and first of all with sorghum (*Sorghum sudanense*). These crops are utilized through grazing or mowing with feeding in mangers.

Problems High energy-intensive systems of fodder production with all-year cattle management on large farms, developed during the years when Ukraine was in the Soviet Union, was found to be untenable

Table 9. Natural resource potential of grassland of Ukraine

	Total	including		
		Polissia	Forest-steppe	Steppe
Area, thousand ha	5 365.2	1 435.8	1 503.4	2 426.0
Yield, dry matter, tonnes/ha	1.48	2.44	1.53	0.88
Potential yield, dry matter, tonnes/ha	2.89	5.40	2.94	1.34
Under-exploitation productive potential, time	1.9	2.2	1.9	1.5

in a market economy. Therefore, we have the task today of turning up to 8 000 000 hectares of arable land into grassland to improve the structure and environmental conditions of agro landscapes, increasing the share of grass fodder in fodder resources (use of pasture would be preferred since they are the least demanding in energy resources), and putting cattle out to graze in summer. However, absence of finances, seeds of perennial grass, poor technical capacities of farms, curtailment of annual scope of pasture establishment makes solution of the task a problematic question. It increases the specific weight of old-sown grasslands and wasteland occupied with low-quality spontaneous vegetation.

Common village pastures are overstocked with animals; this causes serious degradation of the pastures. Land sharing in a number of regions with allotment of land plots to particular owners complicates grazing of collective herds thus increasing individual work loads. Private holdings of the people and small farms have no technical capacities to procure silage and hay for winter; production of grass meal has practically ceased because of high fuel cost. Therefore, winter fodder roughages are based on straw and hay of poor quality made from grass collected when over mature.

Almost everywhere pastures are not (or rarely) given mineral fertilizers; irrigation has ceased due to high electric power cost; regular mowing of weeds is not done. Removal of the surface mass of plant associations as compared with their annual increment frequently exceeds acceptable standards; rates are more than 70–75% in the Steppe, 75–80% in the Forest Steppe and 85–90% in Polissia. This leads to reduction of pasture productivity and deterioration of fodder quality, thus causing reduction in animal productivity.

Cessation of liming of acid soils is a great problem in the Polissia zone in recent years. Natural restoration of the original acidity of sod-podzol soils becomes a limiting factor for use of legumes in plant formations and for efficient rehabilitation of grasslands contaminated with radioactive elements because of Chernobyl NPP disaster. Low professional skills of new farmers may often be seen. All this reduces efficiency of grassland maintenance and has an adverse impact on dairy and meat productivity of animals.

Rotational management of cattle Cattle grazing in Ukraine is recognised as having good prospects, but was not widespread until quite recently because of cheap energy sources. Large collective dairy enterprises organised highly-productive pastures near the main cattle-farming premises, equipped with mechanical milking devices, or near summer camps with the use of small holding-pen grazing using stationary or movable electric fences. Such cattle management almost halves the costs of livestock products and to obtain 9–12 kg of milk from a cow per day with low consumption of concentrates is conducive to good animal health. Nowadays, however, because of deteriorated management and reduction of pasture productivity, such a management system has become a baffling problem for farms with many livestock. Due to poor equipment, late or absence of regular mowing of uneaten plant residues causes accumulation of old grass and weeds leading to pastures of low nutritive value, thus causing the reduction of dairy productivity of a herd. Small-size grazing is still efficient for farms with few livestock.

As a rule, cattle of private holding are grazed on poor pastures used without any set system. It forces owners to compensate any shortage in feeding on the pasture with additional fodder when the cattle come back for mid-day (thrice daily milking) and evening milking.

