Formation of Cost-resource Determinants and Stabilizers of the Development of Hunting in Ukraine

Tatiana I. Yavorska[1,*], Valeriy V. Lysenko[2], Olha O. Sobolevska[2], Valerii I. Apostolov[3] and Iryna V. Ahieieva[4]

[1]*Department of Business, Trade and Exchange Activities, Dmytro Motornyi Tavria State Agrotechnological University, Melitopol, Ukraine;*

[2]*Department of Ecology and Information Technology, Melitopol Institute of Ecology and Social Technologies, University of "Ukraine", Melitopol, Ukraine;*

[3]*Azov-Syvash National Nature Park, Genichesk, Ukraine;*

[4]*Department of Management, Dmytro Motornyi Tavria State Agrotechnological University, Melitopol, Ukraine.*

Abstract: The article forms and implements cost-resource determinants and stabilizers of the economic development of hunting in Ukraine, which take into account the maximum affordable use and income from the use of hunting ground, game breeding and animal protection, stimulating the efficient management of hunting entities and ensuring their profitability. It is substantiated that the use of various methods of indicative analysis of the formation of cost-resource determinants and stabilizers of the economic development of hunting by a set of processes of the resource system of the hunting fund allows combining economic, environmental and social components of individual sectors of the hunting industry with an assessment of interdependent indicators and factors influencing it. The norms of extraction of certain species of hunting animals at their optimal number in the forest-hunting regions of Ukraine are substantiated. Expenditures and revenues from hunting on average per one forest-hunting region of Ukraine are grouped. Changes in the shares of expenditures on protection, reproduction, accounting of wild animals and landscaping in Ukraine have been identified. Permissible norms for the use (shooting, catching) of certain species of hunting animals in the forest-hunting regions of Polissya, Forest-Steppe and Steppe of Ukraine have been established. The forecast value of cost-resource determinants and stabilizers of the economic development of hunting in the forest-hunting regions of Ukraine is calculated.

Keywords: natural resources; hunting; wild animals; biodiversity; animal protection.

JEL Classification: A10, O10

1. INTRODUCTION

Overcoming the negative crisis phenomena that are taking place in Ukrainian economy today is possible only if the environmental, economic, social, political, cultural and other social needs of the country are coordinated and its industries are adequately resourced. Implementation of determinants of cost and resource policy of hunting enterprises operating in an unstable economic situation in the country and the imbalance of financial security of the industry is due, firstly, imperfect distribution of public administration functions, and secondly – insufficient modernization of public hunting policy in temporarily occupied territories of Ukraine. This encourages the use of proper protection of hunting ground. However, due to inefficient management of hunting ground, unproductive management of hunting enterprises, in the absence of a balanced structure of protection costs, measures from the state hunting fund lead to a reduction in game breeding. This situation, in turn, leads to a decrease in the biological diversity of hunting animals, the decline of the hunting industry as a natural complex as a whole.

At the same time, interest in the cost component of the effective functioning of hunting entities is constantly growing, in the context of economic transformation and security of state development, decentralization of local government, taking into account the national characteristics of the country. This is quite logical, as most issues related to minimizing the costs of hunting, including the use, protection and conservation of hunting ground, are addressed through the standards of economic, social and environmental components of the mechanism for regulating the activities of enterprises in this area. At the same time, the programs of state financial assistance to cover the costs of hunting ground, animal protection and game conservation, as well as the recognition of the interests of hunting enterprises at the state level are of fundamental importance. Moreover, in Ukraine there are all the necessary objective prerequisites for the functioning of hunting enterprises, namely: geographical location, climatic and natural landscapes, biological diversity, *etc* (Helmer, 2004; Hadhek *et al*., 2021).

Hunting, as a special branch of the economy, an integral part of nature management, should use all the functionality of animal resources. At the same time is should deal with their reproduction and protection, contain a triad of components of the concept of sustainable development and provide environmental (biodiversity protection), social (recreational and aesthetic needs) and economic (services and resources for further economic activity) functions. The main reason for the loss of hunting enterprises is the inefficient model of market relations in this area, which does not meet European requirements and standards. The lack of mechanisms for the rational use of hunting ground and fees for their use leads to poaching, as well as the inability of programs to breed wild

*Address correspondence to this author at Department of Business, Trade and Exchange Activities, Dmytro Motornyi Tavria State Agrotechnological University, 72310, 18 B. Khmelnitsky Ave., Melitopol, Ukraine

animals, control predators and make clear requirements for the hunting service. This, in turn, reduces the level of hunting culture and ethics of workers, does not encourage them to be productive.

The leading contribution to the process of the formation of costs and revenues from hunting management at the regional level, as well as the study of quantitative and qualitative changes in the reproduction of the resource potential of the industry has been studied by such scientists as F. Achard, H. Eva, H-J. Stibig, P. Mayaux, J. Gallego, T. Richards, J-P. Malingreau (2002), P. Barreto, C. Souza, R. Nogueron, A. Anderson, R. Salomao (2006), N. Berezina (2017), B. Bleher, D. Uster, T. Bergsdorf (2006), D. Bray, L. Merino-Perez, P. Negreros-Castillo, G. Segura-Warnholtz, J. Torres-Rojo, H. Vester (2005), J. Browder (2002), S. Clark, K. Bolt, A. Campbell (2008), L. Curran, S. Trigg, A. McDonald, D. Astiani, Y. Hardiono, P. Siregar, I. Caniago, E. Kasischke (2004), R. DeFries, A. Hansen, A. Newton, M. Hansen (2005). The works of such authors as V. Bondarenko, A. Deineka, V. Burmas, P. Khoietskyi, V. Khodzinskyi (2005), D. Bray, E. Ellis, N. Armijo-Canto, C. Beck (2004), R. Chowdhury (2006), M. Cropper, J. Puri, C. Griffiths (2001), K. Deininger, B. Minten (2002), R. Ewers, A. Rodrigues (2008), J. Jones (1992), M. Kinnaird, E. Sanderson, T. O'Brien, H. Wibisono, G. Woolmer (2003) are devoted to the problems of state regulation of the cost and resource policy of hunting enterprises in the transformation of the economy and the security of their development.

The priority of our study is the implementation of cost-resource determinants and stabilizers of the economic development of hunting, which take into account the maximum affordable use and income from the use of hunting ground, game breeding and animal protection, stimulating efficient management of hunting entities and profitability from them.

2. MATERIALS AND METHODS

The basis of the functioning of hunting entities is the use of hunting ground, game breeding, protection of animals from poachers and the preservation of the necessary types of homes. Within the legal and financial field, hunting entities develop a culture of hunting and trophy business and participate in socially responsible activities. They are responsible for their actions to other economic entities (property owners, neighboring farms, including agricultural ones) and gain an economic advantage from the use of hunting ground, and thus increase the number of game, providing economic incentives and obligations from their activities.

The use of various methods of indicative analysis of the formation of cost-resource determinants and stabilizers of the economic development of hunting by a set of processes of the resource system of the hunting fund allows combining economic, environmental and social components of individual sectors of the hunting industry. In our case, it is necessary to determine not only the current level of cost-resource determinants of the economic development of hunting enterprises, but also the potential dynamics of their resource potential for the formation of a model structure of costs for hunting, breeding, protection of animals from poachers and preserving the necessary types of homes in the event of their occurrence. The set of actions that stop the negative processes of increasing cost resources as factors in the development of cost and resource policy of hunting entities within economic, social, natural, raw materials, land and recreational components, confirms the multifactor model of the environmental management. It includes (Furdychko, 2009) “zero level” of consumption of natural resources; compliance of anthropogenic load to the natural resource potential of the region with hunting ground; preservation of the spatial integrity of the hunting fund as a natural system; preservation of the naturally occurring cycle of substances; coordination of production and natural rhythms; priority of ecological optimality in determining the economic efficiency of nature management.

