INVITED LECTURE

THE POULTRY GENE RESOURCES PRESERVATION PROGRAM IN POLAND – REASON AND AIMS

S. Wężyk

National Chamber of Poultry & Feed Producers, Poznań, Poland

The history of animal breeding and its production is several thousand years old. In the 19th and 20th century the poultry sector followed the dynamic changes related to the development of a global economy. From the second half of 20th century a significant progress in the poultry production took place thanks to the implementation of scientific results of biology, various methods of intensive selection, and the studies on specialized populations of diverse poultry species. Genetic improvement of those populations in the 20th century was possible thanks to early discoveries of 19th century of hereditary traits of breeds existing at that time. Present activities on preservation of existing poultry genetic resources should supply scientific and productive needs. They should also make the continuation of breeding development possible in 21st century (Delany, 2003).

According to FAO, the genetic resources are the populations showing the highest genetics differentiation within species and/or with unique alleles or alleles combinations. After Delany and Pisenti (1998), Pisenti *et al* (1999) and Weigend and Romanov (2001) the poultry genetic resources include:

1. experimental lines utilized for scientific purposes;
2. commercial pedigree flocks and pure line under intensive selection on production trait and fast rate of growth;
3. fancier and showy poultry flocks.

Biodiversity includes every form of life of all species and their genetic varieties as well as all their ecosystems (CAST, 1999). In poultry it refers to the preservation of genetic variation within and between species (hens, turkeys, quails, ducks, geese, and pheasants) and also between all worldwide breeds. Indigenous and local breeds and specialized populations of each poultry species used in the modern commercial production by smallholders and fancy breeders in experimental farms play an important part in the development of mankind. Thanks to biological diversity, poultry could be widely utilized in the processes of food production's modernization, in development of biotechnology, as well as in the theoretical and applied sciences that have a fundamental meaning for human and animal health. Undertaking a decision on preservation of genetics variation within and between specialized poultry population makes it necessary to collect the information about phenotype, production results, and molecular genetic variation of birds.

The fundamental aim of poultry gene resources preservation is the opportunity of utilizing genetic potential of each species and than the maintenance *in vivo* of these valuable collections (Notter, 1999).

Long-term preservation of genetic resources should consist:

- maintenance of population heterozygosis;
- conservation of alleles and allele combinations.

Strategies used in genetic variation preservation are different but depend on specifications of particular poultry genetic resources and therefore there is no one research method for all poultry species and production types.

Poultry biodiversity should be kept in future for obtaining breeding and production progress and also for providing changes in time for the needs of consumers. Maintaining biodiversity of poultry enables not only taking advantage of evolutionary changes but also contributes to increased resistant to diseases and on detrimental environmental conditions. Current poultry genetic resources could be used in scientific research and to increasing profitability of poultry production in the future.

Capacity, preservation, and utilization of biodiversity is essential to the world economy and environment (O'Brien, 1994; CAST, 1999). Intensification of industry diminishes biodiversity (i.e. extermination of species, devastation and changes of ecosystems, and changes in animal' behavior). Knowledge of molecular genetic variation appearing within and between populations could be properly used in the strategy of genetic diversity conservation.

The poultry production is very important because it provides:

1. food for people (animal protein like meat and eggs);
2. scientific model in research of biology on 9000 other birds species and human health;
3. biological material for important pharmacological endeavors and researches (vaccine production, applications in biotechnology);
4. satisfaction and joy (breeding of old, native, and fancy breeds).

The poultry biodiversity preservation has very little to do with wild bird protection. It requires the introduction of the programs of preservation and conservation still existing to nowadays genetic varieties; including:

1. using the specialized populations to study over humans and animals;
2. consolidation of the primary breeder companies;
3. erosion of genetic potential resulted by intensive selection in commercial breeding stocks;
4. using the native breeds well adapted to the local environmental conditions and kept in the small flocks; as well as distinguishing of traits which could be very valuable in the future.

The native poultry breeds are inseparably connected to the agriculture's landscape, traditions, and the farmer's culture and they are the testimony to the multi generation attainments of local breeders. Poultry production based on the local breeds may bring many advantages to the poor agricultural regions by delivering eggs and poultry meat production with unique taste and dietetic value to the market.

Conservation. The theory of genetic species conservation emphasizes their genetic structure and distribution of genetic variation within and between species with substantial evolutional sense.

According to Allendorf (1983) the poultry gene resources are located on two levels:

1. genetic variation between individuals within population;
2. genetic differences between populations.

