

## Part 2. Biotechnology and biology

UDC: 575.17:636.082.12(477)

### ANIMAL GENETIC RESOURCES OF UKRAINE: CURRENT STATUS AND PERSPECTIVES

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**Summary.** The objective diversity evaluation of genetic resources and genetic status of breeds in Ukraine is given. The targeted selection approach application enables a creation of the breeds range, being used in commercial purposes and for manufacturing the high-quality production. The high-priority breeds that need to be saved are determined. The subjects preserving the gene pool of farm animals have to determine the gene pool for herds, farms, holdings, reserves and cryobanks of animal genetic resources. Rational form of the gene pool conservation is to preserve it within herds.

**Keywords:** cattle, breed, animal genetic resources

Animal industry of Ukraine has passed through the stages of profound changes, being associated with a steep decline of farm animal number and decrease of production volumes since independence time. Ukrainian cattle population counted 8378.2 thousand heads in 1990, 3635.0 thousand heads in 2005, and 2508.8 thousand heads in 2013. The milk production was estimated about 24.5 million tons in 1990, 13.7 million tons in 2005-2006 and 11.086 million tons in 2011. Nevertheless, for recent years there has been a steady tendency for agricultural production to have increased due to improved livestock productivity and modernization of production processes. The milk production has increased to 11.378 million tons in 2012 and 11.488 million tons in 2013. The dairy, pig and poultry farming remain to be traditional and economically attractive branches of the animal husbandry in Ukraine. The total numbers of farm animal species distributed between the farms of different ownership form in Ukraine are shown in Table 1.

In contrast to other European countries, the livestock of Ukraine is concentrated in large agricultural holdings being former farms of state or common ownership forms, and in small households having limited capability to meet the safety, production and storage standards of raw milk.

Animal industry modernization lagging determines relatively low or average livestock yield and production parameters for Ukrainian animals compared to European animals (Tab. 2).

About 76 % of the livestock are concentrated in rural households for today, including 52.6 % of cows reared at farms having less than 100 heads of cattle, 38.5 % at farms having 100-500 heads of cattle, and only 8.9 % cows are reared in holdings having more than 500 heads of cattle. Given the abolition of the raw milk quota in the European Union by 1<sup>st</sup> of April 2015, it raises the question of investing in large industrial complexes construction within Ukrainian agricultural holdings and development of cooperative movement oriented to improvement of milk produced at house holdings. Households own a substantial portion of other livestock species and accounted for 51 % of pigs, 85 % of sheep and goats and 42.6 % of all types of poultry.

The number of auditable livestock involved in improvement programs is comparatively small (Tab. 1). Controlled herds size is insufficient for implementation of breeding programs based on the best local gene pools, because these herds account approximately 4,6 % of the total cattle number, 4,4 % of the total pig number and 2,1 % of sheep.

**Table 1** – The total number of farm animals in Ukraine for different year

Branch of animal husbandry	Species	As of 01.01.1916, thousand heads	As of 01.01.2014, thousand heads			
			Farms of all ownership forms, thousand heads *	Including		Auditable animals number **
				Agricultural holdings	Smallholdings (Private farms)	
Dairy cattle	Cow	4115.9	2508.8	565.4	1943.4	115.9
Meat cattle	Cow	-	-	33.4	-	16.3
Pig farming	Pigs, total	6469.2	7922.2	3878.9	4043.3	354.7
	including sows	-	-	252.5	-	32.4
Sheep farming	Sheep, total	6849.0	1735.2	248.5	1486.7	36.6
	including ewes and chilvers	-	-	141.6	-	21.1
Horse breeding	Horses, total	6454.5	354.2	29.1	-	3.8
	including broodmares	-	-	8.9	-	1.4
Poultry farming	All species		230204.7	132072.3	98132.4	2046.0
	including chicken			129392.4		1881.7
	geese			303.3		65.0
	ducks			480.5		79.4
	turkeys			770.3		-
	other			1126.8		19.9

\* According to the Statistics Annual Report 1962, the uses of livestock in 1916 were presented by draft-cattle, meat cattle and cattle of combined use

\*\* According to the "Condition of livestock in Ukraine: Statistical bulletin (2013)", State Statistics Service of Ukraine

