Ministry of Education and Science of Ukraine
Mykolaiv National Agrarian University

ISSN 2313-092X
E-ISSN 2411-9199

Вісник аграрної науки Причорномор'я

Науковий журнал

Ukrainian Black Sea Region Agrarian Science

Scientific Journal

Том 26, № 3

Volume 26, No. 3

Year of establishment: 1997
Publication frequency: Four times a year

Mykolaiv
2022

DOI: 10.56407/2313-092X/2022-26(3)

Рекомендовано до друку та поширення
через мережу Інтернет Вченою радою
Миколаївського національного аграрного університету
(протокол № 1 від 30 серпня 2022 р.)

Свідоцтво про державну реєстрацію
друкованого засобу масової інформації
Серія: КВ № 25119-15059 ПР від 21 лютого 2022 р.

Журнал входить до переліку наукових фахових видань України категорії «Б»:
з економічних, технічних, сільськогосподарських, ветеринарних наук за спеціальностями 051 – Економіка, 071 – Облік і оподаткування, 072 – Фінанси, банківська справа та страхування, 073 – Менеджмент, 075 – Маркетинг, 076 – Підприємництво, торгівля та біржова діяльність, 181 – Харчові технології, 183 – Технології захисту навколишнього середовища, 201 – Агрономія, 202 – Захист і карантин рослин, 204 – Технологія виробництва і переробки продукції тваринництва, 205 – Лісове господарство, 207 – Водні біоресурси та аквакультура, 208 – Агроінженерія, 281 – Публічне управління та адміністрування
(Наказ Міністерства освіти і науки України від 07 травня 2019 р. № 612; від 11 липня 2019 р. № 975)

Журнал представлено у наукометричних базах даних, репозитаріях:
Google Scholar, Academic Resource Index ResearchBib, Open Academic Journals Index, Національна бібліотека України імені В. І. Вернадського, IJIFACTOR, Directory of Research Journals Indexing | DRJI, Crossref, Фахові видання України

Вісник аграрної науки Причорномор'я : наук. журн. / [редкол.: В. С. Шебанін (голов. ред.) та ін.]. – Миколаїв : Миколаївський національний аграрний університет, 2022. – Т. 26, № 3. – 98 с.

Адреса редакції:
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DOI: 10.56407/2313-092X/2022-26(3)

Recommended for printing and distribution
via the Internet by the Mykolaiv National Agrarian University
(Minutes No. 1 of August 30, 2022)

Certificate of state registration of the print media
Series: KB No. 25119-15059 PR of February 21, 2022

The journal is included in the list of professional publications of Ukraine of category "B":
Economic, technical, agricultural, veterinary sciences by specialty 051 – Economics,
071 – Accounting and taxation, 072 – Finance, banking and insurance, 073 – Management, 075 – Marketing,
076 – Entrepreneurship, trade and exchange activity, 181 – Food technologies,
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281 – Public management and administration
(Order of the Ministry of Education and Science of Ukraine of May 7, 2019 No. 612; of July 11, 2019 No. 975)

The journal is presented at scientometric databases, repositories:
Google Scholar, Academic Resource Index ResearchBib, Open Academic Journals Index,
National Library of Ukraine named after V. I. Vernadskyi, IJIFACTOR,
Directory of Research Journals Indexing | DRJI, Crossref, Professional Editions of Ukraine

Ukrainian Black Sea Region Agrarian Science / Ed. by V. S. Shebanin (Editor-in-Chief) et al. Mykolaiv: Mykolaiv National Agrarian University, 2022. Vol. 26, No. 3. 98 p.

Publishing Address:
Mykolaiv National Agrarian University
54008, 9 Georgiy Gongadze Str., Mykolaiv, Ukraine
tel.: +38(0512) 70-93-54
E-mail: info@bsagriculture.com.ua
www: https://bsagriculture.com.ua/en

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UDC 33.061
DOI: 10.56407/2313-092X/2022-26(3)-1

Ukrainian Black Sea Region Agrarian Science
Vol. 26, No. 3

Development of insurance, opportunities and practical experience in the formation of social and economic security (regional aspect)

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Abstract. The development of modern business, the implementation of approaches to local, regional (territorial) development encourage the activation of the spread of the insurance sector. Mechanisms for the introduction of appropriate financial levers make it possible to neutralize threats and increase the financial stability of market entities, which is proven by the experience of European states. The purpose of the study is to substantiate the essence, features and main tasks in the field of insurance, to determine the priority directions of the development of the insurance market, to coordinate the interests of the participants and effective partnership in view of the need to form prerequisites for the socio-economic stability and security of the state and its individual regions. The main task of the research is to assess the situation, existing forecasts and determine the priority directions of the development of the insurance sector, taking into account the needs of society, interests, partnership mechanisms, including at the international level. Methods of scientific knowledge were used during the research. The author has researched the essence and development possibilities of the insurance sector, taking into account the practical experience of the countries of the world and modern trends in the insurance market. The importance of the insurance sector for society, regional development and increasing opportunities in the field of investment activity has been proven. Regional features were analyzed and priority directions of development were determined, taking into account the needs of spheres and branches of the economy, territorial communities. The effect of effective interaction of insurance market participants on the possibilities of expanding insurance services is determined.The relevance of partnership in the implementation of insurance approaches and mechanisms of interaction between participants was determined. The author stipulates the need to regulate the interests of all participants, as well as mutual coordination of actions and levels of responsibility, opportunities for public-private partnership in regional development, investment activities. The need to guarantee the practical results of interaction in the field of insurance and the formation of prerequisites for social and economic security, including taking into account regional characteristics, is stipulated. The results of the author's research can be used for further research in the field of insurance, interaction of participants on the basis of partnership

Keywords: globalization, investment activity, public-private partnership, strategic priorities, insurance premiums, insurance risks

INTRODUCTION

The development of modern business, the implementation of approaches to local, regional (territorial) development encourage the activation of the spread of the insurance sector. Mechanisms for the introduction of appropriate financial levers make it possible to neutralize threats and increase the financial stability of market entities, which is proven by the experience of European states. The urgency of the issue has significantly increased due to the spread of the COVID-19 pandemic, as most business structures were not prepared for such challenges and significant financial losses.

It is the development of insurance that provides an opportunity to ensure the neutralization of threats and determines potential opportunities for leveling

Article's History:
Received: 03.05.2022
Revised: 23.07.2022
Accepted: 26.08.2022

Suggested Citation:
Vyshnevska, O.M. (2022). Development of insurance, opportunities and practical experience in the formation of social and economic security (regional aspect). *Ukrainian Black Sea Region Agrarian Science*, 26(3), 9-19.

financial risks in the activities of individual market entities, encourages the implementation of approaches in the development of spheres, industries and territories. Insurance is a tool for protection against possible risks in various spheres and branches of the economy. Insurance ensures the process of reproduction and socio-economic stability in society (social security), and also acts as a source of investment capital. The advantages of the insurance sector are indisputable, as they provide prerequisites for development and reduce activity risks through insurance protection of participants' interests. Insurance acts as a flexible system that is able to adapt market entities to internal and external challenges through appropriate financial support, insurance mechanisms perform social functions at the state level (medical insurance, pension insurance). Modern international relations and partnerships with international organizations at the state level take place with the participation of insurance companies (international investment projects, grant projects, joint projects, international logistics, etc.).

In view of the existing need to expand the scope of insurance services, it is appropriate to note that insurance in the global environment is a requirement of the time and ensures: stability of the development of spheres and industries, territories; compensates for the loss and ensures the continuity of the activities of individual market entities; creates insurance funds that are converted into investment capital; ensures the solvency of the policyholder at different levels of management; development of international partnership; protection of rights in research and IT spheres; situation monitoring and social orientation of insurance services (insurance due to the spread of COVID-19); protection of the individual at the state level and social stability in society through social support programs; formation of prerequisites for guaranteeing the socio-economic security of the state and its individual regions.

The experience of the countries of the world proves that the effectiveness of the insurance market and the effectiveness of the interaction of its participants make it possible to ensure the social protection of the population, the development of spheres and branches of the economy, territories (the experience of the USA, Canada) [1].

Currently, the fastest rates of spread of insurance services are taking place in Asian countries. It is predicted that the main contribution to the development of international insurance will be left to China, which has significantly increased the capacity of the insurance market in the last 5 years. It should be noted that in recent years, developed insurance markets have slowed down, priority is given to the markets of developing countries, including at the expense of medical insurance [1].

The Swiss Re Institute, in its review "Global Insurance: The Great Eastward Turn Continues", notes that global insurance premiums have surpassed the $5 trillion mark, equivalent to 6.0 percent of global gross domestic product. Analysts note that the increase in the level of insurance premiums is based on the stability of the growth of circulation in the field of general insurance, especially in Asian countries [1].

The relevance of the issue regarding the development of insurance and its influence on the socio-economic development of territories, spheres and branches of the economy is indisputable. Global processes and phenomena, especially due to the spread of the pandemic, have significantly expanded the possibilities of health insurance, which has a direct connection with social mechanisms at the state level. Taking into account the peculiarities of the state and a separate territory, opportunities are formed in the development of the insurance sector. The experience of the countries of the world can serve as a best practice for the introduction and expansion of the sphere of providing insurance services, protecting the population and guaranteeing social and economic security.

The successful operation of insurance companies is the protection of the interests of the participants in the process, the interests of the state and a priority in the socio-economic development of the regions. Providing opportunities for the development of insurance is connected with the need to settle interests and relationships, there is a partial redistribution of national income and the total social product through the process of creating an insurance fund. The role of insurance in the conduct of investment activities, implementation of international agreements and projects is significant. The development of the insurance sector is closely related to the interests of all groups of participants in the process and mechanisms for the protection of the insurance market at the state level due to the possible effect of rare events and the effect of accumulation. During the research, it is advisable to take into account the fact that the insurance carries out the distribution of the damage among the participants of the insurance, which is of a closed nature. International principles of cooperation in the field of insurance include: insurable interest, free choice of insurer, co-insurance, reinsurance, diversification, good faith, as well as insurance risk, compensation within the limits of actual losses, subrogation, contribution, franchise. It is diversification that prompts the expansion of the spheres of activity of insurance companies, including beyond the boundaries of the main business, the territorial and sectoral dispersion of risk insurance is taking place. The development of insurance should

take into account the peculiarities of the territorial and industry specifics in the field of activity of the insurance company, the form of insurance, the scope of insurance liability and the insurance system. Forecasting of the activity of insurance companies should include: historical, economic, social and legal features. The question becomes especially relevant in the context of the implementation of international agreements, cooperation with the World Bank Group.