The value and distribution of genetic variation in population is affected by:

1. genetic drift
2. mutation
3. recombination
4. migration
5. selection

Preservation is often treated as a synonym of conservation. The main goal of preservation is the maintenance of species regardless of their population characteristics.

Therefore in poultry the preservation concerns different species and definite types kept in specific place. So far in preservation of valuable poultry genetics the method of conservation in the liquid nitrogen did not find any usage (Wężyk et al., 1983a, 1983b).

Conservation more than preservation and cryopreservation focuses on the elaboration of long-term programs of maintenance *in situ* small and endangered breeds/strains including estimation of their particular genetics and phenotypic traits, differentiating them from others populations.

In the last decades as the results of strong intensification and globalization of poultry breeding and production, modernization of rearing systems, and preferences toward high effective commercial hybrids, the dramatic decreased of number of poultry breed and varieties accrued. No more than 10 years ago, out of 600 European hen breeds about 200 was endangered of extinction (Everson, 1998). Elimination of poultry population, well adapted to local conditions, contributes to loss of desirable traits such as (Kasznica at al.,1987; Brodacki at al., 1993; Zgłobica at al., 1965; Cywa-Benko, 2002):

- low mortality
- high resistance for diseases and bed environmental conditions
- longevity and ability to high reproduction rate
- instinct of broodiness.

The first works on preservation the old poultry breeds were undertaken in Great Britain in the early seventies of 20th century by the “Rare Breeds Survival Trust”. In short time similar organization were introduced in The Netherland, France and Bulgaria.

In Poland in 1972 the group of scientists under supervision of Professor Stanisław Wężyk (National Institute of Animal Production - NIoAP, Kraków) created the first in Poland conservation farm of hen stocks in Horticultural Farm in Szczytno, collecting 7 old, native breeds/strains of hens. At the same time Professor Adam Mazanowski (Central Laboratory for Poultry Science, Poznań) in Waterfowl Experimental Station Dworzyska gathered 12 native goose breeds and varieties and also a interesting international collection of 6 old breeds of ducks. After a stock analysis of all native breeds and varieties, and after estimation their genetic and production values (Wężyk and Różycka, 1969; Wężyk 1970,1975, 1977, 1984, 1989; Wężyk and Loedl, 1978; , Wężyk and Kasznica 1982; Mazanowski, 1986) both Wężyk and Mazanowski presented jointly elaborated programs of preservation the old native hen, goose and duck breeds and varieties.

Based on PCR method and using two starters number 1 and 8 (Table 1 and 2), the genetic similarity (GS) and genetic distances (GD) between old, native hen breeds were estimated (Table 1 and 2; Figure 1 and 2).

Table 1. Genetic similarity (GS) and genetic distances (GD) between native hen breeds using PCR methods and starter N^{o} 1 (Cywa-Benko, 2002)

GS / GD	Hen strains					
	Z11	G99	R11	H22	S66	Ż33
Z11		0.306	0.357	0.000	0.311	0.446
G99	0.514		0.310	0.339	0.302	0.375
R11	0.447	0.508		0.471	0.738	0.340
H22	1.000	0.470	0.327		0.456	1.000
S66	0.507	0.520	0.132	0.341		0.346
Ż33	0.351	0.426	0.398	1.000	0.461	

Table 2. Genetic similarity (GS) and genetic distances (GD) between native hen breeds using PCR methods and starter N^{o} 2 (Cywa-Benko, 2002)

GS / GD	Hen strains					
	Z11	G99	R11	H22	S66	Ż33
Z11		0.337	0.476	0.259	0.428	0.301
G99	0.485		0.282	0.383	0.288	0.397
R11	0.322	0.550		0.000	0.794	0.108
H22	0.587	0.417	0.100		1.000	0.284
S66	0.368	0.540	0.100	1.000		0.11
Ż33	0.522	0.401	0.967	0.546	0.954	

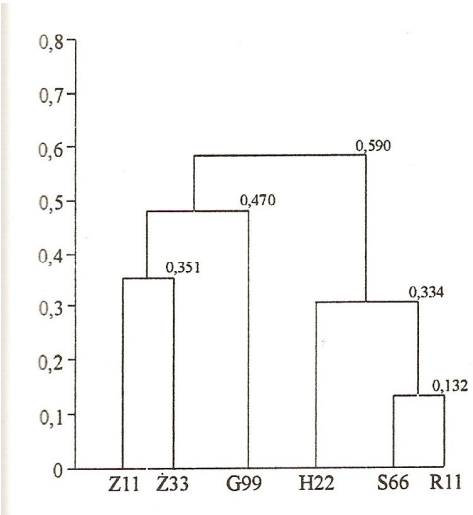

Fig. 1. Dendrite of genetic distances between hen breeds/strains – starter No 1 (Cywa-Benko, 2002)