Production of silage and haylage Silage and haylage are only made by large agricultural enterprises. 15 518 900 tonnes were made in 1999 that is 19.5% less than in 1998 and 47.1% less compared to 1994. Waxy and milky-waxy maize, sunflower at onset of flowering, annual leguminous-poleaceous and poleaceous plant formations, and perennial grasses are the main raw materials for silage. Silage is made in trenches, silos or surface mounds and covered with polyethylene film further covered with a 5-6 cm soil layer. Due to financial problems in 1999, only 503 000 tonnes of silage was covered by film. Silos are more often covered with straw. Poor sealing of silos, prolonged (over 5 days) filling of the silos, non-observance of timing for plant mowing and practically total absence of mineral additives and conservatives (only 40 700 tonnes were made with addition of carbamide and other conservatives in 1999) does not allow us to obtain good quality silage. The problem of production of good quality silage is of top priority today.

Haymaking. Some 2 177 200 tonnes of hay were made in 1999 in Ukraine; that is 15.6% of all forage procurement (with 25.6% of haylage and 58.9% of straw). Large enterprises make hay mechanically,

mainly in the loose form (82.2%); it is stored in the open air close to cow-sheds. Often hay is left in stacks at the places of haymaking and is carried to the farms in winter, when transport facilities and workers are free from field work. Due to machinery shortage, non-observance of haymaking technology, and mowing over mature grass (and due to frequent rains in this period in northern and western regions of the country), haymaking is accompanied by considerable losses of nutrients, giving a poor quality forage.

Private holdings, where hay is the main forage, make hay manually. Grass is mown with scythes. Mowing is in mid-end of June, i.e., during the late stages of meadow vegetation because of the aim of obtaining as much forage as possible; this has an adverse impact on forage quality. Hay is then transported by tractor-trailers, truck or horses. The vehicles are provided on a cash basis or by account payment for the work done. Hay is stored in lofts of ancillary premises or in stacks in the yard (in southern regions).

Seed production Today Ukraine has no reliable statistical data on production of perennial grass seeds. Seed-growing areas of perennial grasses were some 500 000 hectares in 1998 and comprised 180 000–200 000 hectares of *Medicago sativa*, 140 000–150 000 hectares of *Trifolium pratense*, 5 000 hectares of *T. repens*, 5 000 hectares of *T. hybridum*, 80 000 hectares of *Onobrychis*, 60 000 hectares of poaceous grass, 20 000 hectares of *Melilotus* which is used for creating meadows on slopes in the marshy woodlands and the Steppe, on salt soils and as intermediate culture in the field for feed production. In 1998 a large enthusiasm for this culture was observed; today the area of crops has been reduced by more than 10 times and from 5 000 hectares of *Lotus corniculatus* 28 500 tonnes of seed were produced in 1997; which is 69% of their demand.

The former organised seed-production system collapsed after disintegration of the Soviet Union. Some joint-stock companies and agricultural enterprises are dealing with production of perennial grass seeds; it is made often under methodological supervision of plant breeders (originators of cultivars) who transfer their pedigree seeds under contractual grounds for foundation and commercial seed production. However, this system, having no support from the government, provides a poor solution to the seed problem. Because of economic depression in the industry, exiguous technical base and chronic poor solvency of consumers, the production of perennial grass seeds, which is far below the demand, is still decreasing.

Until quite recently, plant breeders in Ukraine maintained high potentialities of types and species of perennial grasses. Their work allowed the inclusion of 165 cultivars of perennial grasses of 33 classes to be entered into the Register of Ukrainian Plants recommended for production in 2001.

Among the above classes, seed production of *Trifolium pratense*, *Medicago sativa*, *Dactylis glomerata*, *Festuca pratensis*, *Phleum pratensis*, *Bromopsis inermis* are in a good state of preservation compared to others; they are considered basic classes. *Trifolium pratense* and *Medicago sativa* produce 50–60 kg/ha (The seed yield of *Trifolium pratense* and *Medicago sativa* is 60–80 kg/ha - in humid regions of the country, and 150–250 kg/ha - in the Forest-Steppe and in the Northern Steppe), *Dactylis glomerata* and *Festuca pratensis*, 250–500 kg/ha, *Phleum pratensis*, 150–200 kg/ha, *Bromopsis inermis*, 200–250 kg/ha. Self-pollinated species of *Yaroslavna* and *Roksolana* lucerne, bred by the Institute of Agriculture of the Ukrainian Academy of Agrarian Sciences, are able to yield 250–300 kg/ha of seed. Some agricultural enterprises in recent years grow seeds of *Lolium multiflorum* and its hybrids with *Festuca orientalis* (*Yaroslav* cultivar), as well as *Lolium perenne*; seed productivity of these reaches up to 800–1 500 kg/ha. Nevertheless, use of these species in ley management is very restricted due to their lack of persistence and poor frost resistance in northern regions or poor resistance to droughts in southern areas. These grasses are the most suitable for sowing in pastures in mixes with other perennial species in moist western regions and on fertile soils in fodder crop rotation with short (2-3 years) rotation of the perennials.