The essence and peculiarities of the development of the global world and processes, their manifestations in various spheres of activity have been studied by a significant number of authors, including: O.G. Belorus [4], V.I. Vlasov [5], A.S. Galchynskyi [6], P. Hurst & G. Thompson [7], R. Robertson [8], D. North [9], C. Whelan [10]. The authors investigated the peculiarities of manifestations of globalization processes in various spheres and branches of the world economy, opportunities and threats of investment activity, the development of spheres and branches of the economy, including the financial sector, the sphere of insurance. The authors proved the specificity of the insurance process due to the randomness of the occurrence of the insured event, the extreme nature of the loss or damage, the objective need to prevent and overcome the consequences of the events that occurred, compensation for material and other possible losses. The authors define the main priorities of the development of the global world, including with regard to social aspects and interaction on aggregated markets, opportunities for the development of spheres and branches of the economy, potential risks of the global world. One of the manifestations is the pandemic, which significantly affected the global world and the field of insurance, including personal insurance. Individual researchers form the main emphasis of the development of the state and society on mentality [11]. Global trends in the development of the world, spheres and branches of the economy, including the sphere of insurance, are summarized by the World Economic Forum [3, 12, 13]. Further research is due to the need to determine the main priorities and features of the development of the insurance sector in view of potential and possible threats, including at the level of each individual.Taking into account the already conducted research, the existing trends and needs of society, the results of the evaluation of the insurance market by international agencies, the conduct of further research is connected with the need to determine the spheres of interaction between participants and the specifics of activity, regional development. Peculiarities (from mental to territorial) form a range of tasks that determine the priorities of interaction, including during the development and implementation of investment projects. Regional features determine the directions and priorities of interaction between participants, and the field of insurance allows to minimize risks and increase the level of trust and effectiveness of cooperation.

In view of the existing trends and forecasts, the issue of coordinating the interests of various groups of participants in the insurance market is a timely issue, there is a need to ensure effective partnership, the formation of opportunities and the use of the best practical experience in expanding the field of insurance for the protection, development and formation of society, the implementation of investment activities , grant activities, development programs and strategies, etc.

The purpose of the article is to substantiate the essence, features and main tasks in the field of insurance, to determine the priority directions of the development of the insurance market, to coordinate the interests of participants and effective partnership in view of the need to form prerequisites for the socio-economic stability and security of the state and its individual regions. The methodological research is based on the assessment and identification of potential opportunities for the introduction of approaches in the insurance sector, on the insurance market, which will contribute to the development of society, the protection of business and personal interests, the implementation of investment projects and the formation of prerequisites for the socio-economic security of the region.

MATERIALS AND METHODS

The main task of the research is to assess the situation, existing forecasts and determine the priority directions of the development of the insurance sector, taking into account the needs of society, interests, partnership mechanisms, including at the international level. It is important to regulate relations between participants in order to ensure the effectiveness of insurance activities, to form prerequisites for social and economic security, taking into account regional characteristics. The development of insurance in the context of the formation of prerequisites for guaranteeing socio-economic security must take into account regional features, primarily due to the concentration of certain industries and spheres of the economy in a certain territory. Sectoral features of the territory will determine the need for insurance services and insurance market players. Regional features are also determined by development programs, which determine the main vectors of interaction and directions of implementation of the planned measures. The purpose of the study is related to the trends in the development of the agrarian sphere, territorial (local,

regional) development, current tasks, which are included in the Plan of measures for the implementation in 2021-2023 of the Development Strategy of the Mykolaiv region for the period until 2027 "High quality of human life". The priorities of regional development are focused on ensuring the prerequisites for guaranteeing socio-economic security and are determined by the principles of state regional policy and the expansion of partnership spheres.

Methodological research is based on the identification of opportunities for the development of the insurance sector and the introduction of effective partnerships with the aim of neutralizing threats, including during investment, implementation of joint projects, reducing the negative impact of risks and increasing the level of trust between participants. In order to learn about phenomena and processes in the field of insurance, to substantiate the author's proposals, a set of research methods and techniques was used. General scientific methods of cognition made it possible to establish the nature of functional dependencies and the parameters of the researched sphere. The set of functional relationships was considered through the corresponding deterministic and stochastic relationships. The use of analysis tools made it possible to identify the reasons for the change in the situation and identify potential opportunities for the development of the insurance sector. The influence of external factors proves the expediency of risk prevention measures, the use of short-term forecasting (planning) of the activities of market entities, the formation and adaptation of analytical tasks, and the adjustment of management decisions. A critical situation may turn out to be limiting the possibilities of adapting the internal environment to unexpected and significant changes, which is confirmed by practical experience in the field of insurance. In order to solve the tasks, the following methods were used: dialectical and logical (during the study and clarification of the main conceptual apparatus, features of processes, generalization of conclusions); bibliographic (in the process of working out scientific works, which are devoted to the essence and features of regional development); historical (when studying the trends of globalization changes); methods of analysis and synthesis (detection of cause-and-effect relationships), analytical groupings (when assessing the current state of the insurance market); graphic (when assessing the investment opportunities of the region); system approach (in the process of justifying the needs and relevance of the partnership).

The information base for the study was: the current regulatory and legal framework, the experience of insurance development and the main practices of the participants' interaction, the possibilities of implementing regional development projects on the terms of partnership.

RESULTS AND DISCUSSION

Experience of interaction of participants in the field of insurance

The development of the insurance sector in accordance with international standards takes into account the fields of mandatory and voluntary insurance (from life insurance to financial assistance insurance). Most of the countries of the world orient the insurance market to the expansion of the field of voluntary insurance, which includes property and personal insurance, insurance of liability and business risks. Property insurance itself is a form of protection against risks that may arise due to changes in the internal and external environment at the level of industries, spheres of activity, business, and individual territories.

The question becomes especially relevant in view of the possibility of neutralizing the threats posed by the natural and climatic factor, the impact of which is particularly felt in the field of agrarian business. Property insurance is a relevant field of voluntary insurance not only for enterprises, but also for territorial communities. The already existing evidence of the introduction of the process of decentralization and transformational processes in local self-government indicates the expansion of the powers of local bodies, the growth of their level of responsibility and the development of communities. Similar approaches in the regional development management system contributed to the attraction of potential investors and infrastructural provision of the territory's development, and also contributed to stimulating the economic growth of territorial communities, business development and functioning. Regional development programs in accordance with the state regional development strategy and grant projects, which have been actively implemented in the Mykolaiv region and other regions of Ukraine in recent years, play an active role in ensuring the development of territorial communities.

The Swiss Re Institute predicts that global insurance premiums will grow by 3.0 percent in the coming years, mainly driven by life and general insurance in emerging markets. Global economic growth will be characterized by a slowdown. Analysts note that it is China that will make the predominant contribution to the growth of premiums in the field of life insurance and general insurance. Life insurance premiums are currently projected to increase, with growth expected to reach 3.0 percent annually, well above the 0.6 percent annual average over the past 10 years. China alone will account for nearly half of global life insurance premium

growth over the next two years, with growth expected at 11.0 percent. The forecast for the development of the insurance sector in other countries of the world is related to the relevant tax incentives, following the example of Argentina. Significant growth of the market of insurance services in the Middle East, Africa and Latin America is predicted [1].

The trends in the development of the insurance market are mainly due to the expansion of spheres and capital in countries that are undergoing a period of socio-economic development.

Analysts at the Swiss Re Institute note that in the period up to 2029, the Asia-Pacific region as a whole will account for 42.0 percent of global premiums. The stakes for the development of insurance remain high in China, which is the main participant in the development of the insurance sector. China's share of global premiums rose from zero percent in 1980 to 11.0 percent in 2018. Analysts predict that China's capacity will reach 20.0 percent in just 8 to 10 years, which is almost as much as is projected for all developed countries in the EMEA region (the region that includes Europe, the Middle East and Africa). China is predicted to have a much higher position than the USA and will be the world's largest market by the mid-2030s [1]. Similar trends reflect global manifestations in the development and opportunities of the insurance market [1-3].

Regional aspect

In accordance with the program for the development of the agro-industrial complex of the Mykolaiv region for 2021-2025, the main priorities for the development of the agrarian sphere and territories have been determined, including through the implementation of investment projects (project ideas). The program for the development of the agro-industrial complex of the Mykolaiv region for 2021-2025 is aimed at implementing the State Regional Development Strategy for 2021-2027, the Development Strategy of the Mykolaiv region for the period until 2027 [14-16].

The program for the development of the agro-industrial complex of the Mykolaiv region for 2021-2025 (hereinafter referred to as the Program) provides support for development in the field of crop production (horticulture, viticulture, berry growing, cultivation of niche agricultural crops, lowering the cost of agricultural crop seeds, production of organic products, increasing soil fertility). , as well as support for the development of the livestock industry, modernization of inter-farm networks, drainage systems and construction of new intra-farm irrigation systems. The program provides assistance in the production of products with high added value, the creation of family farms and agricultural cooperatives in the Mykolaiv region, the development of agricultural consultancy and the implementation of measures to popularize the agricultural sector in order to increase the level of its investment attractiveness [15].

That is why the regional aspect in the development of the insurance sector is related to the potential opportunities of the agrarian sector and the participation of territorial communities, since the main areas of program implementation have a direct connection with representatives of agrarian business and territorial communities. The implementation of the program involves: supporting the development of small and medium-sized enterprises in the field of crop production; support for producers of organic products; implementation of measures to increase soil fertility; support for the development of the livestock industry; modernization of inter-farm networks and construction of new intra-farm irrigation systems; modernization of drainage systems.