\*\*\* According to the "State register of livestock breeding farms (2013)"

**Table 2** – Livestock production parameters for Ukraine as of 01.01.2014

Branch of animal husbandry	Productivity index	Agricultural holdings *	Livestock breeding farms **
Dairy cattle	Milk yield, kg	4840	6116
Meat cattle	Number of calves born per 100 cows, heads	72	76
Pig farming	Average daily gain, g	474	1982
	Number of piglets born per 100 sows, heads	1936	1982
Sheep farming	Fleece per one sheep, kg	1,8	2,8
	Number of lambs born per 100 ewes, heads	76	90
Poultry farming	Average egg production per one hen, eggs	289	308

\* According to the "Condition of livestock in Ukraine: Statistical bulletin (2013)", State Statistics Service of Ukraine

\*\* According to the "State register of livestock breeding farms (2013)"

As for Ruban and Fedota (2013), the one way to manage breeding process within small herds is to identify appropriate gene panels associated with traits of economic importance or hereditary abnormalities and to create national genetic evaluation systems. Such system provides opportunity to accelerate evaluation and to improve the efficiency of livestock breeding, ensuring the livestock production of required genotypes for external and internal commerce. It is appreciated that genomic testing is based on conventional breeding approaches. From the other side, one of the cornerstone

principles of these approaches is well-run breeding records system.

Conforming to the “State register of livestock breeding farms (2013)”, the livestock breed composition of cattle, pigs, horses and sheep in Ukraine is characterized by the great diversity of domestic and imported breeds (Tab. 3–8). Generally, all breeds can be divided into two categories – commercial breeds, being commonly used for livestock production, and numerically small native breeds. The Table 3 shows the data on key milk production traits per cattle breed.

**Table 3** – The cattle breeds composition (dairy and dual-purpose breeds for dairy and beef production) as of 01.01.2014 year \*

Breed	Total population, heads	including cows, heads	Average per breed		
			milk yield, kg	%, fat	%, protein
Ukrainian Black-and-White Dairy	167967	62690	6019	3.83	3.27
Ukrainian Red-and-White Dairy	65499	26395	6103	3.80	3.29
Holstein	27406	11928	7310	3.82	3.30
Ukrainian Red Dairy	16044	6665	5843	3.85	3.25
Red Steppe	8600	3244	4164	3.86	3.74
Simmental	5387	2230	5208	3.84	3.24
Polish Red	1349	506	4098	3.83	3.17
Ayrshire	951	539	6513	3.82	3.14
Angler	300	39	4205	4.21	3.32
Lebedyn	2364	947	4445	3.80	2.94
Brown Swiss	121	100	4145	4.10	3.30
Ukrainian Brown Dairy	742	350	5463	3.89	3.02
Ukrainian Whitehead	848	300	4707	3.78	-
<b>Total</b>	<b>441578</b>	<b>115933</b>	<b>6114</b>	<b>3.77</b>	<b>3.28</b>

\* According to the “State register of livestock breeding farms (2013)”

The Ukrainian Black-and-White Dairy is the most common dairy breed in Ukraine. The animals of this breed are raised in almost all regions of Ukraine, its intra-breed genetic diversity is low and consolidated group of animals show no significant variation in constitutional type and productivity level (Yefimenko, Burkat and Boiko, 1998).

The breed was developed by crossing the local black-and-white cattle of Dutch origin with the Holstein cattle of Canadian and American selection. It should be noted that Holstein breed is ranked third of thirteen species in Ukrainian dairy cattle population (Tab. 3), its popularity caused by import of semen from the USA and Canada sires and this breed’s genetic potential affects the variety of domestic breeds.

The first cattle breed of Ukraine selection is the Ukrainian Red-and-White Dairy having been developed for over 20 years. This breed was developed by crossing the domestic Simmental cattle with imported genetic

material of the Ayrshire (Finland), the Montbéliarde (France) and the Holstein (USA, Canada) breeds (Karasyk, Zubets and Burkat, 1993; Ruban, 1999). The total Ukrainian Red-and-White Dairy population within livestock farms is the second largest after population of the Ukrainian Black-and-White Dairy breed (Tab. 3).