Seed growing for other grasses much needed for the grasslands of Ukraine (*Trifolium repens*, *T. hybridum*, *Lotus corniculatus*, *Poa pratensis*, *P. palustris*, *Festuca rubra*, *Alopecurus pratensis*, *A. arundinaceus*, *Agrostis gigantea*, *Agropyron pectinatum*, *A. desertorum*, *Elytrigia pseudocaesia*, *Roegneria trachycaulon*, *Psathyrostachys juncea* etc.) has very small scope and has no commercial significance.

Ukrainian Institute of Agriculture, Feed Research Institute, Institute of Irrigation Agriculture, Institute Agriculture and Breeding of Animals in Western Regions and other scientific-research institutions are engaged in the selection and testing of new cultivars of the perennials.

6. OPPORTUNITIES FOR IMPROVEMENT OF FODDER RESOURCES

It was decided to take 10 000 000 ha of arable land out of intensive cultivation and to put 8 000 000 million ha of these under grass. It will allow the balance of agro-landscapes and restoration of environment-oriented functions of agro-ecosystems, halting of erosion processes and improvement of the quality of water resources. At the same time, it opens large opportunities for strengthening the fodder base and to increasing the livestock (cattle up to 15 800 000 head, including up to 6 000 000 dairy cows and up to 1 300 000 beef cows, and up to 6 000 000 head of sheep), increasing significantly the share of cheap grass fodder in forage resources and turning cattle out to grazing in summers.

Institute of Agriculture of UAAS, Institute of Agrology and Agrochemistry of UAAS, Institute of Land Utilization of UAAS with participation of and support from the Ministry of Agrarian Policy and Ukrainian Academy of Agrarian Science have elaborated, in 2000, principal criteria and methodical recommendations for withdrawal of low-productive land from intense cultivation as well as their putting down to pasture and rational management.

Having obtained financial support from the US Agency for International Development (USAID) within the framework of a project named “The program to promote sustainable development in Ukraine” in the field of “Implementation of principles of sustainable development of Ukraine on the base of elaboration of an ecology-economic pattern of development of raw material industry and preservation of bio resources” in 2001, an evaluation is being undertaken of modern conditions of natural-resource potentialities of vegetation cover in general (Institute of Botany NAS of Ukraine) and grasslands in particular (Department of Meadow Management of Institute of Agriculture of UAAS) with the purpose of devising some conceptual approaches, eliminating imbalances in ecological, economic and, consequently, in social fields of activities of our state, restoring quality of environment and preserving biodiversity.

According to the Programme, the following objectives were outlined:

1. Evaluation of the present conditions of grasslands in Ukraine and their impact on the structure and development of cattle-raising.
2. Evaluation of grasslands impact on ecological conditions of agro-landscapes, find ways to eliminate any imbalances to provide sustainable optimal functions of agro-ecosystems.
3. Alteration of pasture area in connection with prospects of cattle-breeding development; calculation of optimal pasture areas by agro-ecological zones;
4. Technological, socio-economic and regulatory-legal aspects of rational grassland management.
5. Environmental and economic consequences of transformation of natural resource potentialities of grasslands in Ukraine.