The program takes into account the possibilities of the development of territorial communities and the production of quality products, the creation of family farms and agricultural cooperatives, the development of counseling. Opportunities for improving the investment climate in rural areas and popularizing the agrarian sphere are separately highlighted. The formed directions of development of spheres and branches of the economy, territories (territorial communities) at the regional level are oriented to the use of the best practical experience of partnership in view of the need for the formation of prerequisites for the socio-economic security of the region. Regional aspects are determined by the corresponding concentration of spheres and branches of the economy precisely in rural areas. The development and formation of industries is connected with the possibilities of using property insurance for the purpose of neutralizing risks, including entrepreneurial ones. Mechanisms of property insurance can be used both in the field of agricultural production and the activities of territorial communities.

The program envisages the implementation of investment projects with the involvement of funds from the state budget, regional budget, own sources, as well as funds from investors and sources of financing under grant projects. The implementation of investment programs is focused on attracting financing in the period until 2025 (Fig. 1).

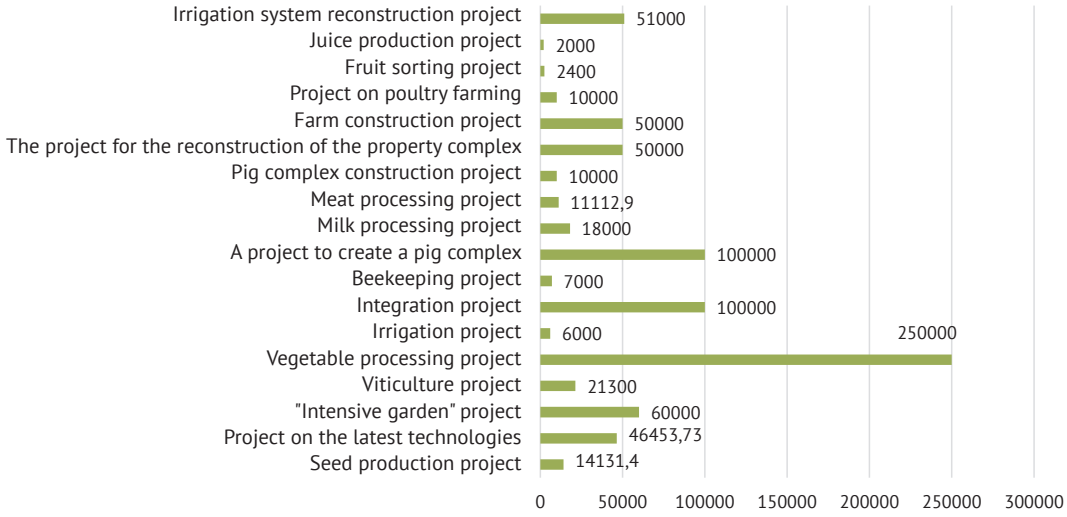

Figure 1. *Investment projects foreseen by the Program for the Development of the Agro-Industrial Complex of Mykolaiv Oblast for 2021-2025*

***Source**: Development Program [14]*

Taking into account the submitted proposals, it is planned to attract 809,398.0 thousand hryvnias at the regional level. additional financing for the implementation of investment projects during 2021-2025. Investment projects for regional development and the agricultural sector were prepared at the initiative of Mykolaiv National Agrarian University and its partners in educational, scientific and practical-production activities, as well as STOV "Promin", "Snigurivska Poultry Farm" Branch, PNVK "Interbusiness", TDV "Zorya Ingulu". Most of the projects provide for the financing of measures involving investment funds – up to 76.0 percent of the total project financing [14]. The question becomes especially relevant in the context of regional development, during the period of restoration of the territory of the Mykolaiv region and the development of spheres and branches of the economy, territorial communities.

The development of the agrarian sphere involves not only representatives from production, but also educational and research institutions. The largest number of investment projects (investment proposals) was provided by the Mykolaiv National Agrarian University to the Action Plan for the Implementation of the Development Strategy of the Mykolaiv Region for 2021-2027. According to the Development Strategy of the Mykolaiv region until 2027, the priority strategic goal is to ensure sustainable economic growth of a multi-sector economy, which cannot happen without the participation of representatives of all spheres and types of activity, including the insurance sphere.

Considering the implementation of projects, the field of property insurance is supplemented by the field of liability insurance, since most projects involve partnership relations, including at the international level. The use of insurance mechanisms may include: property insurance for legal entities, debt insurance and indemnity insurance (fields of insurance: professional liability, civil liability of vehicle owners, personal insurance).

Regional features of the development of spheres and branches of the economy, defined strategic priorities for the development of the agrarian sphere and territorial communities determine the need for the implementation of systemic approaches that should contribute to the development of the insurance market, namely: the creation of an attractive market for insurance services and informing participants about the approaches and features, advantages of property insurance and responsibility; formation of an effective system of interaction between participants; formation of favorable conditions for the expansion of the field of insurance services and consulting for territorial communities; provision of real compensation for losses caused by natural and climatic factors; motivation to cooperate with various groups of investors, under grant projects; participation in public-private partnership projects; adaptation of insurance products taking into account the needs of the agricultural sector and territorial communities; transformation of accumulative insurance reserves into a source of investment of industries, spheres of activity and territories, as well as creation of favorable conditions for cooperation with international partners.

Partnership

The practical implementation of these priorities can be implemented under the conditions of partnership and interaction between participants at all levels of management. That is why the position of spreading joint

projects through public-private partnership and participation in international grant projects is active. Associations of insurers that can perform brokerage and agency activities in the field of insurance (Association of Professional Insurance Intermediaries of Ukraine – APSPU or League of Insurance Organizations of Ukraine – LSOU) can be involved in cooperation.

The common interests of the participants will allow to facilitate coordination of insurance services and satisfaction of needs in view of the requirements of current legislation in the field of property insurance or liability insurance. Such cooperation will allow to optimize the possibilities of obtaining insurance services on optimal terms and to take into account possible risks from the implementation of investment activities.

Insurance risks during the implementation of investment activities may be associated with partial or complete loss of investments, failure to receive the planned investment profit, bankruptcy of the business entity or additional costs during the implementation of the insured investment activity.

Insurance of investment activities allows to ensure the neutralization of risks and threats for participants due to the influence of currency, interest, commercial, market risks, as well as catastrophic risk, which is associated with natural disasters and has a close connection with natural and climatic factors. Catastrophic risk can be a significant threat in the conduct of activities in the agrarian sphere, in rural areas. In recent years, the issue of desertification, soil degradation, and moisture deficit, which is highly relevant for the steppe zone, a zone of risky agriculture, which includes the Mykolaiv region, has become an actual issue.

The assessment and risk prevention capabilities can be a significant advantage in the implementation of investment activities, as some risks may be subject to insurance through the establishment of additional insurance conditions and an increase in the amount of the insurance payment. Conditions may be determined by each individual insurance contract, taking into account industry and regional characteristics. The experience of most European states shows that practical activity in the field of agrarian business insurance has substantial state support, as it is defined as a priority in guaranteeing food security, social and economic security of the territories (region). The vast majority of investors pay significant attention to the need to neutralize threats, including climate threats. During the implementation of investment activities, the issue of risk assessment at various stages is relevant (Table 1).

Table 1. *Directions and conditions of investment risk insurance*

Type of activity	Areas of insurance	Conditions of the investment risk insurance contract
Investment activity Implementation of investment projects	Insurance of the subject of pledge; liability insurance of the recipient of the investment before the investor; insurance of possible investment risks by participants of investment activities (investor, recipient of investment); liability insurance of participants in investment activities (investor before the recipient of the investment); liability insurance of the applicant of the investment project to the customer; liability insurance of investment project experts before the investor; insurance of property and non-property property rights, which are an investment [17; 18]. The insured amount is determined by agreement between the insurer and the insured, within the limits of the insured's actual investments related to the financing of the insured activity. The insured amount can be increased by the amount of the forecasted (expected) profit from the realization of the insured project (upon agreement of the parties). During the implementation of the investment project, the insurance tariff is mainly determined taking into account the terms and volumes of the investment, the specifics of the field of activity, the competence of the insured, the type and nature of the investment, as well as the number and reputation of the participants of the investment project (at various stages of its implementation) and other influencing factors considering the peculiarities of project implementation [17; 18]. In accordance with the practice of implementation of approaches in the field of investment, the insured should not include in the project conditions regarding the extension of the payback period of the project, established for the	According to the current legislation, the contract cannot be concluded later than the day preceding the day of commencement of the works invested by the insured. The term of the contract should be set in accordance with the term of full implementation of the investment project, i.e. obtaining the expected income or social effect [17; 18]. In accordance with current legislation, in order to ensure the payment of insurance compensation, the insured must notify the insurer of the occurrence of an insured event and provide him with documents certifying the facts of the occurrence of the insured event and the amount of losses. It is established by law that after payment of insurance indemnity to the insured, all the rights of claims of the insured against the person responsible for the damage caused or the damage are transferred to the insurer within the limits of the paid amount. The counterparty, the policyholder's partner in the investment project, is responsible for the recourse claims of the insurer. It is provided that in the case of payment of insurance compensation in the amount of the full amount of expenses for the invested project, the insurer acquires the investor's right to it.

Table 1, Continued

Type of activity	Areas of insurance	Conditions of the investment risk insurance contract
Investment activity Implementation of investment projects	implementation of the project and specified in the insurance contract. In order to extend this term, before the payback period of the investment project, the insured must agree on the conditions and obtain the appropriate consent of the insurer (without consent, the insurance contract may be terminated from the moment of making changes to the investment project) [17; 18]. When extending the payback period of an investment project, additional insurance conditions require an additional insurance contract. In accordance with the requirements of the current legislation, if the contract is not concluded, the insurer does not assume obligations to insure additional conditions. Insurance conditions can be supplemented taking into account the requirements of the parties, but within the limits of current legislation.	When insurance compensation is paid in an amount lower than the costs, the insurer has the right, according to the agreement with the interested parties, to pay the amount in the amount of the difference between the full amount of costs and the paid insurance compensation, thus acquiring the investor's rights to the project [17; 18]. Insurance of investment risks is carried out in accordance with the current legislation and at the request of the parties to the investment process.

Source: *summarized by the author in accordance with current legislation [17; 18]*

The implementation of regional and industry development programs involves the involvement of investors. The investor's interests are focused on the possibility of obtaining financial results from the implementation of investment activities, which can be carried out under the conditions of a public-private partnership.