The Ukrainian Red Dairy is a relatively young Ukrainian dairy cattle breed (Polupan et al., 2004). It was developed by the complex reproductive crossing of the Red Steppe cattle with the Angler, Danish, Red-and-White Holstein cattle.

The Red Steppe breed ranks the fifth place in number of dairy cattle, despite this breed in the early 1990s took the second place, and in the middle of the twentieth century was the most widespread Ukrainian breed. The breed was developed by the complex reproductive crossing the domestic Ukrainian Grey with the Red East Friesian, and later with some Swiss Brown and East Friesian, and was named “Red Steppe breed” in 1939.

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The Lebedyn cattle on farms of different ownership account for 1 % of relative small group of brown breeds (Tab. 3, 4). The breed was developed from crossing the local breeds with the Schwyz breed. The Brown Carpathian was developed in the Trans-Carpathian region in result of crossing the Brown Swiss with the local cattle (Boyko, 1981). The Brown Carpathian and the Ukrainian Whitehead are local native breeds, being presented with low numbers in both pedigree and

commercial farms (Tab. 3, 4).

The Ukrainian Whitehead was developed in Ukraine by crossing the local cattle with the Black-and-White Dutch bulls imported from the Province of Groningen, Holland in 1791 (Boyko, 1981).

The volume of beef cattle production in Ukraine is low, but has a potential to growth. The main task of breeding farms is to reproduce the breeding material from both domestic and foreign specialized beef breeds (Tab. 5).

**Table 4 – The cattle breeds composition reared in farms under various forms of ownership as of 01.01.2014 year \***

Breed	Total number of cows		Including						
	thousand heads	%	house holdings		Agricultural holdings				
			thousand heads	%	thousand heads	%	including breeding animals		
							thousand heads	%	
Black-and-White breeds group									
Ukrainian Black-and-White Dairy	962.505	38.3	753.684	38.8	208.821	36.9	62.690	54.0	
Holstein	130.090	5.2	82.847	4.2	47.243	8.3	11.928	10.3	
Other	68.694	2.8	62.953	3.3	5.741	1.1	-	-	
<b>Total for five breeds</b>	<b>1161.289</b>	<b>46.3</b>	<b>899.484</b>	<b>46.3</b>	<b>261.805</b>	<b>46.3</b>	<b>74.618</b>	<b>64.3</b>	
Red-and-White breeds group									
Ukrainian Red-and-White Dairy	336.284	13.9	232.613	11.9	103.671	18.3	26.395	22.7	
Simmental	202.654	8.0	151.422	7.7	51.232	9.0	2.230	2.0	
Other	113.732	4.1	88.886	4.7	24.846	4.5	-	-	
<b>Total for five breeds</b>	<b>652.670</b>	<b>26.0</b>	<b>472.921</b>	<b>24.3</b>	<b>179.749</b>	<b>31.8</b>	<b>28.625</b>	<b>24.7</b>	
Red breeds group									
Ukrainian Red Dairy	40.978	1.6	24.287	1.2	16.691	2.9	6.665	5.7	
Red Steppe	284.194	11.3	236.962	12.2	47.232	8.3	3.244	2.8	
Other	131.561	5.3	127.530	6.6	4.031	0.8	0.526	0.5	
<b>Total for five breeds</b>	<b>456.733</b>	<b>18.2</b>	<b>388.779</b>	<b>20.0</b>	<b>67.954</b>	<b>12.0</b>	<b>10.435</b>	<b>9.0</b>	
Red breeds group									
Brown Carpathian	44.182	1.7	41.714	2.1	2.468	0.4	-	-	
Lebedyn	28.888	1.1	23.576	1.2	5.312	0.9	0.947	0.9	
Other	12.215	0.6	10.882	0.6	1.333	0.3	-	-	
<b>Total for four breeds</b>	<b>85.285</b>	<b>3.4</b>	<b>76.172</b>	<b>3.9</b>	<b>9.113</b>	<b>1.6</b>	<b>0.947</b>	<b>0.9</b>	
Other breeds									
<b>Total</b>	<b>152.832</b>	<b>6.1</b>	<b>106.049</b>	<b>5.5</b>	<b>46.783</b>	<b>8.3</b>	<b>1.332</b>	<b>1.1</b>	
<b>Total for all breeds</b>	<b>2508.809</b>	<b>100.0</b>	<b>1943.405</b>	<b>100.0</b>	<b>565.404</b>	<b>100.0</b>	<b>115.957</b>	<b>100.0</b>	

