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ECONOMIC ANALYSIS OF EFFICIENCY AND WAYS TO IMPROVE THE PROFITABILITY OF POULTRY GENE POOL MAINTENANCE

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Preservation of animal genetic resources is a key component of food security and economic stability. Genetic diversity provides the foundation for breeding work, allows the production systems to adapt to climate change, and reduces risks associated with epidemics and productivity decline. To assess economic efficiency, it is necessary to conduct specific economic calculations for regions or breeds, taking into account costs, risks, time, market conditions, and climatic factors. The study was carried out at the experimental base of the State Poultry Research Station of the Institute of Animal Science of the National Academy of Agrarian Sciences of Ukraine using genetic resources of chickens of different productivity types (egg – Birky Colored; dual-purpose – Poltava Clay; meat-and-egg – Hercules (Plymouth Rock) White) from the collection of the national poultry gene pool of Ukrainian selection. The article presents the results of scientific research aimed at a systematic analysis of economic efficiency and the identification of ways to improve it in maintaining poultry gene pool populations of various productivity directions. The research established the level of economic efficiency of maintaining gene pool flocks of chickens of different productivity directions and identified the main ways to improve their profitability. The obtained indicators serve as an analytical basis for further calculations aimed at improving technologies for the maintenance and conservation of breeding stock. The profitability level of hatching egg production for 42 weeks of life ranged from -14.08 to 19.75 % (egg-type chickens), -14.28 to 3.5 % (dual-purpose), and -32.56 to 2.6 % (meat-and-egg). For the production and sale of day-old chicks, the profitability indicators were -7.03 to 29.57 % (egg-type), -13.50 to 4.4 % (dual-purpose), and -36.35 to -3.15 % (meat-and-egg). Extending the keeping period of birds from 42 to 52 weeks led to an increase in total egg production and profitability indicators. The profitability level of hatching egg production for 52 weeks of life was 30.10 % (egg-type), 36.83 % (dual-purpose), and 4.66 % (meat-and-egg). For day-old chick production and sales, the profitability levels were 40.77 %, 48.89 %, and -1.23 %, respectively.

Keywords: chickens, economic evaluation, genetic resources, productivity, poultry farming, production.

ЕКОНОМІЧНИЙ АНАЛІЗ ЕФЕКТИВНОСТІ ТА ШЛЯХИ ПОКРАЩЕННЯ РЕНТАБЕЛЬНОСТІ УТРИМАННЯ ГЕНОФОНДУ ПТИЦІ

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Збереження генетичних ресурсів тварин є ключовим компонентом продовольчої безпеки та економічної стабільності. Генетичне різноманіття забезпечує основу для селекційної роботи, дозволяє адаптувати системи виробництва до змін клімату та зменшує ризики, пов'язані з епідеміями та зниженням продуктивності. Для оцінки економічної ефективності необхідно провести специфічні економічні розрахунки для регіонів або порід, враховуючи витрати, ризики, час, ринкові умови та кліматичні фактори. Дослідження проведені на експериментальній базі Державної дослідної станції птахівництва Інституту тваринництва Національної академії аграрних наук України з використанням генетичних ресурсів курей різних напрямків продуктивності (яєчний – Бірківська кольорова; м'ясо-яєчний – Полтавська глиняста; м'ясний – Геркулес (Плімутрок) білий) з колекції національного генофонду птиці української селекції. У статті представлено результати наукових досліджень, спрямованих на системний аналіз економічної ефективності та виявлення шляхів її підвищення при утриманні генофондних популяцій птиці різних напрямків продуктивності. Дослідженням встановлено рівень економічної ефективності утримання генофондних стад курей різних напрямків продуктивності та визначено основні шляхи підвищення їх рентабельності. Отримані показники слугують аналітичною основою для подальших розрахунків, спрямованих на вдосконалення технологій утримання та збереження племінного поголів'я. Рівень рентабельності виробництва інкубаційних яєць за 42 тижні життя коливався від -14,08 до 19,75 % (кури яєчного напрямку), від -14,28 до 3,5 % (кури м'ясо-яєчного напрямку) та від -32,56 до 2,6 % (кури м'ясного напрямку). Для виробництва та реалізації добових курчат показники рентабельності становили від -7,03 до 29,57 % (яєчний напрямок), від -13,50 до 4,4 % (м'ясо-яєчний напрямок) та від -36,35 до -3,15 % (м'ясний напрямок). Подовження періоду утримання птиці з 42 до 52 тижнів призвело до збільшення загальної несучості та показників рентабельності. Рівень рентабельності виробництва інкубаційних яєць за 52 тижні життя становив 30,10 % (яєчний напрямок), 36,83 % (м'ясо-яєчний напрямок) та 4,66 % (м'ясний напрямок). Для виробництва та продажу добових курчат рівні рентабельності становили відповідно 40,77 %, 48,89 % та -1,23 %.