Achieving a state of balancing of cost-resource determinants and stabilizers of the economic development of hunting requires a number of prerequisites: a political system capable of ensuring the participation of the general public in decision-making; economic system that could provide expanded reproduction of hunting ground, game breeding, protection of animals from poachers; a social system capable of relieving tensions arising from the conditions of inharmonious economic development of hunting; system of effective reproduction of game and animals, focused on preserving the ecological and resource base of hunting entities; an international system that would promote the stability of trade and financial relations (Hayes, 2006; Jepson *et al*., 2002).

At the same time, the cost approach determines the total labor cost for the development, exploration, involvement in the economic circulation of hunting, quantitative, and qualitative renewal of material resources, as well as funds for the reproduction of hunting ground and protection of various species. In addition, the cost-resource component in determining the value of hunting ground combines the cost of its development and income from the use, thus providing a more effective economic assessment of its safe use. Within an effective approach, the value of hunting ground is the economic effect of entities derived from their exploitation. Income from the use of hunting ground can be both direct and indirect, which is very difficult to estimate. At the same time, hunting ground, as an unused resource, has no value under this approach, although it may be in demand in the future (Oliinychuk, 2010).

Within the reproductive approach, the set of natural resources that are included in the country's hunting fund in a given area and the state of the environment are considered as a starting point for their use, which restores the quality and quantity of hunting ground, taking into account environmental safety. The value of the natural resource of the hunting fund in this case is defined as the sum of costs necessary to reproduce or compensate the loss of hunting ground, natural biodiversity and rare species of animals and protected areas (Myronenko *et al*., 2015).

The economic assessment of cost-resource determinants and incentives for the use of hunting ground as a natural resource for game breeding and animal protection is based on the concept of “willingness to pay”, according to which the value of a certain environmental good includes market value and additional consumer benefits, using methods based on market valuation; rent; cost approach; opportunity cost; general economic value (Oliinychuk, 2009).

In the market assessment of cost-resource determinants and incentives for the use of hunting ground as a natural resource aimed at breeding and animal protection, the price is formed (the ratio of market supply and demand), excluding external costs of society. In addition, this resource price is understated compared to the actual cost.

The rental approach is based on the concept of uniqueness and limited area of hunting ground as a natural resource, which is estimated as follows (Equation (1)) (Protsiv, 2015; Shershun, 2012):

$$P = \frac{R}{r}, \qquad (1)$$

where, P–the price of hunting ground as a natural resource; R– the amount of annual rent; r–discount rate.

In the cost approach, the basis for calculating the price of hunting ground as a natural resource are the costs associated with the use and restoration of resources for game breeding and animal protection. The cost of rebuilding hunting ground includes the potential costs required to replace game and protect animals in the area, taking into account losses due to damage to natural resources. Accordingly, the concept of opportunity cost allows to assess the cost-resource determinants and incentives for the use of hunting ground as a natural object, at a reduced market value (by calculating lost profits), which under favorable conditions could potentially be used for other purposes (for example, the opportunity cost of the reserve – unearned income from the sale of timber, animal husbandry, *etc*.) (Myronenko *et al*., 2015).

However, a comprehensive approach to estimating the cost and resource components of hunting ground for game breeding and the protection of animals from poaching, as a natural object, applies the concept of overall economic value. When using it, resource and assimilation (reconstruction) functions of the natural environment are taken into account. That is, the total economic value of a natural object includes the cost of use, which consists of the direct cost of use; indirect cost of use; the cost of the deferred alternative; the cost of non-use (cost of living). The cost of using hunting ground characterizes the consumer value of a natural object (Myronenko *et al*., 2015).

Thus, the direct cost of use makes it possible to obtain the economic effect (profit) from the exploitation of a natural object or the consumption of a natural resource. Indirect cost of use is revenue from the use of a natural object that arise on a global scale (for example, the formation of natural biodiversity and rare species of animals and territory, water regulation functions). At the same time, the value of the deferred alternative represents the cost of conservation of natural resources for future use of hunting ground and is estimated as the sum of direct and indirect costs of use. The cost of non-use is the cost of recreational capacity of hunting ground in the natural environment. To this should be added the synergetic effect of the preservation of hunting ground for game breeding and animal protection as real and potential resources (Shkuratov, 2013; Kish, 2020).

Operational and protective value of hunting resources is determined based on the total rental income of hunting ground, obtained as a result of using the hunting fund. Valuation of hunting ground can also be determined by a profitable approach. For such purposes, the most commonly used method is the method of capitalization of potential net income from its operation (Equation (2)) (Mugisha and Jacobson, 2004; Protsiv, 2015; Shershun, 2012):

$$S_0 = \frac{D+F-Z_0}{r} \qquad (2)$$

where, S_0 – valuation of hunting ground; D – income from hunting management, for example from accommodation of hunters, provision of various services; F – income from the use of hunting ground; Z_0 – costs of hunting, protection and reproduction of hunting animals, including biotechnical measures, accounting work, hunting facilities; r – capitalization ratio for land (discount rate).

The basis for calculating the amount of income from the use of hunting ground is the indicator of biologically permissible productivity of lands, which characterizes the potential yield in compliance with the norms of animal production. The rate of production determines the number of animals that can be shot or removed from their natural habitat without undermining the reproductive capacity of the population. It is usually close to the annual population growth.

Entities that have large and small plots of hunting ground, count them as the minimum unit for the formation of hunting farms (Figure 1), form cost-resource components on the basis of standards of possible and actual wildlife production (shooting standards). At the same time, the cost of products, which is included in the total cost of ungulates, takes into account the age structure of the population and the number of young animals, the average weight of which is less than the weight of an adult animal. The costs of hunting management, including biotechnical, conservation and reproduction measures, are set from departmental sources at the actual level (Myronenko *et al*., 2015).

The estimated level of payment for granting the right to use hunting fauna resources (license, shooting card) is determined based on the cost of measures for protection, maintenance and reproduction of one animal of a certain species, taking into account the regulatory profit of hunting farms. The normative (normal) profit of hunting entities is set as a percentage of the current costs of protection and reproduction of one animal of the hunting fauna at a level not exceeding the official discount rate of the NBU. Expenses for the operation of hunting ground are determined per unit of calculation (animal of hunting fauna) based on Guidelines for the formation of the cost of products (works, services) at forestry enterprises of Ukraine under the following articles: organization of hunting farms (arrangement of hunting ground and its periodic inventory); costs for biotechnical measures; administrative costs (costs for the protection of hunting ground and resources of hunting fauna, maintenance of management and other categories of employees); special shooting (catching) of wild animals, processing, storage and sale of hunting products; resettlement and acclimatization of valuable species of hunting fauna, its semi-artificial maintenance, breeding work, *etc*.; prevention of damage that may be caused to hunting fauna (shooting of predators, stray dogs, *etc*.);coverage of damage caused by wild animals to agriculture and forestry (loss of wood and reduction of its quality; costs for felling damaged plantations and re-creation of forest crops and felling the old and damaged trees, care for destroyed plantations, *etc*.);prevention of damage that may be caused by wild animals (protection of plantations and agricultural crops, fencing of plots, purchase and use of deterrents, *etc*.);payment for the use of natural resources; dog costs (breeding, keeping and training of hunting dogs); capital construction and repair (hunting lodges, shelters, shooting ranges, *etc*.); purchase of equipment, hunting equipment, ammunition, low-value equipment, *etc*.; scientific work; transportation costs; own expenses and other expenses (Guesmi and Gil, 2021; Lysychko, 2016; Mas, 2005).

The distribution of the above costs is carried out by species of hunting animals (elk, deer, roe deer, and wild boar). In the case where it is impossible to determine equally, which animals are eligible, they are distributed in proportion to the number of animals or their weight (Table **1**, **2**, **3**).

Fig. (1). Distribution of sustainable hunting ground of the Nadkarpattian Regional Forestry Directorate. Source: built by authors based on data Myronenko *et al*., 2015.

Table 1. Estimates of costs for biotechnical measures of hunting.