The Volinian Beef cattle herds are the most abundant, the breed was recognized as the selection achievement in 1993. The breed total number accounted 5 thousand heads, including 2 thousand heads in Volyn and Rivne regions at that time. The Volinian Beef was developed by the complex reproductive crossing of local Polish Black-and-White and the Polish Red cattle with the Aberdeen-

Angus, Limousin and Hereford sires (Yanko, Burkat and Lukash (1998).

The Polissian Beef was developed by the method of complex reproductive crossing for domestic Simmental, the Ukrainian Grey and imported Charolais, Chianina and Angus (Speka, 1999). The Polissian Beef cattle are bred in Zhytomyr, Lviv and Rivne regions.

**Table 5** – The beef breeds composition as of 01.01.2014 year \*

Breed	Total population, heads	including cows, heads
Volinian Beef	11025	4824
Aberdeen-Angus	8926	4110
Polissian Beef	5065	2298
Southern Beef	3132	1122
Simmental Beef**	3070	1345
Ukarainian Beef	1970	831
Charolais	1047	459
Polissian Beef (Znamensk)	1033	348
Ukrainian Grey	928	351
Limousin	636	270
Blonde d'Aquitaine	399	213
Hereford	131	54
Piemontese	49	10
<b>Total</b>	<b>37411</b>	<b>16235</b>

\* According to the "State register of livestock breeding farms (2013)"; \*\* new developing breed (this breed is not yet officially recognized)

The Ukrainian Beef breed is the first domestic specialized breed of cattle, having been adapted to most climatic zones of Ukraine; its population at the moment of approbation in 1993 was about 20 thousand heads, including 5 thousand cows. The breed was developed from complex reproductive crossing of the Ukrainian Grey with improver breeds – the Simmental, Charolais and Chianina (Dorotiuk, Lukash and Harmash, 1998).

The Southern Beef breed was approved in 2009 and was developed from the complex reproductive crossing of the Red Steppe (maternal basis) with the Hereford, Charolais, Santa Gertrudis using hybridization with Cuban zebu hybrids. Breed specific characteristics include zebu-shaped body, disease resistance and toleration to steppe climate (Zubets, Burkat and Melnyk, 2009). The Ukrainian Grey is one of native draft-cattle breeds. The number of the breed in 1916 and 1922 in Ukraine was 2.813 and 2.568 million heads (Zorin, 1953). The total number of the animals is diminished to 147.1 thousand heads in 1949 due to greater use

of agricultural machinery for tillage and other works rather than cattle as a draft power. The Ukrainian Grey cattle population in Ukraine accounted 928 heads in 2013.

The swine rearing is a traditional branch of animal husbandry in Ukraine. The classical breeds are the Large White and the Landras (Tab. 6). The third and fifth by the number are domestic breeds. The Poltavian Meat breed is the first high-yield pig breed in Ukraine, meeting the actual market requirements in respect of the lard or meat taste, having been developed by the complex reproductive crossing of the breeds: the Large White, the Mirgorod, the Landras, the Pietren and the Wessex Saddleback (Bankovskiy, 1998).

The pedigree breeding for the Ukrainian Meat pig breed creation was carried out from 1981 to 1993, using as a basis the Poltavian Meat pigs and pigs of Kharkiv, Belarus and Ascanian selection. The breed is a complex combination of the Large White, the Mirgorod, the Landrace, the Welsh, the Pietrain, the

Wessex Saddleback and the Ukrainian Steppe White genotypes (Gerasimov et al., 2006).

The Red White-Belt Meat pig breed was created out of the Poltavian pigs, the Large White, the Landras, the Durok and the Hampshire breeds by the complex reproductive crossing method, followed by mating within hybrids. When mating the boars of the breed with sows of planned breeds the heterosis effect is about 5–15 %. The Mirgorod pig breed being created by a long-term

massive selection within the Poltava pig population is of particular interest. The breeding of local short-eared pigs with the Berkshire and the Middle White pigs was started in 1880 within small group of animals, but later the large black boars and sows of the Tamworth breed were brought to Ukraine. It brought along creation of the black-and-white pig herds, which found ready market for small households (Rybalko, Buhaiievskyi and Kuian, 2010).