Ключові слова: кури, економічна оцінка, генетичні ресурси, продуктивність, птахівництво, виробництво.

Introduction With the development of industrial poultry farming, where several highly competitive lines, breeds, or crosses displace all others, the issue of preserving the entire diversity of poultry breeds and developing methods for their rational use has become increasingly urgent. Currently, much attention worldwide is paid to the conservation of the gene pool of rare breeds and populations of agricultural poultry; therefore, each country strives to preserve the available poultry gene pool and

resynthesize populations lost during decades of intensive industrialization. This is due to the fact that indigenous poultry are carriers of valuable genes that ensure high adaptability of offspring and excellent taste qualities of poultry products. Consequently, the preservation and restoration of such carriers of valuable genes are of great national economic importance (Melnyk V.O. et al., 2015; Hladii M.V. et al., 2018; Hadzalo Ya.V. et al., 2017; Groeneveld et al., 2016; Hiemstra et al., 2010). At present, there is a sharp narrowing of the genetic base of agricultural poultry worldwide due to the spread of a few breeds that serve as the foundation for final industrial hybrids. Out of 737 breeds of chickens recorded worldwide at the beginning of the 20th century, only 6–7 are now used for producing commercial hybrids: three for egg production and two for meat production (Ladyka V.I. et al., 2023; Katerynych O. et al., 2023; Tixier-Boichard et al., 2011; Muir et al., 2008). Apart from industrial crosses, there are several breeds and populations suitable for small-scale and household farming. These birds have increased body weight, good egg-laying capacity, and are well adapted to extensive rearing conditions (Pokhyl V.I. et al., 2017). Such breeds include Poltava Clay, Kuchyn Jubilee, Adler Silver, Californian Gray, Rhode Island Red, Birky meat-and-egg chickens, among others. These birds demonstrate higher resistance to diseases and temperature stress (Hillel, 2009). At the same time, a number of less common breeds and populations—such as Italian Partridge, Yuriev Loud-voiced, Brahma, Cochin, Padua, Bantam, and others—are also of great value (FAO, 2015; Hladii M.V. et al., 2021). Unfortunately, their population size continues to decline annually due to the absence of a targeted state policy on the conservation of unique genetic resources. In poultry farming, breeding (genetic) resources sold to consumers include hatching eggs, day-old chicks, and reared young stock (Cahaner & Deeb, 2012). Breeding resources are produced in three types of breeding farms: breeding plants, first- and second-order breeding poultry farms. Breeding plants carry out in-depth selection and breeding work with initial cross lines or with individual poultry breeds using individual and family selection methods. These are birds of the highest breeding value and are rarely sold, as they are considered national treasures, and if they are sold, it is at very high prices. First-order breeding poultry farms breed grandparent flocks of crosses, consisting of female birds from maternal lines and male birds from paternal lines. From such flocks, parental forms are obtained, which are sold to second-order breeding poultry producers in certain male-to-female ratios. In the latter, females of the maternal form are crossed with males of the paternal form to obtain final hybrids, which are sold to producers of table eggs and meat. The price of breeding (genetic) resources is determined based on their quality, namely taking into account their superiority in terms of basic productive characteristics over the minimum requirements for breeding resources of each bird species. The minimum requirements are the requirements for assigning the minimum bonitation class, which, according to the "Instructions for the Bonitation of Agricultural Poultry" (2019), is class II. For each species of poultry, and within a species for individual breeds and populations, these requirements are differentiated, especially for the most significant selected traits for each species of poultry. Therefore, calculations of the equivalent price for all types of breeding resources must be carried out separately for each type of farm poultry (egg-laying and meat chickens, turkeys, geese, ducks) (Wolc et al., 2019). To determine the cost of breeding resources of different breeding value, the equivalent price of the product obtained from poultry of the second bonitation class is first determined. For birds of a higher class (1, elite), the price of breeding products is determined by adding a class bonus to the price of class II, which is calculated depending on the level of the bird's advantages over the second class for each trait by which the bird is graded, and the coefficients of inheritance of traits (Plotnikov O., 2022; Chala V., 2023; Petruha N., 2023; Hladii M.V.