Types and Biotechnical Measures	**Cost Rates**
Elk	
1. Manufacture and installation:	
solonetz, pcs.	1-5 animals
feeders, pcs.	1-5 animals
2. Procurement and laying out:	
feed brooms, pcs.	850 per one animal

Types and Biotechnical Measures	Cost Rates
root crops, kg	20 per one animal
salt, kg	3 per one animal
Red deer	
1. Manufacture and installation:	
solonetz, pcs.	1 per 10 animals
feeders, pcs.	1 per 10 animals
drinking water sets, pcs.	1 per 100 animals
2. Procurement and laying out:	
hay, kg	80 per one animal
haylage, kg	40 per one animal
feed brooms, pcs.	100 per one animal
grain, kg	20 per one animal
root crops, kg	80 per one animal
salt, kg	3 per one animal

Source: built by authors based on data Myronenko *et al*., 2015.

Table 2. Optimal densities of the main species of hunting animals, depending on the average class of quality of the forest-hunting region.

Middle Quality Class / Optimal Density (Heads / 1000 ha)	Elk	Deer	Doe	Roe deer	Boar	Hare	Partridge
1.0	11.0	15.0	35	57.0	12.0	100	80
1.1	10.6	14.5	34	55.0	11.7	96	78
1.2	10.3	14.1	33	53.5	11.4	92	76
1.3	9.9	13.6	32	51.5	11.1	89	74
1.4	9.6	13.2	31	50.0	10.8	86	72
1.5	9.2	12.7	30	48.0	10.5	83	70
1.6	8.9	12.3	29	46.5	10.2	79	68
1.7	8.5	11.8	28	44.5	9.9	76	66
1.8	8.2	11.4	27	43.0	9.6	72	64
1.9	7.9	10.9	26	41.0	9.3	68	62
2.0	7.6	10.4	25	39.0	9.0	65	60
2.1	7.3	10.0	24	37.0	8.7	61	58
2.2	6.9	9.5	23	35.5	8.4	58	56
2.3	6.5	9.1	22	33.5	8.1	55	54
2.4	6.2	8.6	21	32.0	7.8	52	52
2.5	5.8	8.2	20	30.0	7.5	49	50
2.6	5.5	7.7	19	28.5	7.2	46	48
2.7	5.1	7.3	18	26.5	6.9	43	46
2.8	4.8	6.8	17	25.0	6.6	40	44

2.9	4.4	6.3	16	23.0	6.3	37	42
3.0	4.1	5.8	15	21.0	6.0	34	40
3.1	3.8	5.4	14	19.0	5.7	31	38
3.2	3.5	4.9	13	17.5	5.4	28	36
3.3	3.1	4.5	12	15.5	5.1	25	34
3.4	2.8	4.0	11	14.0	4.8	22	32
3.5	2.4	3.6	10	12.0	4.5	20	30
3.6	2.1	3.1	9	10.5	4.2	18	28
3.7	1.8	2.7	8	8.5	3.9	16	26
3.8	1.5	2.2	7	7.0	3.6	14	24
3.9	1.2	1.7	6	5.5	3.3	12	22
4.0	0.8	1.2	5	4.0	3.0	10	20
4.1	0.6	0.8	4	2.5	2.7	8	18
4.2	0.5	0.4	3	1.0	2.4	6	16
4.3	0.3	0.2	2	0.5	2.1	4	14
4.4	0.2	-	1	-	1.8	2	12
4.5	-	-	-	-	1.5	1	10
4.6	-	-	-	-	1.2	-	8
4.7	-	-	-	-	0.9	-	6
4.8	-	-	-	-	0.6	-	4
4.9	-	-	-	-	0.3	-	2
5.0	-	-	-	-	0.1	-	-

Note: Source: built by authors based on data Myronenko *et al*., 2015.

Table 3. Rates of Extraction of Certain Species of Hunting Animals with their Optimal Number in the Hunting Regions of Ukraine

Species of Hunting Fauna	**Forest-Hunting Region**	**Permissible Withdrawal Percentage, %**
Elk	For all forest-hunting regions	10
Deer		10
Boar	Polissya, Forest-Steppe, Carpathians	20
	Steppe forest-hunting region	25
Gray hare	For all forest-hunting regions	15
Gray partridge		15
Pheasant	Steppe forest-hunting region	15
Waterfowl	For all forest-hunting regions	20

Note: Source: built by authors based on data Myronenko *et al*., 2015.

The stages of determining the standard of payment for the use of hunting ground of the forest-hunting region are shown in Fig. (**2**).

The formation of a mechanism to ensure the harmonious nature of relations between hunting entities on the basic principle of integrated rational use of cost-resource determinants, will take into account special measures to prevent and compensate the losses from possible mutual negative effects to stabilize economic development of the hunting industry.

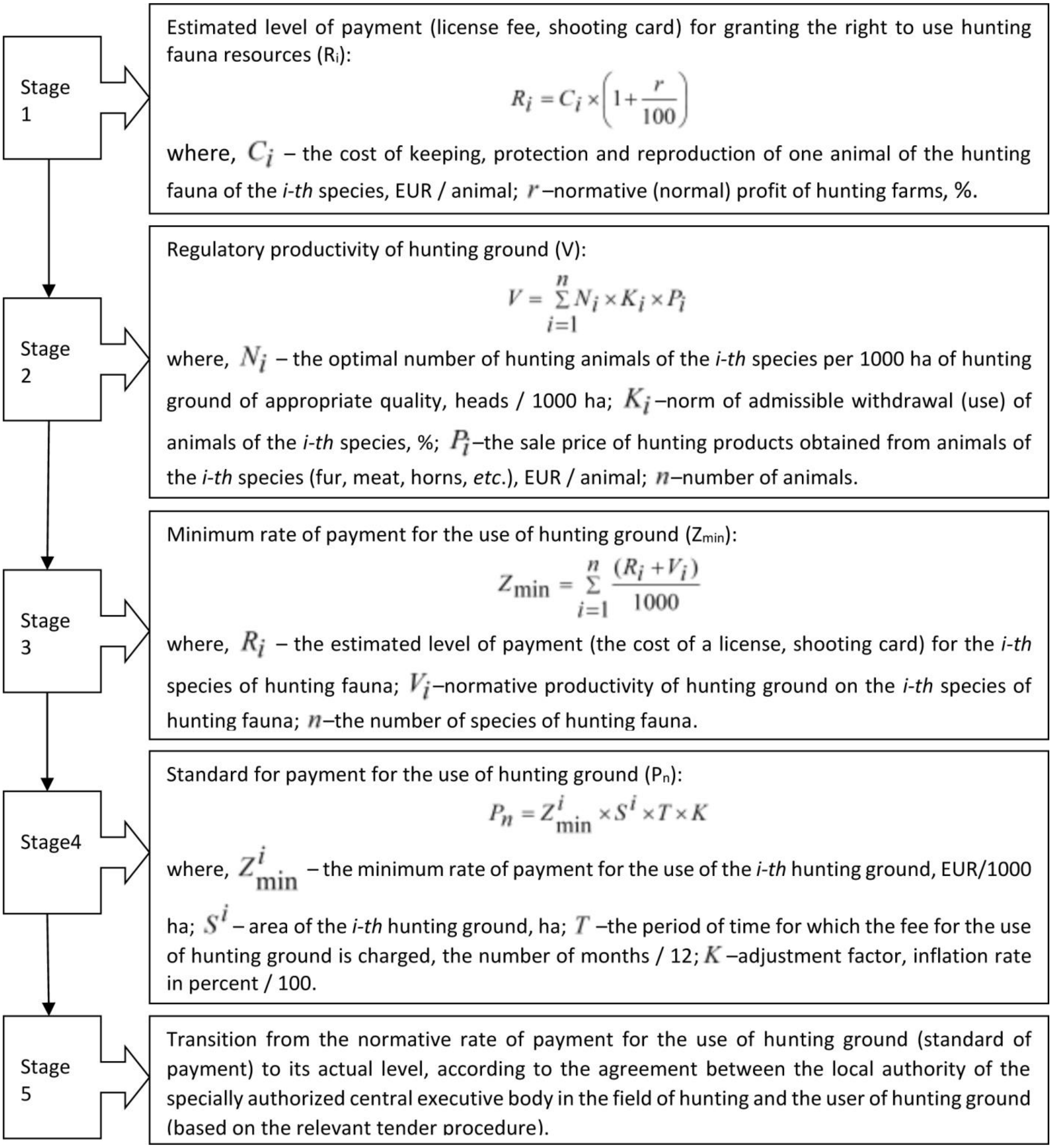

Fig. (2). Stages of determining the standard of payment for the use of hunting ground. (Source: built by the authors according to data Khvesyk *et al*., 2011; Lakyda *et al*., 2010; Zadorozhna, 2008).