**Table 6** – The swine breeds composition as of 01.01.2014 year \*

Breed	Total population, heads	including sows, heads
Large White	183910	13551
Landras	132334	15518
Ukrainian Meat	10033	801
Poltavian Meat	8980	617
Red White-Belt Meat	6444	463
Durok	3767	309
Pietren	2581	255
Mirgorod	2056	171
Large White (English selection)	1615	133
Ukrainian Steppe White	1495	283
Large Black	1076	215
Welsh	313	100
Ukrainian Steppe Black-and-White	92	21
<b>Total</b>	<b>354696</b>	<b>32437</b>

\* According to the “State register of livestock breeding farms (2013)”

The basis of the Ukrainian White Steppe breed, being developed in the Biosphere Reserve “Askania Nova” (Kherson region), was the hybrids from crossing with the English breed boars adapted to the Southern Ukrainian regions. Later, the Ukrainian Steppe Black-and-White breed was created by crossing the Ukrainian White Steppe sows with the Berkshire and the Mangalitsa boars within Biosphere Reserve “Askania Nova”. The last three breeds belong to the minority of local breeds and need the systemic support for their conservation.

The horse livestock population of Ukraine has rapidly reduced for recent years, the population accounted 354.2 thousand heads in 2013 that is 18 times less than in 1916 - 6.4 million heads (Tab. 7). Currently, the total number of breeding horses is 3863 heads, including 1381 heads of broodmares (Tab. 7).

The creation of new domestic roadster breed has been initiated in Ukraine in 1945. When created the

Ukrainian Roadster breed (Tab. 7) the horses of more than 11 breeds were used, including the Thoroughbred, the Trakenenian, the Hungarian, the Russian Trotter, less role played the Hanover, the Arabic and the Akhal-Teke breeds. However, the breed was approved only in 1990, before this it was known as the Ukrainian breeding group. Currently, work for the Ukrainian Roadster breed improving is underway within six state stud farms and 16 private stud farms amounting more than 1,000 horses (Hopka, Skotsyk and Pavlenko, 1998).

Except the Ukrainian Roadster breed, the Ukrainian national heritage includes the Hutsul breed. The Hutsul breed was formed in the Carpathian region, being first mentioned in historical documents in 1603 without any hypothesis to its origin (Golovach M. Y. and Golovach M. M., 2004). According to these authors, the number of the Hutsul horses reached in Poland – 745, Ukraine – 390, Czech Republic – 360,

Romania–200, Slovakia–120, Hungary–100, Austria–51 and Germany – 28 heads. According to several authors, the Hutsul horses are created by crossing the breeds of Tatar and Arab origin with the Tarpan, and have

acquired functionally necessary traits such as good health, labor productivity, efficient feed use, fitness to work both under saddle and packs in result of exploitation of horses in the mountains.

**Table 7** – The horse breeds composition as of 01.01.2014 year \*

Breed	Total population, heads	including broodmares, heads
Ukrainian Roadster	1037	376
Orlov Trotter	803	289
Thoroughbred	688	223
Russian Trotter	629	228
Newolexandrian heavy draft	301	98
Westphalian	166	70
Hutsul	108	50
Trakenenian	50	15
French Trotter	32	12
Russian Heavy Draft	29	10
Torian	20	10
<b>Total</b>	<b>3863</b>	<b>1381</b>

\* According to the "State register of livestock breeding farms (2013)"

The modern sheep breeding in Ukraine aimed at creating the dual-purpose sheep breed for wool and meat production, since this combination provides for maximum profit within this branch of livestock industry (Iovenko et al., 2006).

The list of breeding sheep breeds is headed by the Askanian meat-wool breed with crossbred wool (Tab. 8). The breed is developed out of the complex combination crossing the half-bred Lincoln-Askanian sheep (wool quality of 48-46 grade) with the Lincoln-Tsigai ewes followed by further mating within hybrids. The Askanian crossbred animals are large and precocious, being characterized by the strong constitution, high meatiness, high milk and wool productivity.