As defined by a conceptual model for sustainable development of Ukraine, the area of natural fodder would be increased from 8 400 000 ha to 15 200 000 ha; as a part of this area, fodder lands of agricultural enterprises would be extended from 5 400 000 ha to 14 400 000 ha. Pasture area shall reach 12 800 000 ha, including 11 200 000 ha of permanent pastures (3 700 000 ha to be organised on natural fodder lands and 7 500 000 ha to be organised on land retired from intensive cultivation). In addition to permanent pasture, 1 600 000 ha of one-year pastures – crops of one-year grasses (sudanese grass, sorghum) – will be required for the period of slow regrowth of the perennials (100 000 ha in Polissia, 190 000 ha in the Forest Steppe and 1 310 000 in the Steppe).

If these measures are implemented, they will allow us to:

- change the structure of fodder resources significantly in favour of increased proportion of grass fodder (up to 52% in bulky fodder and to 35.4–40% in pastures);

- turn out cattle to grazing in summer and to transform beef and dairy cattle-breeding into a profitable industry on this base;
- balance agro-landscapes attempting to attain 1:1 ratio between destabilising factors (arable land, gardens) and stabilising ones (natural and sown grasslands, forests, windbreak forest belts) and to halt erosion processes or to reduce them to a minimum;
- improve conditions of meadow ecosystems in terms of species and plant associations, to enhance biosphere role, aesthetic and recreation value of agro-landscapes, to avoid pollution of water resources in the hydrographical network and to form favourable conditions for preservation of valuable gene pool of plants and wild animals.

The following types of arable land will be used as pastures:

- land on slopes with a slope exceeding 3° - for the flat territories of the country;
- low-productive fields where farming is unprofitable;
- previously ploughed fields of hydrographical network;
- fields nearby cattle-raising farms and villages, irrespective of the land plot quality;
- land contaminated with radioactive elements for grazing beef cattle at the first stage of their fattening;
- solonetz complexes and land having a lot of stones.

Implementation of the above conceptual model requires further amplification and solution of a number of scientific and productive tasks, which in their generalised form may be expressed as follows:

1. setting up of an efficient system for seed production of perennials under new economic conditions;
2. elaboration of theoretical principles and rational models for formation of sown mixtures for various cattle types and age groups by agro-ecological zones of our country and grassland types, elaboration of efficient ways and methods for accelerated reclamation of large areas of arable land to be taken out of intensive cultivation to use them as grasslands;
3. maximal use of genetic potentialities of pasture legumes in ley management as a prospective direction towards intensified pasture utilization;
4. elaboration of contemporary technical facilities (similar to Western European models) reliable under conditions of various Ukrainian zone technologies for direct reseeding of valuable grasses into the sod of natural and old-sown plant formations to improve their structure by species and productivity without their re-establishing;
5. improvement of grazing technology with consideration of livestock number, distance to pastures and their specialisation. Formation of a scientific regulatory database and implementation of technical-economic and organizational decisions on cattle grazing;
6. elaboration and wide propagation of rotational grazing to provide uninterrupted feeding of cattle with high-quality green matter on pastures during 220–250 days (from April to December);
7. improvement of technologies for preparation and storage of winter fodder and forage (silage, haylage and hay) applicable for conditions of small private farms and farming enterprises.

Many scientific-research Institutes of Ukraine are engaged in solving these problems. The Ministry of Agrarian Policy has developed “The Program for Fodder Production Development”, where it has outlined a comprehensive approach to solution of these problems with consideration of main characteristics of market relations. However, massive research in the field of pasture farming as applicable to new economic conditions is only starting, and few farms demonstrate productive experience in pasture farming. Any improvements in the field rely only upon general conditions of the agrarian sector and, first of all, upon formation of a favourable economic and legal medium for normal functioning of all economic structures.

Conciliation of inter-industrial relations in the agro-industrial complex and balancing the prices of food and industrial commodities (the ratio between them is 1:5 now), formation of privileged credit-finance conditions at par with use of budgetary donations to promote top priority industries (seed production of perennial forages, liming of acid soils, pasture improvement, introduction of modern technical facilities and grazing technologies, production of high-quality fodder and cattle-breeding products at agricultural enterprises), formation of favourable conditions for distribution of cattle-raising products, pedigree farming (development of breeding material) and restoration of high-productive livestock may be referred to principal strategic levers of the government.