3. RESULTS

The natural and economic potential of hunting in the forest-hunting regions of Ukraine, despite its capacity, is not fully used, causing unprofitability of the industry. The following forms of costs accompany conducting hunting as an independent branch of the economy: wages of workers employed in hunting; protection, reproduction and accounting of wild animals; landscaping of hunting ground. The total cost of hunting in Ukraine as a whole is 3.05 million EUR, of which 1.11 million EUR (23.48 EUR/ha) – are the costs of protection, reproduction of wild animals and conducting biotechnical activities. Revenues from hunting and economic activities amounted to 1.64 million EUR (over 32.79 EUR with one thousand hectares of hunting ground). The number of costs and revenues from hunting on average per one forest-hunting region of Ukraine for 2017-2021 is given in Table **4**.

The annual increase in the total costs of hunting enterprises on average per one forest-hunting region of Ukraine is due to the growth of wages, because this share of costs is the main and most important (over 60%). An integral part of the indicator of efficiency of enterprises for hunting in the forest-hunting regions of Ukraine are the costs aimed at the protection, reproduction and accounting of wild animals and landscaping, which during 2017-2021 remain almost unchanged.

The value of these costs is the lowest in 2021 – 176.8thousand EUR. In general, during this period the number of total costs is the largest – 704.8 thousand EUR. This indicates a low level of funding for the development of the hunting industry. However, despite the annual increase in total costs, their share in the percentage, on the contrary, decreases (Fig. **3**).

The most critical situation in 2021 was accompanied by a reduction in costs for the protection, reproduction, accounting of wild animals and landscaping of hunting ground compared to 2017 and amounted to 12% (or 23 thousand EUR).

The dynamics of the structure for the protection, reproduction, accounting of wild animals and landscaping of hunting ground on average per forest-hunting region of Ukraine is presented in Fig. **4**.

Table 4. Costs and Revenues from Hunting Farms on Average Per One Forest-Hunting region of Ukraine.

Indicators	2017	2018	2019	2020	2021
Total costs of hunting management, thousand EUR	517.9	565.7	646.6	678.4	704.8
including protection, reproduction, accounting of wild animals, management of hunting ground	200.6	207.9	196.1	188.7	176.8
in particular accounting of wild animals	2.9	2.5	2.5	2.4	2.3
protection of wild animals and combating poaching	68.8	76.1	62.6	63.7	61.7
biotechnical measures of conservation and reproduction of wild animals	124.5	124.2	129.9	130.5	131.2
for the arrangement of hunting ground	4.3	5.2	4.4	3.8	2.7
for the costs of artificial breeding of hunting animals for resettlement	5.4	8.3	7.4	6.4	6.2
Proceeds from hunting, thousand EUR	155.3	199.6	229.1	312.7	317.8

Note: Source: calculated by the authors according to data Agriculture, forestry and fisheries.

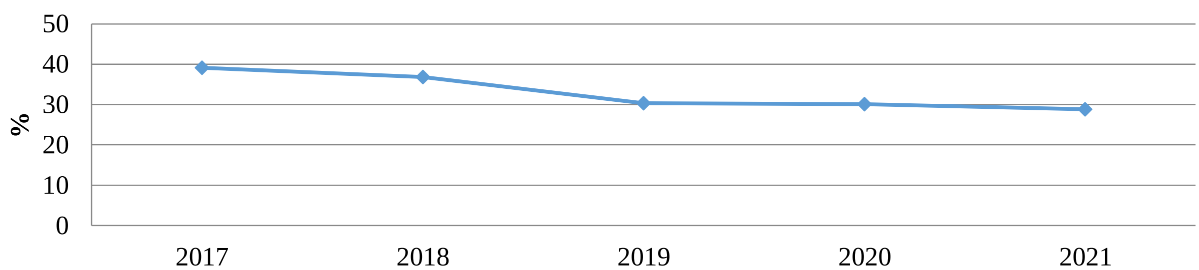

Fig. (3). Dynamics of changes in the share of costs for the protection, reproduction, accounting of wild animals and landscaping of hunting ground of the hunting entities of Ukraine for 2017-2021, %, (Source: calculated by the authors according to data Agriculture, forestry and fisheries).

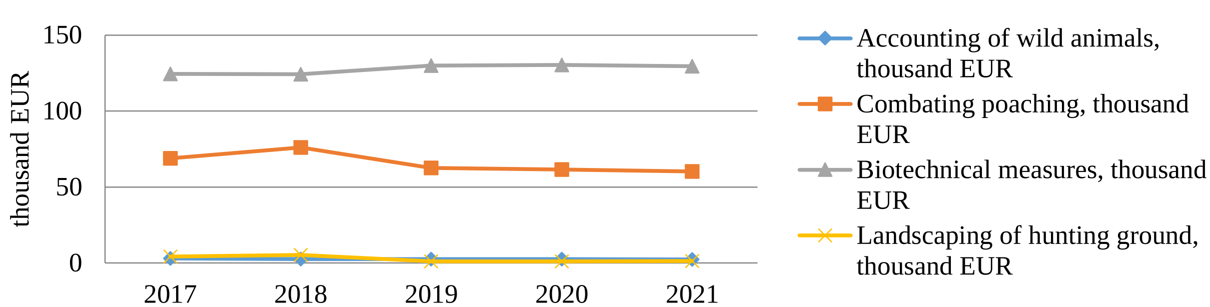

Fig. (4). Structure of expenses for protection, reproduction, accounting of wild animals and arrangement of hunting lands on average per one forest-hunting region of Ukraine, %. (Source: calculated by the authors according to data Agriculture, forestry and fisheries).

The largest share in the overall structure is the cost of biotechnical measures and the combating poaching (over 61% and 34% respectively). In 2021, the share of expenditures on the management of hunting grounds decreased by 90.2%, due to state underfunding of the industry.

The value of revenues from hunting in the forest-hunting regions of Ukraine in 2017-2021 increased by 48%, but it did not exceed the amount of expenditures. Sources of income are mainly generated through the sale of licenses, shooting cards, meat, trophies, as well as the provision of services by the wildlife service and sponsorship. In 2017-2021, revenues from the state budget for the economic development of the hunting industry in the forest-hunting regions of Ukraine (payback of hunting ground) amounted to only from 30.3% to 35.4% total costs. This indicates a low payback of the hunting industry, which is financed mostly by own funds, which are too limited.

In order to improve the stabilizers of the economic development of the hunting industry, it is first necessary to adhere to the principles of conservation of biodiversity and productivity of hunting ground. Hunting entities, in addition to self-financing, need financial and legal support from the state on the basis of a market economy. Applying economic sanctions and fines as a tool to combat poaching and irrational use of hunting resources, as well as the introduction of a single system for inventory of hunting ground and records of captured animals should be adequate to animal production standards set as a percentage of autumn population (Table **5**). Issuance of limits and norms for hunting animals should be introduced for species of hunting animals, the actual number of which has reached and exceeds the level60% of the ratio to the scientifically sound optimal number of hunting animals in the hunting area (calculated on the basis of annual hunting fauna) and not exceeding the indicators of permissible norms of use (shooting, catching) of certain species of hunting animals, depending on their species and natural areas. This will ensure the formation and implementation of state policy in the field of environmental protection and environmental safety of forest-hunting regions of Ukraine.