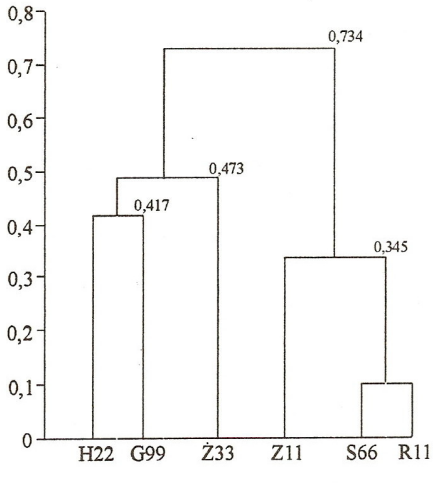

Fig. 2. Dendrite of genetic distances between hen breeds/strain – starter No 8 (Cywa-Benko,2002)

Presented in Table 1 and 2 genetic distances between investigated hen breeds/strains are consistent with draught as dendrite (Fig. 1 and 2). Established genetic differentiations in between particular strains motivate to embrace them in the program of the poultry genetic resource preservation (Cywa-Benko, 2002).

To avoid the increase of undesirable level of inbreeding coefficient in protected populations for each breed/strain in the mating scheme the minimal number of males and

females in each generation was fixed (Table 3, 4 and 5). The hen and duck flocks are divided in groups and according to the scheme of mating, in the definite time, males are exchanging between female groups. Obtained offspring is destined for the flock reproduction. In the hen and duck flocks the changing of generation takes place each year; however in geese flock it happens every 3 to 4 years.

According to the national law of animal breeding and reproduction (2007), the program of poultry gene resources preservation is applied by:

1. breeder – owner of preserved flock;
2. organizations running the herd book for each flock;
3. organizations running the estimation of flock productivity (NIoAP or National Poultry Board);
4. NIoAP – applying and coordinating activity in the sphere of poultry gene resources preservation program.

The effectiveness of poultry gene resources preservation program is estimated by the Working Group for Poultry Gene Resources Preservation (Calik and Krawczyk, 2006).

Table 3. Number of birds in protected hen flock participating in the poultry gene resources preservation program in Poland

Breed/strain	Localization	Number of birds included in program					
		1999		2007		2013	
		M	F	M	F	M	F
Greenleg Patridge Z11	IZ Chorzelów	55	550	62	602	100	1000
Yellowleg Patridge Ż33	IZ Chorzelów	55	550	62	602	100	1000
Rhode Island Red R11	IZ Chorzelów	55	550	62	602	85	850
Leghorn H22	IZ Chorzelów	55	550	62	602	85	850
Leghorn S99	IZ Chorzelów	55	550	62	602	85	850
Sussex S66	IZ Chorzelów	55	550	62	602	85	850
Rhode Island White A33	IZ Duszniki	55	550	136	660	85	850
Rhode Island Red K22	IZ Duszniki	55	550	141	693	85	850
Greenleg Patridge Zk	Agr. Univ. Lublin	55	550	80	598	100	1000
Polbar PB	Agr. Univ. Lublin	55	550	87	600	100	1000

Tabela 4. Number of birds and preserved goose flock participating in the waterfowl gene resources preservation program in Dworzyska (IZ-PIB, Poland)

Breed/strain	Symbol	Number of		Together
		ganders	geese	
Lubelska	Lu	142	142	194
Kielecka	Ki	148	148	201
Podkarpacka	Pd	145	145	197
Garbonosa	Ga	154	154	209
Kartuska	Ka	45	135	180
Rypińska	Ry	52	145	197
Suwalska	Su	54	156	210
Pomorska	Po	55	150	205
Romańska	Ro	57	163	220
Słowacka	Sł	63	193	256
Landes	LsD-01	63	181	244
Kubańska	Ku	80	289	369
Biłgorajska*	Bi	45	172	217
Zatorska**	ZD-1	82	222	304
Together		708	2395	3203

* in poultray farm Rutka; ** in Agricultural University Kraków

Table 5. Number of birds and preserved duck flock participating in the waterfowl gene resources preservation program in Dworzyska (IZ-PIB, Poland)

Breed/strain	Symbol	Number of		Together
		drakes	ducks	
Smaler Duck	K-2	34	172	206
Khaki Campbell x Orpington	Kh0-1	35	176	211
Pekin angielski	LsA	31	154	185
Danish Peking	P-8	30	148	178
French Peking	P-9	32	178	210
Old Polish Peking	P-33	31	152	183
Together		193	980	1173

Lack of native duck breeds in this collection (Table 5) and relatively high costs of its maintenance suggest the necessity of restriction the number of breeds even their elimination.