et al., 2021; Besbes et al., 2007). Based on the above, it can be argued that studies aimed at assessing economic efficiency and identifying ways to improve the profitability of maintaining a gene pool of purebred poultry are relevant, especially in wartime and during the post-war recovery of the country's economy (FAO, 2021; Groeneveld et al., 2016).

Therefore, the aim of our work was to conduct an economic analysis of the maintenance of gene pool poultry and to model promising ways to improve the overall profitability of maintaining domestically bred chickens.

Materials and methods. The study was conducted at the State Research Station for Poultry Farming of the Institute of Animal Husbandry of the National Academy of Agrarian Sciences, in the Department of Innovative Development of Poultry Farming and at the experimental farm "Preservation of the National Gene Pool of Agricultural Poultry." Domestic chickens of various productivity types were used as genetic material (egg-laying – Birkovska Barvysta, A; egg-meat – Poltavska Hlinyata, 14; meat and egg – Hercules (Plumutrok) white, G2), with which constant work is carried out aimed at preserving the gene pool. Young birds were raised on the floor, and adult birds were kept in two-tier group cage batteries. The chickens were fed a complete feed mixture. The microclimate parameters, feeding and watering fronts, lighting regime, and stocking density of all groups of birds complied with the standards of the "Departmental Standards for Technological Design of Poultry Farms" (VNTP-APK-04.05, 2005).

During the productive period (42–52 weeks of life), the birds were evaluated according to a set of economically useful characteristics: live weight, egg production, and feed consumption.

The profitability of poultry production was calculated using the following formula:

$$Pp = (P/Sp) \times 100\%, \quad (1)$$

where Pp - is the level of profitability, P - is the profit obtained from sales, and Sp - is the cost of production.The results obtained were statistically processed using Microsoft EXCEL software.

Research results. The gene pool has unique properties that can be used both now and in the future. For a complete assessment of the economic efficiency of maintaining gene pool flocks using different technologies, modelling of profitability improvement, we conducted a comprehensive analysis of the main economically useful characteristics and calculated the corresponding indicators by year.

Thus, using productivity data (egg production, reproductive qualities), calculations were made and indicators of the profitability of poultry production were modelled for keeping gene pool breeds of chickens of different productivity directions in cages.

The main indicator used to calculate the quantity of breeding products and the level of profitability of their production is egg production. First of all, we conducted a comparative analysis of egg production over 25 weeks of the productive period over three years (Fig. 1).

During the first year of research, we established a highly probable difference in egg production between Poltava clay 61.0% (egg-meat), Birkovskaya colourful 49.2% (egg) and Hercules white 43.3% (egg-meat). The trend in egg production during the second year of research changed significantly. We established the maximum indicator for egg-laying chickens at 59.7 eggs, compared to 50.6 (egg-meat) and 41.5 (meat-egg), with a highly probable difference between the first and last. In the third year of research, the maximum growth in the indicator was established in all groups of chickens.