One of the main features of the richness of the fauna of the forest-hunting regions of Polissya, Forest-Steppe and Steppe of Ukraine is their geographical location in the south and northeast of the country. However, despite the annual growth of the estimated actual number of hunting fauna in some hunting regions, such a system, obviously, does not provide a sufficient level of economic development of hunting enterprises.

As the number of hunting fauna and officially hunting game remains catastrophically low compared to neighboring EU countries, it does not allow obtaining significant financial resources for the development of the economy of local communities and the state as a whole. It should be noted that with the exception of Ukraine, the European hunting is highly profitable in combination with education, training of future ethically formed security guards and users of hunting ground and animal resources. In 2021, the number of major species of hunting animals in the forest-hunting regions of Polissya, Forest-Steppe and Steppe of Ukraine has not changed significantly compared to 2019 (Fig. **5**).

Table 5. Permissible Norms of Use (Shooting, Catching) of Certain Species of Hunting Animals in the Forest-Hunting Regions of Ukraine.

Species of Hunting Fauna	Natural Zone	Ratio of Actual Number to Optimal, %	Permissible Percentage of Catch, %
Elk, Deer noble, Roe deer, Deer spotted, Doe, Wisent	For all regions	from 60 to 80	5
		from 80 to 100	10
		> 100	the total number exceeding the optimal
Wild boar	Polissya, Forest-Steppe, Karpaty Steppe	from 60 to 80	10
		from 80 to 100	20
		> 100	the total number exceeding the optimal
Gray hare	For all regions	from 60 to 80	5
		from 80 to 100	10
		> 100	the total number exceeding the optimal
Gray partridge	For all regions	from 60 to 80	5
		from 80 to 100	10
		> 100	the total number exceeding the optimal
Pheasant	Steppe	from 60 to 80	10
		from 80 to 100	15
		> 100	the total number exceeding the optimal

Note: Source: built by the authors according to data Agriculture, forestry and fisheries; Myronenko *et al*., 2015.

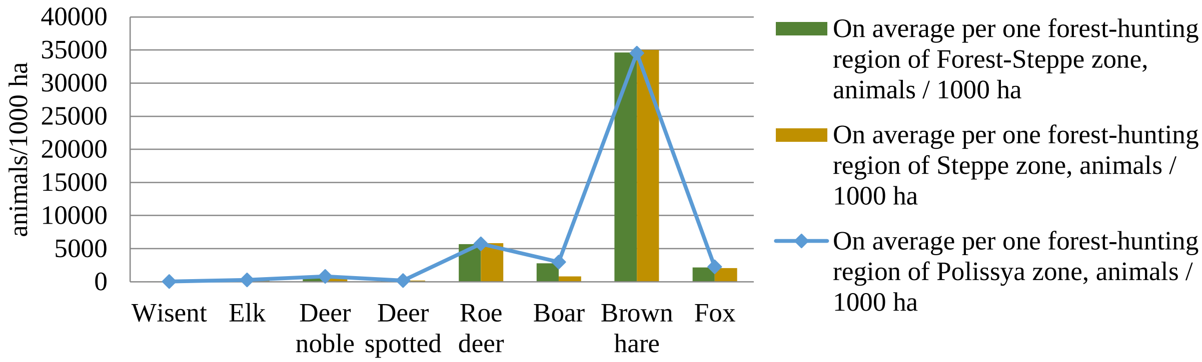

Fig. (5). The number of major species of hunting animals per one forest-hunting region in Polissya, Forest-Steppe and Steppe zones of Ukraine, %. (Source: calculated by the authors according to data Agriculture, forestry and fisheries).

In Ukraine, the average area of hunting ground per hunting user in Ukraine is: Ukrainian Society of Hunters and Fishermen – 84 thousand hectares, State Forest Agency – 24 thousand hectares, other users (mostly public hunting organizations and private enterprises) – 20 thousand hectares. As practice has shown, recently the most efficient are hunting farms with an area of 20-30 thousand hectares, where the investment per 1 thousand hectares of hunting ground is not less than 214.8 EUR.

In conditions of lack of funds, hunting farms with an area of more than 30 thousand hectares are forced to concentrate their activities on that part of the hunting ground (up to 20%), where the highest density of hunting animals is observed. In such areas, mainly bioteches facilities are concentrated, wild animals are fed. At the same time, the rest of the hunting ground is not protected and used inefficiently. This leads to the loss of the entire hunting farm and, in this case, these lands must be transferred to other users, having previously transferred them to the status of a hunting reserve.

It should be noted that the long stay of hunting ground in the status of the state hunting reserve is the reason for the irrational use of hunting ground. After all, the area of use of hunting ground in Ukraine is only 62%, while in European countries this figure reaches 90%.

Thus, it is necessary to optimize the area of hunting ground, the boundaries of which should be determined based on natural criteria (rivers, ridges, roads, power lines, *etc*.). Their area cannot be less than 3 thousand hectares and more, than 30 thousand hectares It should be a continuous area to address the problems of low availability of hunting for the local population. In order to create a mechanism that will ensure the effective use of hunting ground, it is necessary, first of all, to introduce measures to provide hunting ground for the use of local hunters for a period not exceeding 10-15 years as a legal entity (the effectiveness of such a model of hunting management is confirmed by practice, in particular in Poland, Slovakia, Hungary, the Czech Republic, the Baltic States and other countries).

4. DISCUSSION

The cost-resource system of hunting management for the conservation and protection of wild animals needs to be improved, through the use of a wide range of economic phenomena, which are usually determined by a combination of factors. In this regard, the dependence of one variable *y* on several variables $x_1, x_2, \dots, x_m$, was investigated using multiple regression analysis. Factor dependence of receipts of funds y) and expenditures on wages x_1, animal protection $x_2$and biotechnical measures for conservation and reproduction of wild animals were carried out on the basis of hunting enterprises in the forest-hunting regions of the Steppe of Ukraine (Figure 6).

The multiple three-factor model has the form (Eq. (**3**)):

$$\tilde{y} = 217.99 + 0{,}87x_1 + 0{,}2x_2 + 1{,}37x_3, \qquad (3)$$

That is, when wage costs increase by one EUR, the inflow of funds increases by 0.87 EUR; when the cost of animal protection increases by one euro, the acceleration of funds is almost 0.20 EUR; increasing the cost of biotechnical measures for the conservation and reproduction of wild animals by one euro increases the amount of income by 1.37 EUR.

Fisher's calculated F-test is equal to $F_{calculation} = 27.71$, the critical value is equal to value 0.05 $F_{critical}$ = 2,.3. This is significantly less than the estimated value. Therefore, we have identified multicollinearity that allows the determination of the effective sign in a multiple regression model for two or more independent factors that are related to each other or have a high degree of correlation. To assess the multicollinearity of the factors, a matrix of pair correlation coefficients was calculated (Eq. (**4**)):

$$Det|R| = \begin{vmatrix} r_{x_1x_1} & r_{x_2x_1} & r_{x_3x_1} \\ r_{x_1x_2} & r_{x_2x_2} & r_{x_3x_2} \\ r_{x_1x_3} & r_{x_2x_3} & r_{x_3x_3} \end{vmatrix} = \begin{vmatrix} 1 & 0.613 & 0.497 \\ 0.613 & 1 & 0.943 \\ 0.497 & 0.943 & 1 \end{vmatrix} \approx 0.063 \qquad (4)$$

The matrix sign of interfactor correlation is close to zero, so there is a multicollinearity of factors and unreliability of the results of multiple regression. Additional assessment of the value of multicollinearity of factors can be carried out by testing the hypothesis of independence of variables, *i.e.* $H_0: Det|R| = 1$. It is proved that the quantity $\theta = \left[n - 1 - \frac{1}{6}(2m + 5) \cdot lg\, D\,et|R|\right]$ has an approximate distribution $\chi^2$with the number of degrees of freedom $\frac{1}{2}m(m-1)$. If the actual value of the variable is exceeded in relation to the tabular (critical) value, the hypothesis $H_0: Det|R| = 1$ is rejected, and multicollinearity is considered proven. Accordingly, we have the following estimated value (Eq. (**5**)):

$$\theta = 33 - 1 - \frac{1}{6}(2 \cdot 3 + 5) \cdot lg\, 0{,}063 \approx 34.2 \quad (5)$$

Especially high is the collinearity of factors $x_2$and x_3, $r_{x_1 x_3} = 0.94$. It is logical to exclude those factors from the regression equation that have a lower pair correlation coefficient. Since $r_{yx_2} = 0.752$ and $r_{yx_3} = 0.705$, we exclude the factor x_3.