Insurance of investment risks during the implementation of projects is aimed at prevention and neutralization of possible threats, for the agricultural sector the issue of avoiding risks of a natural and climatic nature is relevant. Consistency of interests of all parties will ensure the possibility of implementation of the Plan of measures for the implementation of the Development Strategy of the Mykolaiv Region and the Program for the Development of the Agro-Industrial Complex of the Mykolaiv Region, taking into account the identified priorities. The participation of insurance companies in the conduct of investment activities and the determination of optimal conditions of interaction between participants will provide wider opportunities for cooperation.

Risks in the field of investment

Partnership in insurance activity allows not only to ensure the neutralization of potential threats in view of regional and industry specifics, but also to mutually agree on urgent issues regarding the fulfillment of obligations under investment projects, active participants of which can be: the state, association of policyholders, territorial communities, institutions education under the conditions of public-private partnership.

Such cooperation and guarantees of the state make it possible to increase the level of investment attractiveness of spheres, industries and territories, which is proven by the experience of other countries of the world. Features and conditions of insurance must be agreed upon at all stages of project implementation. The right of participants to adapt to changes in the external and internal environment should be ensured, and the level of trust between participants should not be high and should not provoke threats.

The conducted research provides an opportunity to justify the main priorities of the development of the insurance market in view of regional features. The experience of other countries of the world and the results of research by other authors and international organizations prove that most types of insurance act as an effective mechanism for the interaction of participants, especially during the period of investment and neutralization of threats that may arise during the implementation of investment projects. The situation due to the martial law has significantly reduced the investment attractiveness of the developed initiatives and proposals. Given the potential risks, there is an urgent need to neutralize threats through risk insurance and ensure an appropriate level of trust between participants in conditions of significant influence of globalization processes and trends. O.H. Belorus & V.I. Vlasov in his research formed the paradigm of the global world and the main trends in the development of spheres and branches of the economy, society based on the orientation of the world to global trends, technical and technological processes and the adaptation of social processes to changes [5; 6]. P. Hurst, G. Thompson & R. Robertson in their research identified the main vector of globalism and its manifestations, substantiated the potential directions and priorities of world development and possible threats that may arise due to increased global competition, including in the financial market [7; 8]. D. North &

Ch. Wilan in his research focused on the main priorities and needs of world development, requests and needs of society depending on the features (mental, territorial, industry, etc.), similar features also determine potential opportunities or threats that may arise in various spheres of activity, including in the field of insurance and investment [9; 10].

Analysts of intelligence agencies have determined the main directions and features of the development of the global world in view of the existing trends in the field of insurance and the needs of society and the business environment [1; 12]. The authors' research and their own research on the development and trends in the formation of priorities in the global world prove the need to ensure an effective partnership in conducting business, implementing investment projects and developing the insurance sector, taking into account the existing features, including those of a regional nature.

The definition of features and directions of interaction in the global world is determined by the competitive positions of the state, which can encourage development or limit the possibilities of implementing strategic and operational tasks in the business environment and society. The practical experience of forming approaches to socio-economic security shows that the competitive positions of the state have a priority role, as they encourage investors to expand the spheres of interaction. The influence of regional factors is similar, which allow to clearly formulate strategic and operational tasks, provide prerequisites for development and reduce potential risks, including through the use of activity insurance mechanisms, implementation of investment projects. In view of this, the development of insurance and the best practices of the interaction of participants during the implementation of investment projects allow to significantly increase the level of trust and guarantee the expected result of cooperation.

CONCLUSIONS

In view of the main globalization trends in the world, there is a need to research various spheres of activity and identify features that allow us to establish the main priorities for further development and neutralization of threats, including during the implementation of investment projects. The effectiveness of regional and sectoral development programs is a prerequisite for ensuring the social and economic security of the region, and the development of insurance activities and the expansion of spheres of interaction provide opportunities for the implementation of investment projects. At the same time, the development of the insurance sector must take into account regional features, and the sectoral features of the territory determine the need for insurance services and insurance market participants. Regional features determine the main vectors of interaction and directions for the implementation of certain initiatives at different levels of management (personal or local, branch, territorial). The practice of regional and branch development through the spread of joint projects on the basis of public-private partnership and participation in international grant projects is effective. Associations of insurers can participate in the implementation of development projects, perform brokerage and agency activities in the field of insurance. The common interests of the participants make it possible to ensure coordination of insurance services, satisfaction of needs in view of the requirements of current legislation and international law. It is stipulated that such cooperation allows to optimize the possibilities of obtaining insurance services under optimal conditions and to take into account possible risks from the implementation of investment activities, implementation of regional and branch development programs, personal insurance.

The effectiveness of cooperation in the implementation of projects aimed at the socio-economic development of the state and its regions is due to the need to expand cooperation with international organizations, including the World Bank Group. The common interests of the participants and their coordination at the first stages of interaction will allow to minimize risks and ensure effective cooperation in view of the programs and strategies of socio-economic development of territories (regions), the state. The issue of restoration of territories, spheres and branches of the economy of Ukraine is gaining special relevance in the immediate future. The experience of the countries of the world proves that the opportunities for interaction between participants of the insurance market can be provided under the condition of effective partnership and the orientation of the participants to obtain practical priorities in guaranteeing the social and economic security of the state and its regions, taking into account their peculiarities. It is the regional features that determine the directions and priorities of interaction between the participants, and the field of insurance allows to minimize risks and increase the level of trust and effectiveness of cooperation.

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Розвиток страхування, можливості та практичний досвід у формуванні соціально-економічної безпеки (регіональний аспект)

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Анотація. Розвиток сучасного бізнесу, реалізація підходів щодо місцевого, регіонального (територіального) розвитку спонукають до активізації поширення сфери страхування. Механізми запровадження відповідних фінансових важелів дозволяють нейтралізувати загрози та підвищити фінансову стійкість суб'єктів ринку, що доводить досвід європейських держав. Метою дослідження є обґрунтування сутності, особливостей та основних завдань у сфері страхування, визначення пріоритетних напрямів розвитку страхового ринку, узгодження інтересів учасників та результативного партнерства з огляду на необхідність формування передумов до соціально-економічної стабільності та безпеки держави та окремих її регіонів. Основне завдання дослідження полягає у проведенні оцінки ситуації, існуючих прогнозів та визначенні пріоритетних напрямів розвитку сфери страхування з огляду на потреби суспільства, інтереси, механізми партнерства, у тому числі на міжнародному рівні. Під час дослідження використано методи наукового пізнання. Автором досліджено сутність та можливості розвитку сфери страхування з урахуванням практичного досвіду держав світу та сучасних тенденцій на ринку страхування. Доведено значення сфери страхування для суспільства, регіонального розвитку та підвищення можливостей у сфері інвестиційної діяльності. Проаналізовано регіональні особливості та визначено пріоритетні напрями розвитку з огляду на потреби сфер та галузей економіки, територіальних громад. Обумовлено вплив результативної взаємодії учасників страхового ринку на можливості розширення страхових послуг. Визначено актуальність партнерства у реалізації підходів страхування та механізмів взаємодії між учасниками. Автором обумовлено необхідність врегулювання інтересів усіх учасників, а також взаємоузгодженості дій та рівнів відповідальності, можливостей державно-приватного партнерства у регіональному розвитку, інвестиційній діяльності. Обумовлено потребу гарантування практичних результатів взаємодії у сфері страхування та формування передумов до соціально-економічної безпеки, у тому числі з урахуванням регіональних особливостей. Результати дослідження автора можуть бути використані для подальших досліджень у сфері страхування, взаємодії учасників на засадах партнерства

Ключові слова: глобалізація, інвестиційна діяльність, державно-приватне партнерство, стратегічні пріоритети, страхові премії, страхові ризики

UDC 336.143.23
DOI: 10.56407/2313-092X/2022-26(3)-2

Ukrainian Black Sea Region Agrarian Science
Vol. 26, No. 3

Public participation in the decision-making process at the level of territorial communities

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Abstract. The purpose of the article is to generalize the theoretical foundations and justify the feasibility of using innovative tools to involve citizens in the decision-making process at the level of territorial communities, spread the practices of participatory budgeting, which will contribute to the formation of an active civil society. The following methods were used to implement the tasks: abstract-logical; monographic and comparative; graphic; sociological survey method. The expediency of using the participatory budgeting mechanism for territorial communities is justified, which will contribute to the establishment of social dialogue between local self-government bodies and residents of the territorial community. A sociological survey was conducted to identify the realities of increasing public involvement in the decision-making process at the territorial community level. It was found that the respondents are equally concerned about urban and personal problems of planning the socio-economic development of the territory. Innovative mechanisms of public participation (consensus conference, consultative survey, guided visualization, world cafe, workshop, imagination, public development of alternatives) are proposed, which will contribute to the formation of an active civil society and increase the level of civic education. Public space is another innovative tool for the participation of community residents in the decision-making process. The conducted research contributed to solving the task and justifying the expediency of using innovative tools of public participation in the decision-making process, spreading the practices of participatory budgeting, which will contribute to the formation of an active civil society. The formulated author's conclusions and recommendations are characterized by a positive impact on the involvement of the public in the decision-making process, since the creation of a higher culture of decision-making and the activation of civil society at the level of the territorial community can contribute to receiving better services and improving the quality of life of the population

Keywords: local self-government, civil society, participatory budget, citizens' appeals, public hearings

INTRODUCTION

The influence of society on state decision-making has been discussed since the 20th century. Today, various forms of governance are united by the need for direct and centralized involvement of citizens, non-governmental organizations, and public movements in policy formation and implementation [1].

The National Strategy for Promoting the Development of Civil Society in Ukraine for 2021-2026 defines that the main tasks are to create favorable conditions for the development of public initiative, the formation of a system of civil society institutions, the establishment of communications and interaction between them and the authorities [2]. Effective interaction with the public is also the foundation for the formation of a transparent system of decentralized state administration, as stated in the program of Sustainable Development Goals of Ukraine until 2030 [3]. The Concept of the Reform of Local Self-Government and Territorial Organization of Power emphasizes the importance of maximum involvement of citizens in the decision-making process on local government issues and promoting the development of direct democracy [4].