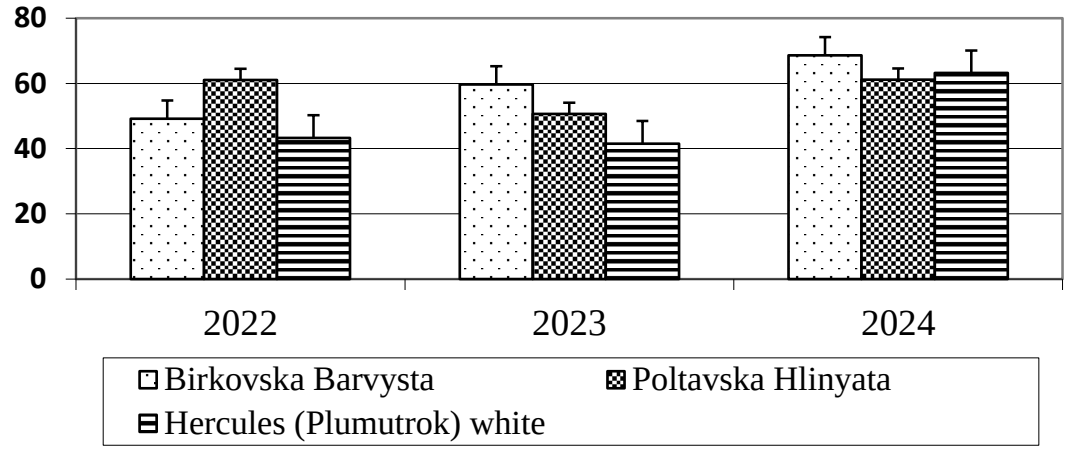

Fig. 1. **Dynamics of egg production over 25 weeks of the productive period for chickens of different productivity types**

The maximum indicator was established for egg-laying chickens (68.57 eggs) and the minimum for egg-meat chickens (61.10 eggs) with high probability ($p<0.05$). Taking into account the data obtained, we subsequently performed calculations and a comparative analysis of the economic efficiency of keeping chicken breeds of different productivity types. Table 1 presents data on the productivity of chickens from the gene pool population of the egg-laying type – Birkovskaya Barvysta.

Table 1

Dynamics of economically useful traits and profitability of breeding production of the gene pool of egg-laying chickens over 42 weeks of life (2022-2024)

No	Indicators	Values	Years		
			2022	2023	2024
1	Laying capacity	pcs.	49,20^{b***}	59,70^{c***}	68,57
2	Average intensity	%	28,11	34,11	39,18
3	Breeding egg yield	%	50,00	50,00	50,00
4	Incubation egg sales	%	70,00	70,00	70,00
5	Incubation eggs sold	pcs.	17,22	20,90	24,00
6	number of day-old chicks	pcs.	12,92	15,67	18,00
7	number of commercial eggs	pcs.	31,98	38,81	44,57
8	cost of incubation egg	UAH	20,00	20,00	20,00
9	cost of day-old chicks	UAH	35,00	35,00	35,00
10	cost of commercial eggs	UAH	4,00	4,00	4,00
11	revenue from the sale of incubation eggs	UAH	472,32	573,12	658,27
12	profit from the sale of hatching eggs	UAH	-77,40	23,40	108,55
13	profitability level from the sale of hatching eggs	%	-14,08	4,26	19,75
14	Revenue from the sale of day-old chicks	UAH	511,07	620,13	712,27
15	Profit from the sale of day-old chicks	UAH	-38,66	70,41	162,55
16	Profitability from the sale of day-old chicks	%	-7,03	12,81	29,57

*Notes. a – statistical significance of the difference between 2022 and 2023; b – statistical significance of the difference between 2022 and 2024; c – statistical significance of the difference between 2023 and 2024; *p<0.05; ** p<0.01; *** p<0.001 – level of statistical difference*

Based on the results of the egg production indicator, a highly probable ($p<0.001$) difference was established between the years of the study. The minimum egg production index was established in 2022 at 49.2 eggs. In subsequent years, a highly probable increase in the value to 59.70 (2023) and 68.57 (2024) eggs was established. The average laying intensity for the productive period (25 weeks) ranged from 28.11 to 34.11 and 39.18%, respectively, by year.