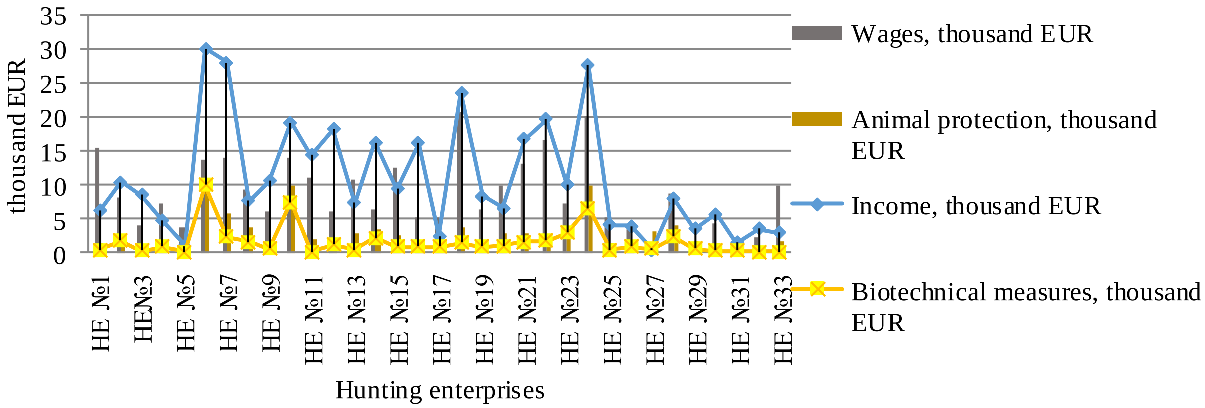

Fig. (6). Initial data for calculating the factor dependence of cost-resource determinants of economic development of hunting enterprises in the forest-hunting regions of the Steppe of Ukraine, %. (Source: calculated by the authors according to data Agriculture, forestry and fisheries).

Let's build regression on factors $x_1$andx_2. The multiple two-factor modelshave the form (Eq. (**6**)):

$$\tilde{y} = -215.09 + 0{,}79x_1 + 1{,}37x_2, \quad (6)$$

Thus, with an increase in wage costs by 1 euro, the amount of income increases by 0.79 EUR; when the cost of animal protection increases by one euro, the amount of cash inflows increases by almost 0.38 EUR. That is, the constructed equation explains almost 71% of the whole variation of sign *y*. In this case, Fisher's calculated F-test is equal to $F_{critical}\ (0.05,\ 2.30) = 3.32$. That is, the value of the regression coefficient for the variable$\boldsymbol{x_2}$is achieved.

Comparison of elasticity indicators with each other also allows ranking the model factors by the strength of their influence on the resulting factor ***y***. We find the coefficients of elasticity between the dependence of factors (Equation (7)) (Artiushok, 2012; Lakyda *et al*., 2010):

$$E_i = b_i \cdot \frac{\bar{x}_i}{\bar{y}}, \quad (7)$$

where, b_i – the coefficient of “pure” regression at factor x_i;$\bar{y}$– the average value of the effective sign; $\bar{x}_i$ – the average value of sign x_i.

Thus, with an increase in wage costs by 1%, the inflow of funds into the hunting industry increases by 0.642%; with increasing costs for the protection of animals on 1% – revenues increase by 0.377%.

To determine the adequacy of the regression model on the basis of residual values, the following requirements were checked: levels$\varepsilon_i$of a number of residues are random; mathematical expectation of the levels of a number of residues is zero; values$\varepsilon_i$are independent of each other, *i.e*. there is no autocorrelation.

The criterion of turning points (peaks) was used to check the randomness of a number of residues. A point ε_i is considered a turning point if the following conditions are met (Equation (8)) (Artiushok, 2012; Lakyda *et al*., 2010):

$$\varepsilon_{i-1} < \varepsilon_i > \varepsilon_{i+1} \text{or} \varepsilon_{i-1} > \varepsilon_i < \varepsilon_{i+1}, \quad (8)$$

The number of turning points *p* is calculated. The criterion of randomness with a 5% level of value, *i.e*. with a confidence level of 95%, is the fulfillment of the inequality (Equation (9)) (Artiushok, 2012; Lakyda *et al*., 2010):

$$p > \left[\frac{2}{3}(n - m - 1) - 1{,}96 \cdot \sqrt{\frac{16n - 29}{90}}\right], \quad (9)$$

where $[\ldots]$–is an integer part of the number. If the inequality is held, the model is considered adequate.

There are 20 significant points in factorx_1, which are ranked in ascending order (Fig. **7**).

$$20 > \left[\frac{2}{3}(33 - 2 - 1) - 1.96 \cdot \sqrt{\frac{16 \cdot 33 - 29}{90}}\right] = [15.38];\ \ 20 > 15 \quad (10)$$

The inequality is true, the residues are considered random (Eq. (**10**)).

Verification of the independent sequence of residues (no autocorrelation) was performed using the Darbin-Watson d-test, according to Eq. (**11**) (Artiushok, 2012; Lakyda *et al*., 2010):

$$d = \frac{\sum(\varepsilon_i - \varepsilon_{i-1})^2}{\sum \varepsilon_i^2}, \quad (11)$$

and is compared with the lower$(d_1 or d_L)$and upper critical values of Darbin-Watson statistics.

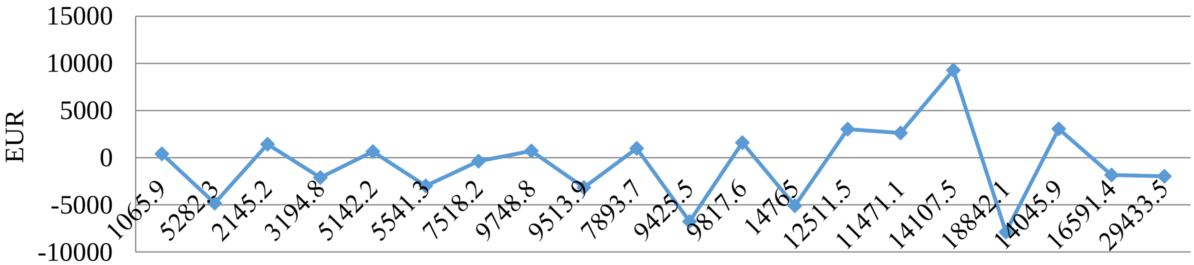

Fig. (7). Dependence of random balances of labor costs of hunting management in the forest-hunting regions of the Steppe zone of Ukraine on the theoretical values of regression. (Source: calculated by the authors).

The following cases are possible:

if $d < d_1$, the hypothesis of residual independence is rejected, and the model is considered inadequate by the criterion of residual independence;

if $d_1 < d < d_2$, including these values themselves, it is considered that there are no sufficient grounds to draw a conclusion;

if $d_2 < d < 2$, the hypothesis of independence of residues is accepted and the model is considered adequate according to this criterion;

if $d > 2$, it indicates a negative autocorrelation of residues. In this case, the calculated value of the criterion must be converted by Equation $d' = 4 - d$ and compared with the critical value not d but d'.