Article's History:
Received: 17.04.2022
Revised: 06.06.2022
Accepted: 26.08.2022

Suggested Citation:

Kormyshkin, Yu. (2022). Public participation in the decision-making process at the level of territorial communities. *Ukrainian Black Sea Region Agrarian Science*, 26(3), 20-31.

The concept of the development of civic education in Ukraine emphasizes that the citizen's participation should be comprehensive in the conduct of state affairs, in various social processes. Citizens should understand, take part in the discussion and make decisions related to management and thereby influence both their own life and the life of the community [5].

For this, citizens need to be both competent in public and political issues, as well as tools guaranteed by the government and understanding from public managers [6].

Many well-known domestic and foreign scientists made a significant contribution to the research of public participation in management. Thus, according to I. Shumlyaeva [7, p. 113], it is determined that the level of citizen participation in solving local issues in Ukraine is largely influenced by modern European trends in the democratization of management processes and the stimulation of citizen participation in local public life. The scientist suggested distinguishing three successive levels of citizen participation in decision-making at the local level. These levels are classified depending on the type of relationship, the degree of participation of members of the territorial community and the intensity of the process (low – basic information, medium – consultations with the public, high – partnership dialogue), the definition of forms on each of them has a corresponding meaning.

The results of research into the mechanisms of public involvement in the decision-making process [8, p. 3] show that an important element of citizen participation in socio-political life and the decision-making process is the cooperation of the city government with public associations (public organizations, self-organization bodies of the population, initiatives and activists).

According to F. Kamberi & B. Baliqi [1], community participation in decision-making is considered an essential characteristic of democracy and, in particular, of local self-government. Thus, local self-government bodies, with the help of various democratic forms, seek to involve the community in the decision-making process. The study provides a holistic approach to the development of communities in the municipality, the level of participation in decision-making processes, forms of communication between the local government and the community, as well as the impact of community development on the development of state policy at the local level. The methodology used here focuses on various studies and reports on local authorities and communities, as well as quantitative studies measuring public opinion. The general results of this work emphasize that, although there are institutional mechanisms for participation in decision-making, there is a decrease in community participation in decision-making and in the process of developing local public policy strategies.

Scientists Laura Jankauskaite-Jureviciene & Ausra Mlinkauskiene [9], are convinced that participation in decision-making processes involves giving citizens, communities, non-governmental organizations and other interested parties the opportunity to influence the formation of policies and laws that affect them.

The study by N. Hertting & C. Kugelberg [10] emphasizes the role of participation mechanisms as a political resource for the local ruling elite or the mayor, as such mechanisms create an atmosphere of democratic will.

The position that public participation is aimed at increasing the effectiveness of management by involving citizens in the processes of forming management policy and decision-making is expressed by scientists M.S. Nyaranga *et al*. [11, p. 29]. We support the opinion of scientists, because such participation will contribute to the transparency, accountability and efficiency of any modern government. Scientists [11] emphasize the need to strengthen public participation by creating an independent institution that will manage public participation processes.

The Food and Agriculture Organization (FAO) also supports the position of public participation in management decision-making. Thus, in the publication "Citizen participation in sustainable rural development" [12] it is emphasized that significant participation of citizens is necessary for effective development. Since rural development is a people-oriented programme, it is very important that people actively participate in rural development. As an important pillar of democratic transformations and the transformation of the civil service, local self-government is the place from which the solution to the problems of democratic development should begin. One of the important ways to strengthen democratic institutions without weakening the executive power is to ensure the active participation of citizens in the process of village development by providing a standing committee of local self-government.

Despite the large amount of scientific work in this field, a number of issues of the theoretical plan regarding forms of public participation in the decision-making process and practical recommendations at the level of territorial communities require further research.

The purpose of the article is to generalize the theoretical foundations of forms of citizen involvement in solving community problems, their legal regulation, and justification of the feasibility of using innovative

tools of public participation at the level of territorial communities. The set goal determined the solution of the following tasks: to systematize scientific views on the essence of the concept of "public participation"; carry out an assessment of the spread of the practice of participatory budgeting for local self-government bodies; to carry out a sociological study in order to determine the realities of public involvement in the decision-making process at the level of the territorial community; justify the expediency of using innovative tools to involve citizens in decision-making at the level of territorial communities.

MATERIALS AND METHODS

This article is aimed at consolidating and conducting a literature review with the aim of summarizing the theoretical foundations of public participation in the decision-making process by local self-government bodies and substantiating the feasibility of using innovative tools of public participation in the decision-making process at the level of territorial communities, the spread of participatory budgeting practices, which will contribute to the formation of active civic society.

An analysis of the most important regulatory and legal documents describing public participation in the decision-making process was carried out in order to find out the ways, means and emerging problems of involving the public in the decision-making process at the territorial community level. The following methods were used in the research process: abstract-logical to substantiate the research methodology and determine theoretical generalizations; monographic and comparative – to systematize the scientific approaches of scientists to the theoretical aspects of public participation in the decision-making process and expand the methodological base in order to substantiate the feasibility of using innovative tools of public participation in the decision-making process, spreading the practice of participatory budgeting; graphic – for visualization of research results; sociological survey method – to reveal the realities of citizens' involvement in the decision-making process at the level of the territorial community. A voluntary sample was used for the sociological survey. The questionnaire was distributed among residents of the Berezan settlement territorial community with the help of social networks. This method of data collection was purposefully used to find out who and how active they are in social networks and how interested they are in the issues of the territorial community where they live. The survey consisted of several main research structures: clarification of the personal attitude of citizens to participation in decision-making processes and the approach of local self-government bodies to the consideration of public opinion in the process of adopting documents on various aspects of territorial development.Out of 44 respondents, the distribution in age groups 18-29, 30-40, 41-50, 51-60 was almost even: 24.5; 25.4; 23.8 and 26.3%, respectively. It is interesting that persons aged 18-29 make up 12%; respondents aged 51 and over – 20%. The majority of respondents were women (73%). It is noteworthy that by education, about 88% of respondents have a complete higher education; 68% of respondents have a basic higher education and 20% have a professional and technical education. The surveyed residents of the community are representatives of various types of activities, namely: 32.1% of respondents are social workers; 16.2% – civil servants; 24.1% – entrepreneurs and farmers; 18.8% – run a household; 3.5% are studying; 5.3 – pensioners. It is worth noting that 16 respondents (36.4%) called themselves active members of the community.

The majority of respondents (64%) consisted of residents of the urban-type village of Berezanka, 36% of respondents were residents of other villages of the specified territorial community. Such activity of the residents of one settlement in answering the questions of the questionnaire can be based on the interest of the residents in the development of the settlement and the growth of well-being, raising the standard of living and social protection of the population.

The information provision was made up of normative and legal acts of Ukraine, in particular the Constitution of Ukraine [13], Laws of Ukraine "On Appeals of Citizens" [14], "On Local Self-Government in Ukraine" [15], "On Bodies of Self-Organization of the Population" [16] and others; European Strategy for Innovation and Good Governance at the Local Level [17]; Internet resources; monographic, periodical and reference publications; reporting materials of The Food and Agriculture Organization [12]; results of own research and calculations.

In accordance with the formulated goal, the stages of the research were: generalization of the theoretical foundations of the involvement of citizens in decision-making and their legal regulation; evaluation of the spread of the practice of participatory budgeting for local self-government bodies; conducting a sociological study in order to determine the realities of public involvement in the decision-making process at the level of the territorial community; justification of the feasibility of using innovative tools of public participation in the decision-making process at the level of territorial communities.

The used methodology contributed to solving the task and justifying the expediency of using innovative tools of public participation in the

decision-making process, the spread of participatory budgeting practices, which will contribute to the formation of an active civil society.

RESULTS AND DISCUSSION

At different stages of the management decision-making process, the level of participation of the public and non-governmental organizations may differ depending on the intensity of involvement. In 1969, Sherry Arnstein was the first to propose a typology of levels of citizen participation in the process of making managerial decisions regarding socio-economic development. In her article, the author describes the influence of society on government decision-making using a ladder model, where Manipulation and Therapy are on the first and second rungs, respectively, followed by Information, Counseling, Reconciliation, Partnership, Delegation of Powers, and Citizen Control on the top eighth [18, p. 9-10]. By stepping on such a ladder, society rises to the highest level – true civic participation. Note that all other modern forms of public participation to one degree or another are based on this foundation.

The Council of Europe, in accordance with the "Code of Best Practices for Public Participation in the Decision-Making Process", distinguishes four levels of participation. These include: information, consultations, dialogue and partnership [19, p. 7].

According to the level of active participation of citizens in public life, the authors of the training manual "Personnel management in public authorities" [20] give the following gradation of their main types: absenteeism; observer; consumer; lobbyist; public figure; functionary.

As part of the "European Strategy for Innovation and Good Governance at the Local Level", the principles of participatory democratic governance are defined, which are based on principles, rules and practices developed around the world [17].

Recommendations regarding public participation in the process of making political decisions were adopted by the Committee of Ministers on September 27, 2017 at the 1295th meeting of deputy ministers [21]. The recommendations state that public participation should be based on and motivated by principles that apply to all participants who publicly participate in solving the problems of territorial communities.

As L. Kovshun notes, "since civic participation is a global trend, each country and organization develops its own policy for its implementation" [22]. According to the activist, this requires, on the one hand, the presence of appropriate legal mechanisms and procedures that allow citizens to influence the resolution of the problems of territorial communities, and on the other hand, provide the opportunity to participate in the adoption of these decisions. Let's explore the essence of the tools of public participation and public influence on the government, which are provided for by the current legislation of Ukraine. Citizen appeals are the easiest way for citizens to communicate with the authorities, with the help of which citizens of Ukraine have the right to submit comments, complaints and proposals to state authorities and local self-government bodies [14].

With the help of general meetings of citizens, you can decide on your own, without the intervention of the authorities, a significant part of your rights as a citizen. The Law of Ukraine "On Local Self-Government in Ukraine" refers to the competence of citizens' assemblies to resolve issues of local importance [15].

Local initiatives are another way of facilitating consideration by the local council of issues that affect the interests of citizens and are within the competence of local self-government bodies. It should be noted that the decision of the local council is issued based on the results of consideration of the local initiative [15].