Taking into account the breeding egg yield of 70% and their sales of about 70%, the production of this main product ranged from 17.22 (2022) to 20.9 (2023) and 24.0 (2024) eggs. The average number of commercial eggs per year was 31.98–38.81–44.57 eggs per head. With the cost of an incubation egg at 20.0 UAH/unit and a commercial egg at 4.0 UAH/unit, the proceeds after sale were 472.32 (2022), 537.12 (2023) and 658.27 (2024) UAH per head, respectively. Thus, taking into account the costs, the profit per head of the gene pool flock ranged from -77.40 (2022) to 23.40 (2023) to 108.55 (2024) UAH per head. The profitability level we calculated in this case was –14.08 (2022) – 4.26 (2023) – 19.75 (2024) %.

At the same time, we calculated the profit and profitability indicators if day-old chicks were sold instead of hatching eggs. The cost of incubation is 4.0 UAH per egg. Thus, it would be possible to obtain a reliable ($p<0.001$) higher revenue from sales, at the level of 511.07 (2022) – 620.13 (2023) and 712.27 (2024) UAH per head. In this case, the profit would be -38.66 (2022) – 70.41 (2023) and 162.55 (2024) UAH per head. The profitability level was -7.03 (2022) – 12.81 (2023) and 29.57 (2024) %, which is significantly higher than the sale of hatching eggs.

Thus, the data we obtained allow us to evaluate, adjust and propose ways to improve the economic efficiency of keeping purebred poultry as a gene pool in the future.

The next typical representative of gene pool breeds of chickens for egg and meat production is the Poltava clay breed.

Taking into account the productivity indicators, we calculated the profitability of poultry production for cage rearing of this breed over three years using the proposed model (Table 2).

Over three years of research, we have established a highly probable ($p<0.001$) decrease and increase in egg production, from 61.0 to 50.6 and 61.1 eggs, respectively. At the same time, the general trend in the dynamics of egg production is different from that of egg-laying poultry.

The average productivity and egg production intensity (25 weeks) throughout the entire period was 34.86 (2022) – 28.91 (2023) – 34.91 (2024) %.

Taking into account the yield of breeding eggs at 70% and their sale at about 60%, the production of hatching eggs by year was about 25.62 (2022) – 21.25 (2023) and 25.66 (2024) eggs.

The average number of commercial eggs per year was 35.28–29.38–35.44 eggs per head. With the cost of an incubation egg at 20.0 UAH/piece and a marketable egg at 4.0 UAH/piece, the proceeds after sale were 705.16 (2022), 584.94 (2023) and 706.32 (2024) UAH per head, respectively. Taking into account the costs presented above, the profit per head of the parent flock of egg-meat chickens ranged from 22.77 (2022) – -97.45 (2023) to 23.93 (2024) UAH per head.

The level of profitability calculated by us is set at – 3.34 (2022) – -14.28 (2023) – 3.51 (2024) %.

Along with this, we have presented calculations, as for laying hens, of the profitability of selling day-old chicks, taking into account incubation at 4.0 UAH per egg. As a result of our calculations, the level of revenue from product sales ranges from 711.57 (2022) to 590.25 (2023) and 712.73 (2024) UAH per head.

Table 2

Dynamics by year of economic and useful characteristics and profitability of breeding production of the gene pool of egg-meat chickens over 42 weeks of life (2022-2024)