Thus, the value of the Darbin-Watson test is equal to 2.25, namely (Equation (12)):

$$d = \frac{\sum(\varepsilon_i - \varepsilon_{i-1})^2}{\sum \varepsilon_i^2} = \frac{1.24803 \times 10^{12}}{5.543 \times 10^{11}} \approx 2.25. \qquad (12)$$

We have a negative autocorrelation of residues ($d > 2$). We consider $d' = 4 - d$, $d' = 4 - 2.25 = 1.75$.

The critical values of the Darbin-Watson test are found for given volumes of observations n and the number of independent model variables. In our case $d_1 = 1.321$; $d_2 = 1.577$. Since $d_2(1.321) < d(1.75) < 2$, the hypothesis of residual independence is accepted and the model $\tilde{y} = -215.09 + 0.79x_1 + 1.37x_2$ is considered adequate according to this criterion and can be used for forecasting.

The point forecast $\tilde{y}_{mo4}$ of the regression equation is carried out by substituting the values of the regressors directly into the regression equation itself. Thus, based on the value of the most important variable – the cost of wages (equal to the maximum result of observations, which is increased by 10%) and the value of the second most important variable – the cost of animal protection (equal to the minimum of observations, reduced by 10%), interval forecast of the value of funds (y) is reliable 0.95.

The maximum observed value of the factor –20908.20, the minimum – 262.30. Forecast values of factors (Eq. (**13**)):

$$x_1 = 20908.2 \times 1.1 = 22999;$$
$$x_2 = 262.3 \times 0.9 = 236.07 \qquad (13)$$

Then (Eq. (**14**)):

$$\tilde{y}_{exactly} = -215.09 + 0.79 \times 23607 + 1.37 \times 236.07 \qquad (14)$$

The confidence interval for this forecast cash flow (y) is as follows (Eq. (**15**)) (Artiushok, 2012; Lakyda *et al.*, 2010):

$$\tilde{y}_{exactly} - t_{tabular} \cdot \mu_{\tilde{y}} \le \tilde{y}_{forecast} \le \tilde{y}_{exactly} + t_{tabular} \cdot \mu_{\tilde{y}}, \qquad (15)$$

Accordingly, the value of the marginal error of the forecast is determined by Eq. (**16**) (Artiushok, 2012; Lakyda *et al.*, 2010):

$$\Delta_{y_p} = t_{tabular} \times m_{\tilde{y}}, \qquad (16)$$

where, $t_{tabular}$–the corresponding critical value of the Student's criterion; $m_{\tilde{y}}$–forecast value error (in our case $t_{tabular} = 2.042$)

The error of the forecast value of the regression function is obtained by Eq. (**17**) (Artiushok, 2012; Lakyda *et al.*, 2010):

$$m_{\tilde{y}} = S\sqrt{X_0{}^T \times (X^T \times X)^{-1} \times X_0}, \qquad (17)$$

where, S – standard regression error; X – matrix of observed values of factors $x_1, x_2, ..., x_m$; X_0 – vector-column of values of factors $x_1, x_2, ..., x_m$, for which it is necessary to find the interval forecast$y$.

Parameter S – standard regression error – is given in the latest regression statistics$S = 4456.76$.

Matrix X_0 consists of numbers: $X_0 = \begin{pmatrix} 1 \\ x_{2forecast} \\ x_{3forecast} \end{pmatrix}$. That is $X_0 = \begin{pmatrix} 1 \\ 22999 \\ 236.07 \end{pmatrix}$, then the transposed matrix has the form $X_0^T = (1 \quad 22999 \quad 236.07)$Matrix X consists of numbers$X = \begin{pmatrix} n & \sum x_2 & \sum x_3 \\ \sum x_2 & \sum x_2^2 & \sum x_2 x_3 \\ \sum x_3 & \sum x_2 x_3 & \sum x_3^2 \end{pmatrix}$.

In this case,

$$X = \begin{pmatrix} 33 & 289970.03 & 98418.03 \\ 289970.03 & 3.21012E+12 & 1.06113E+12 \\ 98418.03 & 1.06113E+12 & 4.81911E+11 \end{pmatrix}.$$

Matrix X is symmetric, *i.e.* $X^T = X$. We find the product of matrices.

$X^T \times X$	8.72284E+13	3.15758E+19	1.08313E+19
	3.15758E+19	1.14309E+25	3.91772E+24
	1.08313E+19	3.91772E+24	1.35823E+24

The inverse matrix has the form:

$(X^T \times X)^{-1}$	0.013566346	-3.46997E-08	-8.09664E-09
	-3.46997E-08	8.87543E-14	2.07094E-14
	-8.09664E-09	2.07094E-14	4.83223E-15

We find the product of matrices ${X_0}^T \times (X^T \times X)^{-1}$ (dimension of the matrix of product 1×3).

${X_0}^T \times (X^T \times X)^{-1}$	-0.010832775	2.77079E-08	6.4652E-09

We find the product of matrices ${X_0}^T \times (X^T \times X)^{-1} \times X_0$ (dimension of the matrix of product 1×1, *i.e.* only one number).

$${X_0}^T \times (X^T \times X)^{-1} \times X_0 = 0.00865.$$

The error of the forecast value of the regression function is as follows (Equation (18)):

$$m_{\hat{y}} = 4456.76 \times \sqrt{0.00865} \approx 414.5 \quad (18)$$

Marginal forecast error: $\Delta_{y_p} = t_\alpha \cdot m_{\hat{y}} = 2.042 \times 414.5 = 846.41$

Confidence interval of the forecast:

$$18355.45 - 846.41 < \tilde{y}_{forecast} < 18355.45 + 846.41$$
$$17509.04 < \tilde{y}_{forecast} < 19201.41$$

Thus, the forecast amount of cash inflows of hunting in the forest-hunting regions of the Steppe zone of Ukraine with an increase in wage costs by 10% and a decrease in animal welfare costs by 10%, with probability 95%, will be in the range from 17.51 thousand EUR to 19.20 thousand EUR.

5. CONCLUSIONS

Thus, the hunting industry should make a significant contribution to the economy of the state and the formation of cost and resource policy of the forest-hunting regions of the country to sustainable nature management and environmental protection. Relevant priorities of the state policy in the field of hunting and economic development of the hunting economy should be the improvement of the legal framework for hunting, development of hunting science, creation of a state specialized service for protection of the state hunting fund and control over its use, and creation of a specialized Ukrainian state fund of support of hunting at the expense of deductions of manufacturers of hunting armaments and trade organizations which realize such armament, in direct dependence on volumes of its realization. All this will help increase employment in the hunting industry. Implementation of the mechanism of rational allocation of costs for protection, biotechnological and reproductive measures for game populations will improve the state of the industry; significantly increase the number and volume of annual production of major species of hunting fauna, increase revenues to the state budget and income of hunting ground users and thus promote the development of foreign hunting tourism.

This should be facilitated by the planning of such measures as: reducing the burden on the state budget by increasing revenues from hunting and economic activities; growth of investments in the field of hunting, development of tourism and creation of a positive image of Ukraine, as well as harmonization of norms of hunting management of Ukraine to the relevant criteria of European and world standards; improving the system of state support for the hunting industry, transferring the industry to the principles of sustainable development and effective management of the hunting economy; a significant increase in the number of state hunting fund and the volume of hunting animals; conservation of biodiversity under conditions of inexhaustible hunting use, formation of high-quality composition of hunting resource populations; reduction with further elimination of the impact on wild animals of such a harmful phenomenon as violation of hunting rules (poaching); creation of more favorable conditions for the development of the hunting industry, increasing the share of hunting products in the gross domestic product; meeting the needs of society in hunting resources.

REFERENCES

Achard, F., Eva, H. D., Stibig, H-J., Mayaux, P., Gallego, J., Richards, T., and Malingreau, J-P. (2002). Determination of deforestation rates of the world's humid tropical forests. Science, 299, 999-1002. https://doi.org/10.1126/science.1070656

Agriculture, forestry and fisheries. http://www.ukrstat.gov.ua/druk/publicat/kat_u/publ7_u.htm

Artiushok, V. S. (2012). Criteria for compliance of forestry enterprises with the strategic goal in terms of sustainable development. Scientific notes of the National University “Ostroh Academy”. Series. Economy, 19, 95−98.