A vivid example of such a level of citizen participation as delegation is the self-organization bodies of the population. Local councils can allow local residents to create various bodies of self-organization of the population and endow them with part of their own competence, finances, property [13, Article 140, 15, Article 14, 16, Article 2]. It is appropriate to note that the essence of the idea of creating a body of self-organization of the population consists in delegating part of the powers of the local government according to the principle of subsidiarity to the directly organized part of the community.

A local referendum is a form of decision-making by residents of a territorial community through direct voting. For global practice, a local referendum is a common form of direct democracy. Public decisions made at local referenda are binding [15].

Public hearings are the most common mechanism of local democracy. The leadership of the territorial community can hold public hearings, organize meetings with deputies and officials of local self-government. During such meetings, matters of local importance, which belong to the competence of local self-government [6], are discussed.

Electronic petitions are a modernized form of public participation. This is a form of petition that is signed online, usually through a form on a website. Visitors to the online petition sign the petition by adding their details, such as name and email address [23, Article 23].

Having studied the forms of public participation and their regulation by current legislation, we

believe that an important direction is the involvement of the public in the process of making administrative decisions, a tool of direct democracy, with the help of which every resident of the territorial community has the opportunity to join the budget process, understand its principles and influence decision-making regarding of the expenditure part of the local budget, there is a public budget or a participation budget [24]. From the point of view of territorial development, this tool helps to use budget funds to solve issues that are vital, according to the users of project results (local communities). Participation in decision-making processes involves giving citizens, communities, non-governmental organizations and other interested parties the opportunity to influence the formulation of policies and laws that affect them [9]. The result of the implementation of the participation budget is an increase in the number and quality of the requested public and private goods and services provided to the population of the territory as a result of the development or reconstruction of public infrastructure facilities. We believe that the spread of such practice for territorial communities will contribute to the establishment of communication between the local government and the population of the territorial community, to create conditions for the participation of residents of the territorial community in the distribution of budget funds to meet their needs.

The creation of initiatives that allow citizens to be involved in the processes of making administrative decisions provide an opportunity to establish interaction between the authorities and the community. However, participation strategies and means of participation are also different and strongly depend on who organizes the participation and for what purpose. Public participation can take the form of constructive cooperation with local authorities to plan for socio-economic development, or it can be adversarial if initiatives are rejected. Ideally, public participation should lead to outcomes that serve the interests of as many members of the territorial community as possible, not just one group of stakeholders. According to V.S. Kravtsiva & I.Z. Supportive policies, which at the stage of development had wide public perception, are more successful than policies that are unknown to society [25]. Most of the decisions of the authorities concern the citizens of the territory. When people are aware of these decisions and feel that they have put effort into developing them, they are more likely to follow through on them.

A survey of 44 respondents was conducted to identify the realities of citizen involvement in the decision-making process at the territorial community level. To the question "To what extent are you personally active in expressing your opinion or submitting proposals to the municipal government when preparing documents on social and economic development?" 39% of respondents stated that they are neither passive nor active. However, even more than a third of respondents answered that they are active (27%) and very active (9%). When examining the relationship between gender and social activity, it was observed that the percentage of responses between the different sexes for activity was very similar, with 50% of males saying they were inactive and 50% saying they were active. Accordingly, the female gender assessed their activity as follows: 53.1% are inactive and 46.9% are active. Respondents had to rate their level of activity on a 5-point Likert scale. To the question "Do you have enough information about the possibilities of public participation in the decision-making process at the level of the territorial community?" as many as 84% answered that the information is too limited.

In addition, the question "From what sources do you learn about projects or decisions that are being considered in the community?" was considered. Respondents were able to choose several answers, but the vast majority (78%) indicated that the most popular source of information is social networks (for example, Facebook). Respondents also answered that they look for information about various social and economic development projects on the website of the territorial community (32%) and ask active members of the community (50%). Only 5% of respondents ask the community leaders about the socio-economic development issues that concern them, and none of the respondents answered that they received information about it from the head of the community or elders. The survey showed that residents of the Berezan territorial community are equally concerned about personal housing and local problems, but most often they discuss these problems not with governing bodies, but with friends and acquaintances (89%). Figure 1 below shows that respondents use social networks more often to communicate with government officials than to participate in project presentations or interviews with government officials. In addition, considering that 46% of respondents indicated that they did not communicate with representatives of local self-government bodies and did not send requests/complaints, it can be argued that most respondents express their point of view only in an informal setting that does not affect the planning of socio-economic development of the territory.

The majority of respondents believe that the residents of the Berezanka settlement territorial community are actively seeking to express their opinion or submit proposals regarding socio-economic planning

documents to representatives of the authorities (52%), however, it cannot be claimed that the majority of the residents of the Berezanka settlement think so, since the majority of respondents are residents of one territory Examining the opinion of respondents about why citizens do not participate in public decision-making, it was observed that disappointment in self-governance prevails, since nothing is expected from participation (75%), they also do not trust their knowledge – 54% and 66% of respondents believe, that most citizens do not have information about planning processes. Some respondents also chose answers that indicate a lack of personal interest – 36% do not have time for it, or 18% believe that it is not of interest to the population. Only 5% of respondents believe that citizens do not take part in public decision-making because they trust the decisions of council members. Table 1 below shows the views of the respondents regarding the involvement of citizens in the decision-making process at the level of the territorial community.

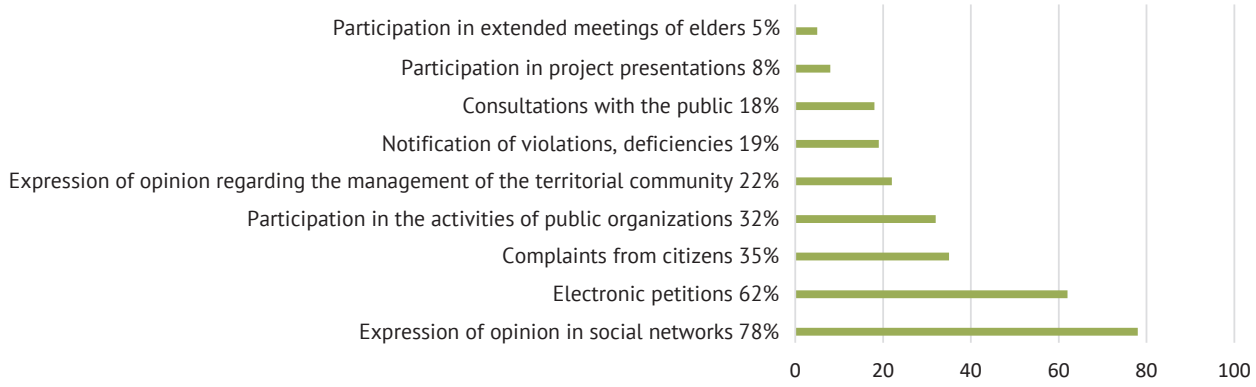

***Figure 1**. Forms of public participation in the decision-making process at the level of the Berezan settlement territorial community, which were used during 2021*

***Source**: author's development*

***Table 1.** The opinion of respondents regarding the participation of citizens in the decision-making process of the territorial community (on the example of the Berezan settlement territorial community)*

Number of participants	Completely disagree	Disagree	Somewhere in the middle	Agree	Completely agree
The legislation provides sufficient opportunity for citizens to participate in the decision-making process	22.7	31.8	27.3	13.6	4.5
The management is interested in cooperating with the residents of the community	52.3	29.5	11.4	2.3	4.5
The information provided for decision-making is easy to understand	31.8	50.0	11.4	2.3	6.8
The community responds to the opinion of citizens	38.7	34.1	20.5	4.5	2.3
Citizens have enough information about opportunities to participate in decision-making	45.5	31.8	9.0	11.4	2.3
Citizens trust the decisions made by local government	52.3	25.0	15.9	2.3	6.8
Residents have sufficient competence to participate in decision-making	11.4	15.9	29.5	22.7	20.5
Citizens have the skills to participate in decision-making	9.0	20.5	25.0	20.5	22.7

***Source**: author's development*

The statements were formulated according to two research constructs: trust in local self-government bodies and legislation and respondents' confidence in their knowledge. Respondents believe that local self-government bodies are not interested in cooperation with the population, and the information provided by the community is not clear and easy to understand. However, even if local self-government bodies do not respond to citizens' opinions, according to the respondents, citizens have enough information about opportunities to participate in the decision-making process and trust the decisions of the territorial community. From the responses regarding self-confidence, it can be seen that the respondents, although doubtful, agree that they have sufficient competence and skills to participate in decision-making. Indeed, more than half of the respondents believe that the TG should not only inform the public about ways and opportunities to participate in public decision-making, but also give advice and take more into account the needs and wishes of society before making decisions. The majority of respondents believe that there is an urgent need (84%) or a need (9%) for cooperation between the TG and citizens in decision-making regarding socio-economic development planning. So, the sample population for the analysis was 44 respondents. From the survey, it was observed that respondents are equally concerned about local and personal issues when participating in the decision-making process of socio-economic planning, but they are more likely to discuss these issues with their friends and acquaintances and use social media than to participate in project presentations or interviews with government officials. Thus, different tools and mechanisms can be used to support public participation at all stages of the management process.

Any successful communication between different groups of people can be considered the result of conversations, dialogues or negotiations. However, activists of social and political life are constantly looking for new forms and practices of communication. These practices are built on the basis of the specifics of the development of individual territories, the formation of a culture of dialogue and many other factors. We study the practices described by the Analytical Center CEDOS [8]. The following can be the most adapted and possible for use in territorial communities (Fig. 2).

Consensus conference
- A conference at which communication between citizens from different social groups and experts allows to make the most comfortable decision for everyone

Advisory survey
- A tool that allows you to experimentally influence public opinion and see its change.

Guided visualization
- Imagine your day in the city a year from now and learn about the opportunities to change that future.

World Cafe
- Combines the characteristics of a free space and a chat cafe, where participants have a free discussion, but aim to create an outline for future projects.

Workshp
- A class during which several groups of experts approach the solution of a specific problem from different angles and, as a result, draw up a joint plan.

Predictions
- An event that allows you to understand and borrow best practices from the past for future use.

Public development of alternatives
- A group of activists asks community residents the question: "How to make our city better for life?" – and records thousands of answers, which he then presents to the community. The community chooses the most important projects and unites in working groups for their implementation.