No	Indicators	Values	Years		
			2022	2023	2024
1	Laying capacity	pcs.	61,00 a***	50,60 b***	61,10
2	Average intensity	%	34,86	28,91	34,91
3	Breeding egg yield	%	70,00	70,00	70,00
4	Incubation egg sales	%	60,00	60,00	60,00
5	Incubation eggs sold	pcs.	25,62	21,25	25,66
6	number of day-old chicks	pcs.	19,22	15,94	19,25
7	number of commercial eggs	pcs.	35,38	29,35	35,44
8	cost of incubation egg	UAH	22,00	22,00	22,00
9	cost of day-old chicks	UAH	35,00	35,00	35,00
10	cost of commercial eggs	UAH	4,00	4,00	4,00
11	revenue from the sale of incubation eggs	UAH	705,16	584,94	706,32
12	profit from the sale of hatching eggs	UAH	22,77	-97,45	23,93
13	profitability level from the sale of hatching eggs	%	3,34	-14,28	3,51
14	Revenue from the sale of day-old chicks	UAH	711,57	590,25	712,73
15	Profit from the sale of day-old chicks	UAH	29,18	-92,14	30,34
16	Profitability from the sale of day-old chicks	%	4,28	-13,50	4,45

*Notes: a – statistical significance of the difference between 2022 and 2023; b – statistical significance of the difference between 2023 and 2024; *** p<0.001 – level of statistical difference*

In this case, the profit would be 29.18 (2022) – -92.14 (2023) and 30.34 (2024) UAH per head.

The profitability level was 4.28 (2022), 13.50 (2023) and 4.45 (2024) %, which is not significantly higher than the sale of hatching eggs.

An analysis of the results of maintaining a population of meat-and-egg chickens, namely White Hercules, is presented in Table 3.

Based on the results of a comparative analysis of egg production, a highly probable ($p<0.001$) increase in this indicator was established in 2024 (63.15) compared to 2022 (43.3) and 2023 (41.5) eggs.

The average egg production intensity for the productive period (22 weeks) was established at 28.12 to 26.95 and 41.01%, respectively, by year. At the same time, for 2024, the maximum productivity for meat-and-egg chickens was set at 41.01% compared to other poultry groups (39.18% and 34.91%).

Taking into account the breeding egg yield of 60% and their sales of about 60%, the total production of hatching eggs was 15.59 (2022), 14.94 (2023) and 22.73 (2024) eggs. The production of commercial eggs per year was at the level of 27.71–26.56–40.42 eggs per layer. With the cost of an incubation egg at 24.0 UAH/piece and a commercial egg at 4.0 UAH/piece, after sale, 484 (2022), 464.80 (2023) and 707.28 (2024) UAH per head were received, respectively.

Table 3

Dynamics by year of economic and useful characteristics and profitability of breeding production of the gene pool of meat-and-egg chickens over 42 weeks of life (2022-2024)

No	Indicators	Values	Years		
			2022	2023	2024
1	Laying capacity	pcs.	43,30 a***	41,50 b***	63,15
2	Average intensity	%	28,12	26,95	41,01
3	Breeding egg yield	%	60,00	60,00	60,00
4	Incubation egg sales	%	60,00	60,00	60,00
5	Incubation eggs sold	pcs.	15,59	14,94	22,73
6	number of day-old chicks	pcs.	11,69	11,21	17,05
7	number of commercial eggs	pcs.	27,71	26,56	40,42
8	cost of incubation egg	UAH	24,00	24,00	24,00
9	cost of day-old chicks	UAH	35,00	35,00	35,00
10	cost of commercial eggs	UAH	4,00	4,00	4,00
11	revenue from the sale of incubation eggs	UAH	484,96	464,80	707,28
12	profit from the sale of hatching eggs	UAH	-204,22	-224,38	18,10
13	profitability level from the sale of hatching eggs	%	-29,63	-32,56	2,63
14	Revenue from the sale of day-old chicks	UAH	457,68	438,66	667,50
15	Profit from the sale of day-old chicks	UAH	-231,49	-250,52	-21,68
16	Profitability from the sale of day-old chicks	%	-33,59	-36,35	-3,15

*Notes: a – statistical significance of the difference between 2022 and 2024; b – statistical significance of the difference between 2023 and 2024; *** p<0.001 – level of statistical difference*

Taking into account the amount of expenses, the profit per head of experimental poultry calculated by us was from -204.22 (2022) – -224.38 (2023) – 18.10 (2024) UAH per head. The profitability level calculated by us in this case was -29.63 (2022) – -32.56 (2023) – 2.63 (2024) %.