The history of Sokilska sheep breed in Ukraine counts about 500 years. Apparently, its pedigree includes the sheep raised for milk and fur, having been introduced by Tatarian invaders from the lower Volga. There are two versions about the origin of this sheep breed, the most probable is to be originated out of crossing a local rat-tailed sheep with the Karakul and Malich (Iovenko et al., 2006).

The Askanian Fine-wool sheep breed is derived from crossing the local Merino sheep with the Rambouillet of American selection and simultaneous improvement of animals feeding conditions.

The Ukrainian Carpathian Mountain breed is created out of the reproductive crossing the Tsakel sheep, the local rough-wool sheep breed with the half-fine-wool Tzigaia sheep (Petryshyn, 1998). The Ukrainian Carpathian Mountain sheep are reared in farms of all ownership forms in foothill and mountain regions of Zakarpattia, Ivano-Frankivsk, Lviv and Chernivtsi. The total number of breeding animals is 2.7 thousand heads (Tab. 8).

There are regional programmes for the conservation of the Askanian Fine-wool, the Ukrainian Carpathian Mountain, the Tsigai, the Romanov, the Sokilska breeds.

The poultry industry is one of the industrial and high-tech livestock industries in Ukraine through the implementation of major projects for the egg and meat production using specialized crosses.

The Ukrainian Vushanka characterized by ruggedness and durability is the breed developed in 17<sup>th</sup> century in Central and Northern parts of Ukraine. It was called due to its external exterior signs – the ear lobes, being closed dense fine feathers (Ruban, 2002).

The Romensky geese breed is developed in Sumy region, based on local breeds. To date this breed is widely spread in households of such areas as Sumy, Kiev, Chernigiv, Poltava, Luhansk and other regions (Pabat et al., 2006).

**Table 8** – The sheep breeds composition as of 01.01.2014 year \*

Breed	Total population, heads	including ewes, heads
Askanian meat-wool breed with crossbred wool	8250	5146
Askanian Karakul	7748	4830
Askanian Finewool	7516	4072
Prekos	3179	1470
Ukrainian Carpathian Mountain	2760	2114
Merinolandshaft	2124	972
Tsigai	2113	1200
Romanov	1836	589
Sokilska	610	382
Latvian Blackhead	229	160
North-Caucasian	256	171
<b>Total</b>	<b>36621</b>	<b>21106</b>

\* According to the "State register of livestock breeding farms (2013)"

The number of the Romensky geese reached 38 thousand heads, at ten years after the geese herd decreased twice. To date the number of the Romensky geese is about 22,500. Predominantly, the geese are reared in small farms.

The population of the Ukrainian White-Breasted Black ducks (Podstreshny and Bondarenko, 1998b) is developed within the Poultry Research Institute of the UAAS in the 50s of the last century out of the complex reproductive crossbreeding the local Ukrainian White-Breasted with the Pekin breed and Khaki Campbell breed ducks. The Ukrainian Grey and the Ukrainian Clay ducks are bred by the Poultry Research Institute in 40s – 60s years of the 20<sup>th</sup> century. The breed group is created by the authors under the guidance of Dahnovskij using breeding only within local gray duck breeds (Podstreshny and Bondarenko, 1998a).

**Conclusion.** The livestock of Ukraine is characterized by a wide variety of the species and breeds. However, there was a significant reduction in the livestock number for the last two decades followed by the decreased diversity of farm animal species.

The Ukrainian Grey, the Ukrainian Whitehead, the Brown Carpathian, the Lebedyn cattle breeds, the Hutsul horsed breed, the Sokilska and the Ukrainian Carpathian Mountain sheep breeds, the Mirgorod, the Ukrainian Steppe White and the Ukrainian Steppe Black-and-White pig breeds are threatened breeds. Mainly, the domestic poultry breeds are reared within private collection farms or households. The subjects preserving the gene pool of farm animals have to determine the gene pool for herds, farms, holdings, reserves and cryobanks of animal genetic resources. Rational form of the gene pool conservation is to preserve it within herds.

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