At first costs of maintenance of protected hen and waterfowl flocks was covered by National Institute of Animal Production and Central Laboratory of Poultry Science however later on this activity was supported by Ministry of Agriculture and Rural Development in the frame of Biological Development Found. At present Ministry of Agriculture (in published each year order) establishes value of donation for implementation of poultry gene resources preservation program (Calik and Krawczyk, 2006).

The estimation of productivity embracing following traits in each hen flock every year is implemented by:

- survival rate of chickens in the rearing period (%);
- body mass of pullets in the 20th week of age;
- sexual maturity (pinpointed by days) at the 30% and 50% of laying rate;
- number of eggs/hen till 64th week of age in all flocks with the exception of A33 and K-22 strains (to 270th day of life);
- fertility (%), hatchability from set (%) and fertile (%) eggs;
- survival rate of hens in the laying period;
- quality traits of shell and egg content in 32nd week of hen age.

Table 6. Production traits of hen breed/strain participating in the hen gene resources preservation program (Calik and Krawczyk, 2008; Pałyszka, 2008)

Trait	Symbol of preserved breed/trait of hens									
	G99	H22	S66	R11	Z11	Ż33	A33	K22	Zk	Pb
Mortality (%) to 8 week of life: - M	5.0	2.5	2.5	2.5	1.3	0.0	2.0	5.3	0.4	0.8
- F	5.0	4.2	2.9	3.8	3.0	1.75	2.2	2.3	4.5	6.9
Mortality (%) to 20 week of life: - M	6.3	2.5	2.5	2.5	1.3	0.0	10.0	9.3	0.6	1.4
- F	6.50	5.1	3.3	4.3	3.0	1.91	4.2	5.4	5.3	9.7
Eggs/ hen	148	160	152	155	128	153	214	225	185	162
Fertility (%)	94.44	92.2	90.2	91.5	90.2	91.0	94.2	96.4	83.3	86.1
Hatchability (%) from:										
- set eggs (%)	76.5	77.9	73.3	75.1	70.0	73.0	77.3	81.1	72.3	73.9
- fertile eggs (%)	81.0	84.5	81.3	82.0	78.0	80.0	82.0	84.1	86.7	85.6
Body mass (g) in 1th day: - M	40.25	40.12	36.01	32.12	38.37	37.00	-	-	-	-
- F	39.19	39.37	33.94	36.55	35.11	35.02	41.00	41.6	36.2	36.7
- in 20th week of age (g): - M	1803	1823	2001	2165	1777	1959	1990	2281	1587	1710
- F	1516	1403	1637	1832	1499	1532	1540	1630	1150	1156
Egg mass (g):										
- 33 week of age	57.0	59.0	48.0	50.0	48.0	49.0	60.0	59.4	46.7	49.8
- 53 week of age	65.0	66.0	56.0	58.0	58.0	58.0	61.9	62.3	52.1	53.3
Sexual maturity (day)	158	161	151	153	163	158	162	163	141	165
Egg mass (g)	57.0	58.2	50.0	51.0	49.0	51.0	-	-	-	-
Yolk mass (g)	14.5	14.2	13.1	14.4	14.1	14.1	-	-	-	-
Cholesterol mg/g of yolk	14.4	14.5	15.0	14.5	14.4	14.6	14.5	14.7	14.2	14.4
Cholesterol mg/yolk	208.7	205.0	196.2	208.5	202.6	207.1	-	-	-	-
Shell strength (N)	37.3	30.8	28.0	23.0	35.0	33.1	-	-	-	-
Yolk color (La Roche)	6.95	7.35	7.45	7.6	6.8	7.45	-	-	-	-
Shell color (%)	69.65	70.35	43.3	45.4	62.15	53.8	31.8	34.5	-	-

Estimation of goose production includes following traits:

- body mass in 8th and in 12th week of age;
- keel length (cm) in 12th week of age;
- thickness of breast muscle in 12th week of age;
- survival rate of gosling in the growing period;
- number of egg/goose until 28th week of laying season;
- egg mass weighted (g) measured in two weeks after 47th week of age;
- fertility (%);
- hatchability of set (%) and fertile (%) eggs.