***Figure 2**. Innovative mechanisms of public participation for territorial communities*
***Source**: developed by the author based on research [8]*

Public space is another innovative tool for the participation of community residents in the decision-making process. Public space is a component of the space within the settlements that are part of the community [26]. Public space can be created to provide opportunities for recreation, realization of communicative potential, satisfaction of social and public needs, sustainable and harmonious development of community territories.

The issue of effective participation and cooperation of civil society in authorities became the subject of scientific research by V.M. Semyanovsky [27]. The study emphasizes the need to reform the system of cooperation between authorities and citizens in Ukraine based on the use of European experience. The author emphasizes that Ukrainian legislation, together with international obligations and standards, lays a reliable legal basis for the wide participation of civil society not only in symbolic events, but also in defining the agenda, making decisions and drawing conclusions about events. We support the opinion of the author and are convinced that only a system of joint decision-making and implementation can guarantee continuous and effective feedback between people and the authorities. And scientists emphasize that in order to discover what attracts civic behavior, it is worth finding out how state support can promote active citizenship and contribute to the creation of an undeveloped civil society.

The work of L.S. Doskich [28]. The author justified the need to activate civil society institutions at the level of territorial communities and revealed the relationship between the effectiveness of the processes of local political activity and public participation. We are convinced that, at the same time, it is important to constantly search for new forms and practices of communication, which are built on the basis of the specifics of the development of individual territories, the formation of a culture of dialogue and many other factors. We believe that innovative mechanisms of public participation will contribute to the formation of an active civil society and increase the level of civic education. The authors [29] are of the same opinion. In their research, the authors [30] state that at the local level around the world, governments, communities and other organizational partners are experimenting with different approaches to increase public participation and influence on decision-making and action at the regional, city and/or district levels.

In the course of the conducted research, it was established that the tools of e-democracy are being implemented the most. The same conclusions were made in the studies of I.R. Tymechko [31]. At the same time, the author revealed a low level of activity in the creation of self-organization bodies and the use of public control tools, at the same time it was noted that in the processes of solving the tasks of the development of territorial communities of the Carpathian region, there are active public and charitable organizations that contribute to the active involvement of additional financial resources.

The implementation of a participatory budget allows for an increase in the activity and involvement of the public in public participation in the decision-making process regarding the distribution of financial resources in local budgets [32]. Authors of a similar opinion [33], who proposed the main components that should be included in the process of participatory budgeting, the purpose of which is to promote the establishment of social dialogue between local authorities and residents of the territorial community and create conditions for the participation of residents of the territorial community in budget processes to meet their needs. We believe that participatory budgeting makes it possible to meet the urgent needs of the community in a relatively short period of time, stimulates economic development at the local level, and improves relations between institutions and representatives of both civil society and the government. This tool of direct democracy is more helpful for the socially protected majority to care for vulnerable minorities, such as the disabled, the unemployed, the internally displaced, the elderly, the homeless, and orphans.

Research by O.V. Ivanin [34] emphasize that despite the spread and availability of various forms of public participation and the opportunity for citizens to join the decision-making process on issues of social and economic development of the community, the direct participation of residents remains at a low level. There is a small part of active citizens or even civil society organizations that participate in communication with local self-government bodies, but such participation can hardly be called effective and one that expresses the opinion of the entire community.

Investigating the opinion of respondents about why citizens do not participate in public decision-making, it was observed that disappointment in self-governance prevails, citizens also do not trust their knowledge, and 66% of respondents believe that most citizens do not have information about planning processes. Some respondents also chose answers that indicate a lack of personal interest and believe that the population is not interested in this. Only 5% of respondents believe that citizens do not take part in public decision-making because they trust the decisions of council members. In turn, the study [35] indicates that the dominant or indecisive attitude of local

government officials and the emphasis on rules and expert knowledge can hinder the authentic participation of citizens in the decision-making process. Scientists [36] in the course of the conducted research conclude that the majority of respondents are sincerely interested in increasing objectivity and representation through citizens' dialogue.

Public participation in the context of the management of local self-government bodies allows taking into account social, environmental and other factors in the activity, reduces risks due to the joint implementation of management decisions taking into account the interests of certain social groups in them, as well as their involvement in the process of making management decisions. Scientists [37] have a similar position, who claim that urban development initiatives affect the everyday life of citizens, so citizens often participate in these processes themselves. The same opinion is supported by the authors [38] and they believe that, on the one hand, citizens should be aware and informed about the possibility of their participation in local affairs, decision-making regarding local development, and on the other hand, there should be a desire of local authorities to listen, take into account and adequately respond to the opinion of citizens. Indeed, in the course of our sociological research, it was established that more than half of the respondents believe that the TG should not only inform the public about ways and opportunities to participate in public decision-making, but also give advice and take more into account the needs and wishes of society before making decisions. We are convinced that only under such conditions, the involvement of citizens in solving local self-government issues will be mutually beneficial both for the residents of the respective territory and for the local self-government body.

CONCLUSIONS

Forms of public participation and their regulation by domestic legislation are defined. It is substantiated that the most popular way of communication between citizens and representatives of the authorities is the tools of electronic democracy.

The expediency of using the participatory budgeting mechanism for territorial communities is substantiated, which will contribute to establishing a social dialogue between community leaders and members during decision-making, creating conditions for the participation of residents of the territorial community in the formation of the budget to meet their needs.

A sociological survey was conducted to identify the realities of citizen involvement in the decision-making process at the territorial community level. As a result, it was observed that the respondents are equally concerned about urban and personal problems of planning the socio-economic development of the territory, but they more often discuss these problems with their friends and acquaintances and use social networks than participate in project presentations or interviews with government officials. Thus, to support public participation at all stages of the management process, it is worth using innovative tools and mechanisms.

Innovative mechanisms of public participation (consensus conference, consultative survey, guided visualization, world cafe, workshop, imagination, public development of alternatives) are proposed, which will contribute to the formation of an active civil society and increase the level of civic education. Public space is another innovative tool for the participation of community residents in the decision-making process. The formulated author's conclusions and recommendations are characterized by a positive impact on the involvement of the public in the decision-making process, since the creation of a higher culture of decision-making and the activation of civil society at the level of the territorial community can contribute to receiving better services and improving the quality of life of the population. Further study of the forms of public participation in the decision-making process at the level of territorial communities necessitates a study of the degree of awareness of the population regarding the possibilities of such participation and the desire of local authorities to listen to the opinion of citizens, respond adequately to it, which will be mutually beneficial for all parties.

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Участь громадськості в процесі прийняття рішень на рівні територіальних громад

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Анотація. Метою статті є узагальнення теоретичних основ та обґрунтування доцільності застосування інноваційних інструментів залучення громадян до процесу прийняття рішень на рівні територіальних громад, поширення практик бюджету участі, що сприятиме формуванню активного громадянського суспільства. Для реалізації поставлених завдань використовувалися такі методи: абстрактно-логічний; монографічний та порівняльний; графічний; метод соціологічного опитування. Обґрунтовано доцільність використання механізму партиципаторного бюджетування для територіальних громад, що сприятиме налагодженню соціального діалогу між органами місцевого самоврядування та мешканцями територіальної громади. Проведене соціологічне опитування щодо виявлення реалій активізації залучення громадськості до процесу прийняття рішень на рівні територіальної громади. Виявлено, що респондентів однаково хвилюють міські та особисті проблеми планування соціально-економічного розвитку території. Запропоновані інноваційні механізми громадської участі (консенсусна конференція, консультативне опитування, керована візуалізація, світове кафе, воркшоп, уяви, громадська розробка альтернатив), що сприятиме формуванню активного громадянського суспільства, підвищенню рівня громадянської освіти. Ще одним інноваційним інструментом участі жителів громади в процесі прийняття рішень є громадський простір. Проведене дослідження сприяло розв'язанню поставленого завдання та обґрунтуванню доцільності застосування інноваційних інструментів участі громадськості в процесі прийняття рішень, поширенню практик бюджету участі, що сприятиме формуванню активного громадянського суспільства. Сформульовані авторські висновки та рекомендації характеризуються позитивним впливом на залучення громадськості до процесу прийняття рішень, оскільки створення вищої культури прийняття рішень та активізація громадянського суспільства на рівні територіальної громади може сприяти отримуванню якісніших послуг та покращенню якості життя населення

Ключові слова: місцеве самоврядування, громадянське суспільство, бюджет участі, звернення громадян, громадські слухання

UDC 621.6.031:631.15
DOI: 10.56407/2313-092X/2022-26(3)-3

Ukrainian Black Sea Region Agrarian Science
Vol. 26, No. 3

Determination of the parameters of the use of water-lifting equipment in the conditions of livestock farms

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Abstract. The main task of water supply systems is to expand the technological capabilities of the water supply process, increase its reliability, reduce its capital and operating costs, and simplify design. The purpose of the article is to determine the optimal parameters for the use of the proposed constructive solution of water-lifting equipment in the conditions of livestock farms. The research was conducted in laboratory conditions with further use of mathematical statistics methods. The criteria for optimizing the use of the proposed design of water-lifting equipment in the conditions of livestock farms include the amount of water flow and the speed of the flow. The article establishes the most optimal structural and technological parameters of water-lifting equipment, namely: head height; volume of transit tanks; pipeline diameter; pipeline length. The principle of operation of the proposed constructive solution of water lifting equipment for use in livestock farms is based on increasing the necessary pressure for the water supply network by direct repeated use of gravity forces in the form of the weight of the liquid column from natural or artificial pressure. The ratio of criteria for optimizing the process of using water-lifting equipment in the conditions of livestock farms and optimal structural and technological parameters of the proposed solution was determined. The use of technology in compliance with the recommended structural and technological parameters will solve the problem of improving the quality of water supply to consumers in the conditions of livestock farms, reducing energy consumption during the operation of the water supply system and maintaining the necessary pressure in the water supply network

Keywords: farm mechanization, farms, evaluation of the quality of the technological process, animal husbandry, structural and technological parameters

INTRODUCTION

One of the most important problems in livestock farms is the creation of a modern water supply system. Water supply systems are complex engineering structures that provide both water supply to consumers and drainage and wastewater treatment. The use of water supply systems requires a lot of energy, so the creation of systems that will contribute to energy saving is necessary for the development of the industry in the country.