Barreto, P., Souza, C., Nogueron, R., Anderson, A., and Salomao, R. (2006). Human pressure and protected areas: results and discussion. Washington: DC World Resources Institute.

Berezina, N. Yu. (2017). Legal regulation of relations in the field of hunting land use: some aspects and features of the subject composition. Entrepreneurship, Economy and Law, 8, 89-93.

Bleher, B., Uster, D., and Bergsdorf, T. (2006). Assessment of threat status and management effectiveness in Kakamega Forest, Kenya. Biodiversity and Conservation, 15(4), 1159-1177. https://doi.org/10.1007/s10531-004-3509-3

Bondarenko, V. D., Deineka, A. M., Burmas, V. R., Khoietskyi, P. B., and Khodzinskyi, V. P. (2005). Hunting economy of Ukraine. Lviv: Spolom.

Bray, D. B., Ellis, E. A., Armijo-Canto, N., and Beck, C. T. (2004). The institutional drivers of sustainable landscapes: A case study of the “Mayan Zone” in Quintana Roo, Mexico. Land Use Policy, 21, 333-346. https://doi.org/10.1016/j.landusepol.2003.11.001

Bray, D. B., Merino-Perez, L., Negreros-Castillo, P., Segura-Warnholtz, G., Torres-Rojo, J. M., and Vester, H. F. M. (2003). Mexico's community-managed forests as a global model for sustainable landscapes. Conservation Biology, 17(3), 672-677. https://doi.org/10.1046/j.1523-1739.2003.01639.x

Browder, J. O. (2002). Conservation and development projects in the Brazilian Amazon: Lessons from the Community Initiative Program in Rondonia. Environmental Management, 29(6), 750-762. https://doi.org/10.1007/s00267-001-2613-3

Chowdhury, R. R. (2006). Landscape change in the Calakmul Biosphere Reserve, Mexico: Modeling the driving forces of smallholder deforestation in land parcels. Applied Geography, 26, 129-152. https://doi.org/10.1016/j.apgeog.2005.11.004

Clark, S., Bolt, K., and Campbell, A. (2008). Protected areas: an effective tool to reduce emissions from deforestation and forest degradation in developing countries? Cambridge: UNEP World Conservation Monitoring Centre.

Cropper, M., Puri, J., and Griffiths, C. (2001). Predicting the location of deforestation: the role of roads and protected areas in North Thailand. Land Economics, 77(2), 172-186. https://doi.org/10.2307/3147088

Curran, L. M., Trigg, S. N., McDonald, A. K., Astiani, D., Hardiono, Y. M., Siregar, P., Caniago, I., and Kasischke, E. (2004). Lowland Forest loss in protected areas of Indonesian Borneo. Science, 303(5660), 1000-1003. https://doi.org/10.1126/science.1091714

DeFries, R., Hansen, A., Newton, A. C., and Hansen, M. C. (2005). Increasing isolation of protected areas in tropical forests over the past twenty years. Ecological Applications, 15(1), 19-26. https://doi.org/10.1890/03-5258

Deininger, K. and Minten, B. (2002). Determinants of deforestation and the economics of protection: an application to Mexico. American Journal of Agricultural Economics, 84(4), 943-960. https://doi.org/10.1111/1467-8276.00359

Ewers, R. M., and Rodrigues, A. S. L. (2008). Estimates of reserve effectiveness are confounded by leakage. Trends in Ecology and Evolution, 23(3),13-16. https://doi.org/10.1016/j.tree.2007.11.008

Furdychko, O. I. (2009). Forest industry of Ukraine in the context of balanced development: theoretical and methodological, regulatory and legal and organizational aspects. Kyiv: Osnova.

Guesmi, B., and Gil, J. M. (2021). The impact of public R&D investments on agricultural productivity. Review of Economics and Finance, 19, 284-291.

Hadhek, Z., Nafti, S., Mrad, F., and Lafi, M. (2021). Dynamic panel data analysis of the impact of climatic shocks on food-security. Review of Economics and Finance, 19, 255-263.

Hayes, T. M. (2006). Parks, people, and forest protection: an institutional assessment of the effectiveness of protected areas. World Development, 34(12), 2064-2065. https://doi.org/10.1016/j.worlddev.2006.03.002

Helmer, E. H. (2004). Forest conservation and land development in Puerto Rico. Landscape Ecology, 19(1), 29-40. http://dx.doi.org/10.1023/B:LAND.0000018364.68514.fb

Jepson, P., Mornberg, F., and Noord, H. (2002). A review of the efficacy of the protected area system of East Kalimantan Province. Indonesia. Natural Areas Journal, 22(1), 28-42.

Jones, J. R. (1992). Environmental issues and policies in Costa Rica: control of deforestation. Policy Studies Journal, 20(4), 679-694. http://dx.doi.org/10.1111/j.1541-0072.1992.tb00190.x

Khvesyk, M. A., Shubalyi, O. M., and Vasylyk, N. M. (2011). Complex use of forest resource potential: incentive mechanisms, institutional, and innovation-investment provision. Kyiv: DKS LLC.

Kinnaird, M. F., Sanderson, E. W., O'Brien, T. G., Wibisono, H. T., and Woolmer, G. (2003). Deforestation trends in a tropical landscape and implications for endangered Large Mammals. Conversation Biology, 17(1), 245-257. http://dx.doi.org/10.1046/j.1523-1739.2003.02040.x

Kish, R. J. (2020). Energy and water policy. Review of Economics and Finance, 18, 1-12.

Lakyda, P. I., Vasylyshyn, R. D., and Zibtsev, S. V. (2010). Assessment of potentials of forest biomass in Ukraine. Education, research and innovations in forestry and park management in Ukraine in the context of regional and global challenges. Kyiv: DKS LLC.

Lysychko, A. M. (2016). Methods of economic analysis of objects that make up forestry activities. http://www.economy.nayka.com.ua/?op=1&z=6270

Mas, J. F. (2005). Assessing protected area effectiveness using surrounding (buffer) areas environmentally similar to the target area. Environmental Monitoring and Assessment, 105, 69-80. http://dx.doi.org/10.1007/s10661-005-3156-5

Mugisha, A. R., and Jacobson, S. K. (2004). Threat reduction assessment of conventional and community-based conservation approaches to managing protected areas in Uganda. Environmental Conversation, 31(3), 233-241. https://doi.org/10.1017/S0376892904001432

Myronenko, M. O., Sheremet, I. M., Protsiv, O. R., Bashta, A.-T., Delehan, I. V., Vovchenko, V. Iu., Stankevych-Volosianchuk, O. I., Burmas, V. R., Novikov, R. I., and Karabchuk, D. Iu. (2015). Draft model of reforming and developing the hunting economy of Ukraine. http://www.fleg.org.ua/wp-content/uploads/2016/01/Proekt-modeli-reformuvannya-i-rozvytku-myslyvskogo-gospodarstva-Ukrayiny.pdf

Oliinychuk, O. I. (2009). Features of forestry production and increase its efficiency. Actual Problems of Economic Development of the Region, 5(2), 148-154.

Oliinychuk, O. I. (2010). Methods of accounting for costs of manufacturing products of the forest industry and its improvement. Scientific Bulletin of NLTU of Ukraine, 20(1), 231–238.

Protsiv, O. R. (2015). Fees for the use of hunting grounds or corruption tax? Hunting and Fishing, 10(168), 1.

Shershun, M. Kh. (2012). The effectiveness of forestry enterprises in a market economy. Economics of Nature Management and Environmental Protection, 2, 209-214.

Shkuratov, O. I. (2013). Estimation of competitive potential of forestry enterprises. Scientific Bulletin of NLTU of Ukraine, 23(3), 309-314.

Zadorozhna, O. (2008). Accounting and economic evaluation of by-products of forestry. Innovative Economy, 4(10), 81-85.

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