Table7. Results of estimation production traits of goose breed/trains participating in the waterfowl gene resources preservation program (Calik et al. 2006, 2008; Rabsztyn *et al.* 2008; Kolodziej and Wencek, 2008)

Trait	Symbol of preserved breed/strain of duck												
	Ga	Ka	Ki	Ku	LsD	Lu	Pd	Po	Ro	Ry	Sl	Su	ZD1
Mortality (%) to 8 week of life: - M	4.0	1.7	0.0	-	0.0	3.3	0.0	5.0	-	0.0	0.0	1.7	3.9
- F	8.0	0.8	2.0	8.0	2.0	2.9	2.5	1.0	1.5	3.0	0.0	1.3	6.7
Mortality (%) from 1th day do end of rearing: -M	4.0	3.3	5.0	-	5.0	3.3	1.7	5.0	-	0.0	1.7	3.3	5.9
- F	6.0	2.1	4.0	14.0	4.0	2.9	3.3	3.0	3.8	4.0	0.0	2.9	8.3
Eggs/ goose	50	42	31	70	58	35	40	51	49	43	50	47	47
Fertility (%)	86.5	89.1	85	86.7	88.2	89.2	89.7	91.7	89.5	90.5	92.0	89.8	47.7
Hatchability (%) from:													
- set eggs (%)	70.1	74.6	69.3	72.5	75.8	74.1	75.1	77.3	76.2	77.0	77.5	75.8	16.3
- fertile eggs (%)	81.0	83.7	81.4	83.6	85.9	83.1	83.8	84.3	85.2	85.1	84.3	84.4	32.4
Body mass (g) 8 week of age: - M	3643	3981	3506	-	4101	3616	3686	4100	-	3562	3923	3841	3856
- F	3096	3485	2990	3159	3725	3148	3178	3482	3629	3112	3466	3346	3428
- 12 week of age (g):													
- M	4625	5066	4135	-	4955	4662	4559	4515	-	4678	4468	5077	4666
- F	4147	4399	3829	3935	4799	4074	3930	3894	4193	3965	3874	4422	4051
Keel length (cm) in 12 week of life (g): - M	15.7	16.0	15.8	-	17.4	15.6	15.4	16.6	-	16.2	16.3	16.5	12.0
- F	15.5	15.1	14.2	15.8	16.1	14.8	14.5	-	15.6	15.0	15.4	15.4	11.2
Egg mass (g):	160	183	152	161	174	169	174	180	184	170	180	172	174
Thickness of breast m. (cm) in 12 week of age: - M	1.7	2.1	2.1	-	2.0	-	2.1	1.9	-	2.0	1.9	2.2	
- F	1.7	2.0	1.9	2.0	1.8	1.9	2.0	1.7	1.9	1.9	1.8	2.0	

In July, 2006 the flock of Bilgorajska breed was moved from University of Warmia and Mazury to the farm Majątek Rutka in Puchaczowo, woj. Lubelskie and therefore there is lack of estimation results.

Estimation of duck production includes following straits:

- body mass at 3th and at 7th week of age;
- survival rate (%) of duckling in the growing period;
- number of eggs/duck until 26th week of laying season;
- egg mass (g) weighted during two weeks until 26th of laying season;
- egg mass (g) weighted during two weeks by 80% of laying rate;
- fertility (%);
- hatchability of set (%) and fertile (%) eggs.
- survival rate (%) of ducks in the laying season;

Tabela 8. Results of estimation of the production traits of duck breeds participating in the waterfowl gene resources preservation program (Calik and Książkiewicz, 2008)

Trait	Symbol of preserved breed/trait of ducks					
	K-2	KhO-1	LsA	P-8	P-9	P-33
Mortality (%) to 7 week of age: - M	0.0	0.0	0.0	2.0	0.0	0.0
- F	0.6	1.1	0.0	0.0	0.0	0.0
Mortality (%) from 1 day do the end of rearing period: - M	0.0	0.0	4.0	2.0	0.0	2.0
- F	0.6	2.8	2.6	0.0	0.0	3.0
Mortality (%) during the production season: - M	6.5	0.0	19.4	10.0	15.6	22.6
- F	3.7	6.4	7.8	10.1	6.2	10.6
Eggs/duck	119	127	140	134	136	126
Fertility (%)	84.9	88.7	88.6	87.9	81.5	91.7
Hatchability (%) from:						
- set eggs (%)	64.1	65.4	70.1	76.3	69.2	78.0
- fertile eggs (%)	75.5	73.7	79.1	86.8	84.8	85.0
Body mass (g) in 3 week of age: - M	766	712	1025	982	825	893
- F	703	681	944	949	782	869
Body mass (g) in 7th week of age: - M	1755	1787	2419	2501	2350	2365
- F	1478	1667	2216	2381	2239	2248
Keel length (cm) in 7 week of age: - M	-	-	12.3	12.0	11.8	11.6
- F	-	-	12.0	11.9	11.7	11.6
Thickness of breast m. (cm) in 7 w. of age: - M	-	-	1.2	1.0	1.0	1.0
- F	-	-	1.2	1.1	1.0	1.1
Egg mass (g)	77	76	94	91	86	89