At the same time, we calculated the amount of profit and profitability from the sale of day-old chicks at a price of 35.0 UAH per head. The cost of incubation is 4.0 UAH per egg. In this case, based on our data, the revenue from sales could amount to – 457.68 (2022) – 438.66 (2023) and 667.50 (2024) UAH per head. In this case, the profit would be -231.49 (2022) - -250.52 (2023) and -21.68 (2024) UAH per head. The profitability level was -33.59 (2022) – -36.35 (2023) and -3.15 (2024) %, which is the lowest among chickens of different productivity types.

Thus, the data we have obtained is the basis for calculations to improve or refine the technology for maintaining and preserving the gene pool, possible subsidies from the state to improve the economic efficiency of keeping purebred poultry as a gene pool.

Purebred poultry, which is the object and unit of gene pool preservation, has many positive qualities, but not always high indicators of economically useful traits, which is why the economic efficiency of genetic resource preservation may be low. In our work, we modelled and tracked a number of economic and technological solutions that can improve the economic indicators for maintaining the gene pool. The main one is the extension of the productive period. Unfortunately, in Ukraine, the breeding season to

meet the needs of private and commercial farms falls in March–June, which significantly reduces (almost 2.5 times) the use of breeding products. At the same time, in our case, it is micro, small and medium-sized poultry farms that are consumers of purebred poultry. Therefore, in our research, we increased the use of poultry from the Ukrainian gene pool by 10 weeks (70 days) from 42 weeks of age to 52 weeks of age and made a comparative analysis of chickens of different productivity types. The results of productivity and economic efficiency when keeping chickens up to 52 weeks of age are shown in Table 4.

According to our data obtained from keeping chickens of different productivity types in cages, the maximum egg production over 52 weeks of life (87.1 eggs) was established for chickens of the Poltava clay breed (egg-meat). The minimum values (64.4 eggs) were obtained for white Hercules (meat and egg). Egg-laying chickens (Birkovskaya Barvysta) had an intermediate value (74.5 eggs). The difference between the maximum and minimum values is highly significant ($p<0.001$).

Table 4

Comparative analysis of economic traits and profitability of breeding production of the gene pool of chickens of different productivity types at 52 weeks of age (2023)

No	Indicators	Values	Performance direction, analogues		
			egg-laying, Birkovskaya colourful	egg-laying, Birkovskaya colourful	egg-laying, Birkovskaya colourful
1	Laying capacity	pcs.	74,50 a,b***	87,10 c***	64,40
2	Average intensity	%	30,41	35,55	26,29
3	Breeding egg yield	%	50,00	70,00	60,00
4	Incubation egg sales	%	70,00	60,00	60,00
5	Incubation eggs sold	pcs.	26,08 a***	36,58 c***	23,18
6	number of day-old chicks	pcs.	19,56 a***	27,44 c***	17,39
7	number of commercial eggs	pcs.	48,43	50,52	41,22
8	cost of incubation egg	UAH	20,00	20,00	24,00
9	cost of day-old chicks	UAH	35,00	35,00	35,00
10	cost of commercial eggs	UAH	4,00	4,00	4,00
11	revenue from the sale of incubation eggs	UAH	715,20	933,71	721,28
12	profit from the sale of hatching eggs	UAH	165,48	251,33	32,10
13	profitability level from the sale of hatching eggs	%	30,10	36,83	4,66
14	Revenue from the sale of day-old chicks	UAH	773,87	1016,02	680,71
15	Profit from the sale of day-old chicks	UAH	224,14	333,63	-8,47
16	Profitability from the sale of day-old chicks	%	40,77	48,89	-1,23

*Notes. a – statistical significance of the difference between egg-laying hens and egg-meat hens; b – statistical significance of the difference between egg-laying hens and meat-egg hens; c – statistical significance of the difference between egg-meat hens and meat-egg hens. *** $p<0.001$ – level of statistical difference*

The average laying intensity of the experimental birds during the productive period was set at 30.41% (egg-laying), 35.55% (egg-meat) and 26.29% (meat-egg) chickens.