Adoption of a Grassland Code (similar to the Forest Code of Ukraine) at a legislative level is a long-felt need; this Code would govern legal relations with the purpose of providing increased productivity, protection and reproduction of grasslands on the grounds of their rational management with observance of technical schedules. The supervision shall be effected through administrative or law and order authorities at all levels and shall be realised by land users of any land ownership pattern.

7. RESEARCH AND DEVELOPMENT ORGANIZATIONS AND PERSONNEL

Establishment and contact details	Key personnel	Research topics
Institute of Agriculture of UAAS 08162, Chabany, Kievo-Svyatoshinsky distr., Kiev reg. Tel.: +38 044-2662327 Fax: +38 044-2661107 E-mail: selectio@ukrpack.net	Academician V.Sajko	Director
	Professor A. Bogovin	Head of grassland department
	Professor V. Kurgak	Creation and use of sowing meadows
	Doctor S. Dudnik	Flood-lands meadow cultivation
	Artificial and natural grassland, management of structure of plant association, effective use of grassland resources, selection of fodder crops	
Feed Research Institute of UAAS 21100, Vinnitsa prosp. Yunosty, 16 Tel./fax: +38 0432-464146 E-mail: fri@mail.vinnica.ua	Academician A. Babich	Director
	Doctor S. Nazarov	Head of department of hayfield and pasture
	Professor P. Makarenko	Hayfield and pasture
	Doctor E. Kovtun	Sowing pasture
	Sowing, selection and seed of annual and perennial grass, fodder crops, soy; technology of feed production	
Institute of Agriculture and Animal Breeding Western region UAAS 81115, Obroshyno village, Pustomyty distr., Lviv reg. Tel.: +38 0322-396265 Fax: +38 0322-396322	Doctor P. Muzika	Director
	Professor J. Maschak	Head of grassland department
	Professor M. Yarmoluk	Grassland researcher, grassland management
	Doctor L. Lubchenko	Mountain meadows
	Doctor L. Bugrin	Use of hillside land
	Grassland research, selection and seed of perennial grass and fodder crops, breeding of cattle, sheep and geese.	
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	Academician M. Zubets	Head of department of selection of cattle
	Professor V. Kuznetsov	Biotechnology in animal selection
	Academician V. Burkat	Live-stock breeding
	Genetics and selection, breeding of dairy and beef breeds of cattle	
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	Doctor I. Vishnevskaja	Head of feed production department
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Institute of Animal Breeding UAAS 62404, Kulynichi, Kharkiv distr., Kharkiv reg. Tel./fax: +38 0572-953181	Professor M. Bezuglij	Director
	Academician G. Bogdanov	Feeding of animals, fodder production
	Professor D. Volkov	Horse breeding
	Animal breeding, fodder production	
Institute of beef cattle-breeding UAAS 02160, Kiev prosp. Vossoyedinenia, 15 Tel.: +38 044-2388313 Fax: +38 044-2388359	Doctor G. Shkurin	Director
	Doctor V. Kobko	Head of pasture department
	Genetics and selection, breeding of beef breeds of cattle; creation of pastures	
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	Doctor M. Popov	Scientific secretary
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	Academician O. Malinin	Ecology and veterinary pharmacology
	Academician V. Busol	Epizootology and infectious pathology
	Veterinary inspectors, development and production of medical prophylactic preparations	

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9. ACKNOWLEDGEMENTS

I express thanks to Dr S. Dudnyk for active partnership as co-author in realisation of this work, and also to workers of the Department of Strategy of Development of Agrarian Economy of the Ministry of Agrarian Policy of Ukraine for kindly providing information for this profile.

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This profile was written in May 2001.

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[The profile was edited by J.M. Suttie and S.G. Reynolds in July 2001 and F. Nachtergaele provided clarification on soils, S.G. Reynolds modified some of the livestock data in October 2006.]