Organizational principles of program realization

According to the poultry genetic resources preservation program (hens, geese and ducks) in Poland (Calik et al., 2007) accepted by the Scientific Board of NIOAP (March 22, 2007) and introduced by Director of the Institute into practice through the order No 16/07, June 01, 2007, poultry breeds/strains may be protected and included under estimation of productivity i.e.

- fulfilling conditions of registration in the herd book of definite breed/strain;
- have a phenotype compatible with breed/strain standard.

The realization of program is taken by:

- breeders – owners of preserved hen, duck and goose flock;
- institutions carry over books for protected poultry breeds/strains;
- National Poultry Board managing the productivity estimation in protected flocks that don't belonging to the NIoAP);
- NIoAP realizing or coordinating the activity in the sphere of domestic animal genetic resources preservation.

The institution caring over the herd book for the certain poultry breed/strain is responsible for the realization of this program. For general activity in the sphere of preservation poultry gene resources, according to the Ministry of Agriculture order (Dz.U., 2004, No 152., pos. 1604) the NIoAP sustains the role of the main coordinator.

The principles of participation of certain breed/strain protection program is define by a contract between the breeder – owner of the poultry flock and the institution that

caries over the herd book. The effectiveness of realization of this program depends on financial resources i.e:

- covering the costs of maintenance of protected flock participating in program;
- covering the costs for a release of breeding material threatened by extermination;
- covering the cost of realization the *ex situ* method of poultry genetic resources preservation program and also, for creation the gene bank.

Institutions realizing programs should gain the financial resources from the national budget, scientific projects of research institutes and from not governmental sources.

For this reason additional activities should be taken such as:

- scientific research on the protected population characteristics including genetics markers and polymorphism of blood serum proteins,
- specific biological traits and utility of protected breeds/strains in farther genetic development of different poultry productive types;
- utilization of protected poultry population in gaining and promotion of branded poultry food products;
- promotion of maintenance of protected poultry population on small holder scale particularly in ecologically and agro-tourist farms.

The Working Group for Poultry Gene Resources Preservation in the NIoAP Production estimates the state of realization and efficacy of program, based on:

- yearly analysis of protected populations size (number of birds/flock);
- periodically analysis of productivity results;
- conformity with method of maintenance defined protected poultry breed/strains.

Utilization of protected poultry breeds/strain in practice

Additional and not utilized for creation of following generation of protected breeds/strains incubation eggs, one day chicks, young and adult birds are being sold to: (a) the farmers who keep small flocks of hens, geese or ducks, (b) to research units for scientific purposes, (c) to breeding companies for genetic development theirs pedigree flocks. Collections of national breed/strains of hens and waterfowl are also utilized for didactic purposes by academic teachers on exercises on poultry courses with students.

Final remarks

We live in times during which the word “crisis” applies to economical and political sphere as well as other problems of world’s food maintenance, energy deficit, and global poultry breeding with its’ specific biodiversity preservation.

Globally dominating on the large scale poultry breeding and its production, affected significantly the consolidation of poultry breeding companies that almost completely subordinated the market. Actually the poultry world market was taken over by few breeding consortiums controlling almost all global egg and poultry meat production. Although these companies are descend from the North part of globe, the market actually grows at South part of globe due to the large scale poultry production founds, special promotion, and friendly environmental conditions.

The development on the large scale poultry production in consequence cuts down the small holders’ existence. Moreover this model of production is based on dangerously narrowing global biodiversity and poultry genetic resources. This risky system provides however more and more relatively cheap eggs and poultry meat. In spite of solicitations by different groups of ecologists on the ecological poultry products the price decides

about the market. Therefore the preservation of poultry genetic resources requires international collaboration and governmental and not governmental financial support.

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