According to our own data, the maximum yield of breeding eggs was established for the Poltava clay breed (egg-meat), followed by Hercules white (meat-egg) and Birkovska colourful (egg), respectively 70.0 – 60.0 – 50.0%.

Taking into account the seasonality of production and sales of breeding products, the sales rate for hatching eggs is set at 60.0 (egg-meat, meat-egg) – 70.0 (egg) %.

With the price of hatching eggs at 20.0 (egg-laying) – 22.0 (egg-meat) – 24.0 (meat-egg) UAH per piece and commercial eggs at 4 UAH the total sales revenue was, respectively, from 715.20 (egg) to 721.28 (meat-egg) and 933.71 (egg-meat) UAH per head.

Taking into account the cost of raising and maintaining chickens, the profit was set at 165.48 (egg-laying) – 251.33 (egg-meat) – 32.10 (meat-egg) UAH per head.

The level of profitability of breeding production for cage-reared gene pool flocks of chickens of different productivity types per year of life (52 weeks) is set at 30.10 (egg-laying) – 36.83 (egg-meat) – 4.66 (meat-egg) UAH per head. According to the results of a comparative analysis of the profitability of keeping chickens for 42 and 52 weeks, an average increase of 37.07–0.53% was established for egg-laying chickens; 33.32–51.11% for egg-meat chickens; 2.03–37.22% for meat-egg chickens.

Discussion Thus, extending the period of poultry rearing allows for an increase in productivity and improves the profitability of preserving the gene pool. Increasing the yield of breeding eggs to the minimum standard level (VNTP-APK-04.05) – 75%, and their sale at 100%, with the above-mentioned productivity indicators will increase the level of profitability by 116.84 (egg) – 104.22 (egg-meat) – 77.55 (meat-egg) %. An additional potential for increasing profitability is the growth in the price of breeding resources, but this is currently not possible for the domestic market of Ukraine.

Another additional area for increasing profitability is the incubation and sale of day-old chicks. In this case, sales revenue could increase by 8.0–8.8% for egg and egg-meat poultry. Unfortunately, for meat-and-egg chickens, at such a price for day-old chicks, it may decrease by 6%. The level of profitability may increase by 10.67% and 12.06% for egg-laying and egg-and-meat poultry. For meat-and-egg poultry, it will be -1.23%.

Conclusions

1. Based on the results of the economic analysis, the level of efficiency was established and ways to improve the profitability of maintaining the gene pool of chickens of different productivity directions were determined. The data obtained are the basis for further calculations to improve or refine the technology for maintaining and preserving the gene pool of agricultural poultry.

2. A reliable difference has been established between the gene pool populations of chickens of domestic selection in terms of egg production, the value of which determines the direction of productivity and affects the economic indicators of the profitability of poultry maintenance. Based on the results of a systematic analysis, the profit and profitability of chickens of different productivity directions were calculated for the sale of breeding products in the form of hatching eggs and day-old chicks. The level of profitability of hatching egg production (by year, for 42 weeks of life) for chickens of different productivity directions was set at the following levels, respectively -14.08 – 19.75 % (egg-laying chickens); -14.28–3.5% (egg-meat); -32.56–2.6% (meat-egg). For the production and sale of day-old chicks, the profitability level is, respectively: -7.03–29.57% (laying hens); -13.50–4.4% (egg-meat); -36.35–3.15% (meat-egg).

3. Ways to improve the overall level of profitability while preserving the gene pool have been identified. Increasing the retention period of poultry from 42 to 52 weeks of age leads to an increase in overall egg production and corresponding indicators of profitability in the production of breeding products. The level of profitability of hatching egg production (at 52 weeks of age) for chickens of different productivity types was set at 30.10% (egg-laying chickens); 36.83% (egg-meat chickens); 4.66% (meat-egg chickens). For the production and sale of day-old chicks, the profitability level is 40.77% (egg-laying hens); 48.89% (egg-meat); -1.23% (meat-egg), respectively.

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