If an effective water supply system is used, the productivity of livestock farms increases. Water consumption on dairy and fattening farms can reach several thousand cubic meters. To create operational water supplies, water towers are used, the filling of which requires significant energy costs.

Thus, the task of water supply systems is to expand the technological capabilities of the water supply process, increase its reliability, reduce its capital and operating costs, and simplify design. Therefore, it is proposed to carry out the process of increasing the pressure by gravity in the form of the weight of a liquid column of the required height by implementing a system of gravity water lifting equipment, which provides

Article's History:
Received: 01.05.2022
Revised: 21.07.2022
Accepted: 26.08.2022

Suggested Citation:
Babenko, B., Dotsenko, N., Batsurovska, I., & Gorbenko, O. (2022). Determination of the parameters of the use of water-lifting equipment in the conditions of livestock farms. *Ukrainian Black Sea Region Agrarian Science*, 26(3), 32-46.

an automatic process of reusing the pressure that exists in the water supply system of livestock farms.

The given data demonstrate a tendency to reduce livestock in livestock farms of Ukraine [1]. Researcher O. Zakharchenko analyzed the quantitative composition and dynamics of livestock and poultry and, taking this into account, calculated the volume of technical water used in livestock and poultry farming [2]. As the cost of energy continues to rise, the development of more efficient equipment will contribute to energy conservation [3]. The functioning of cattle fattening farms is based on the compliance of the technical characteristics of livestock facilities with modern requirements and the efficiency of production [4]. During the development of technical solutions for cattle fattening farms, key aspects of EU regulatory requirements should be taken into account [5].

Let's consider the points of view of foreign researchers on the investigated problem. M. Ali identified opportunities to reduce the energy consumption of the pumping system by means of intelligent design, modernization and operation [6]. The authors P. Rajkova & Z. Kubik analyzed the relationship between farm mechanization and the need for labor, increasing the level of farm mechanization reduces the demand for hired labor [7]. The authors Y. Zhang *et al*. determined that the suction of coarse solid particles in a hydraulic collector is effective in the context of working with particles of different densities [8]. The article by J. Qian *et al*. presents a comprehensive review of the progress made in recent years on cavitation in valves, including check valves [9]. The article by R. Aryal *et al*. presents a semi-analytical model that facilitates the optimal design of small hydropower systems so that the maximum possible energy can be collected under conditions of low head and flow in channel conditions [10]. E. Katsuno cites several practical applications in fluid mechanics aimed at reducing energy dissipation by reducing resistance or pressure drop [11]. However, when adapting and applying energy benchmarking methodologies elsewhere, site-specific factors such as different discharge conditions, topographic boundary conditions, volume and composition of wastewater must be considered and these factors must be taken into account by practitioners. during the assessment of energy comparative analysis [12].The development of water resources, especially hydropower, is an important source of renewable energy. In the work of F. Tian, this relationship was investigated using data on the construction of reservoirs, the use of hydropower and water [13]. Water engineering modeling tools and mathematical tools provide an information resource for practitioners who want to learn more about different water engineering methods and models and their practical applications and case studies [14].

The device for raising water [15], proposed by researchers Y.F. Samedov & E.S. Strelskyi is distinguished by the fact that the pipe for raising water in the upper part has an extended part, which is located at a height of 10 meters. A shut-off valve is placed in the lower part of the pipe for raising water, which is below the water level in the source of supply. The disadvantages of the device include the fact that the height of the water rise is limited, it is affected by the magnitude of the water level drop.

Also known is the device for raising and supplying water [16], proposed by the inventors D.G. Parmenova & G.G. Deligiosis. It is equipped with an additional pipeline with a pump. A siphon line contains a gate valve that is installed at its discharge end before the reservoir or power supply being filled. The siphon pipeline is connected to an additional valve with a filling tank. But the design dimensions of the device limit the length of the water transportation path.

The authors investigated separate agricultural production [17] and mathematical modeling of the technology of processing agricultural products [18], but determining the efficiency of using water-lifting equipment in the conditions of livestock farms was not a special subject of research.

The analysis of literary and patent information sources devoted to the problem of using water-lifting equipment in the conditions of livestock farms makes it possible to conclude that:

- the lack of modern water-lifting equipment in the conditions of livestock farms does not allow to fully realize the possibility of providing them with easy-to-use and energy-efficient systems;
- the study of known solutions of equipment for raising water, makes it possible to conclude that the functioning of the system becomes possible only under the condition of creating a constant necessary pressure of water in the supply pipeline;
- in literary sources, there is a limited number of technically justified constructive solutions of water supply systems for the consumer in conditions of insufficient pressure from the water supply source.

Thus, the task of water supply systems for livestock farms is to expand the technological capabilities of the water supply process, increase its reliability, reduce its capital and operating costs, and simplify construction.

To solve it, it is proposed to implement a constructive solution of water-lifting equipment in the

conditions of livestock farms, equipped with a device that provides an automatic process of multiple use of the pressure that exists in the system for supplying water to the consumer.

The task of the constructive solution proposed by the authors is to increase the efficiency by reducing the energy consumption of water supply systems, ensuring optimal pressure in the water supply network and improving the quality of water supply to consumers.

The purpose of the article is to determine the parameters of using the proposed constructive solution of water-lifting equipment in the conditions of livestock farms, to conduct experimental studies and to prove the effectiveness of the use of similar devices in the conditions of agriculture.

MATERIALS AND METHODS

The methods of physics, hydraulics, analysis and modeling were used to solve the research tasks. The methods of physics and hydraulics were used to study the patterns of fluid movement using the balance equation of the specific energy of the moving fluid in the pipe. The process of raising water using the proposed constructive solution of water-raising equipment in the conditions of livestock farms is based on the use of three laws in one process: the basic law of hydrostatics, the Boyle-Marriott law of gas dynamics and the law of connected vessels with liquid. Hydraulic dependencies were used to determine the required volume of water consumption and the speed of movement of the liquid flow. In the case of the proposed constructive solution of water-lifting equipment in the conditions of livestock farms, the law of fluid movement in the gap from one transit container to another is considered. For this purpose, the regularity of fluid movement is considered using the balance equation of the specific energy of the moving fluid in the pipe (D. Bernoulli's equation). For the sudden expansion of the pipeline, when a pipeline with a smaller diameter passes into a pipeline with a larger diameter, the head loss during a sudden expansion of the pipeline was determined by Borda's formula. Based on these dependencies, the area of the pipeline diameter is theoretically determined.

Reference literature for process and plant engineers [19], water treatment plant operators, and environmental consultants [20] was used in the design of the laboratory plant. An analysis of the main technical achievements in the design of water-lifting devices with an emphasis on modern hydraulic engineering technologies was also performed [21].

The study of technological parameters of water-lifting equipment was carried out in laboratory conditions by methods of mathematical statistics [22] with data processing on a PC. Experimental studies of water lifting by water-lifting equipment were carried out on a specially designed installation. The program of experimental research involves checking the structural scheme of water-lifting equipment in the conditions of livestock farms, determining the quality indicators of the technological process (height of the liquid column; volume of transit tanks; pipe diameter; pipe length) according to the following optimization criteria: volume of water consumption, speed of flow. Optimization of structural and technological parameters was carried out using a full factorial experiment.

- factors that least affect the technological process were equaled to zero, and the number of significant factors should not exceed two; otherwise, the study of the response surface on a two-dimensional plane is impossible;

- taking the derivatives of each of the two remaining factors, the center of the response surface was located, where the value of the optimization criterion was determined; in the case of the absence of the center or its location outside the experimental zone, the center was placed in the zone of the optimal combination of factors;

- the regression equation was reduced to the canonical form, after which contour curves of two-dimensional intersections were constructed;

- alternately equating the factors to zero, leaving any two others not equal to zero, we get the regression equation for the volume of water consumption and the speed of the flow.

RESULTS AND DISCUSSION

Theoretical justification of the application of the proposed constructive solution of water-lifting equipment in the conditions of livestock farms

The process of raising water in the proposed constructive solution of water lifting equipment in the conditions of livestock farms is based on the use of three laws in one process: the basic law of hydrostatics, the Boyle-Marriott law of gas dynamics and the law of connected vessels with liquid [23]. It was this set of laws that made it possible to create a system of the proposed constructive solution of water-lifting equipment in the conditions of livestock farms. At the same time, the force of gravitational action appears in the form of the weight of a column of liquid, which is equal to the pressure, that is, the force of gravitational action F is equal to:

$$F = \frac{m_1 M_2}{r^2} \gamma_{\text{cgr.const}}, \quad (1)$$

where, m_1 is the weight of the liquid column, kg; M_2 – weight of land, kg; r – is the distance between the centers of gravity, m; $\gamma_{gr.const}$ is the gravitational constant.

The basic equation of hydrostatics establishes a relationship between the hydrostatic pressure at a point of the liquid, its location (coordinates) in the liquid, and the density of the latter. It is an equation of an applied nature, with its help in engineering practice the hydrostatic pressure at any point of the liquid is found.

To substantiate the basic equation of hydrostatics, consider the case when a liquid in a state of equilibrium is in a vessel and only the force of gravity acts on it. In this case, the projections of mass forces on the axis of coordinates, related to a unit of weight, will be equal to:

$$x = 0, y = 0, F_z = -g. \quad (2)$$

Let's substitute the value of the projections into the equation $dp=\rho(F_x\,dx+F_y\,dy+F_z\,dz)$, we will get the dependence:

$$dp = -\rho g dz. \quad (3)$$

By integrating this equation with the condition that and that $\rho=const$ within the volume of the liquid under consideration, the change in the acceleration of free fall can be neglected, i.e. $g=const$, we get:

$$p = -\rho g z + c, \quad (4)$$

where c is an arbitrary constant.

Dividing equation (4) by ρg, we get:

$$z + \frac{p}{(\rho g)} = const. \quad (5)$$

Dividing equation (4) by ρ, we get:

$$gz + \frac{p}{\rho} = const. \quad (6)$$

Note that the terms of equation (5) are assigned to a unit of weight, and (6) to a unit of mass. Boundary conditions on the surface of the liquid are known: $z=z_0$, $p=p_0$, and, then:

$$c = z_0 + \frac{p_0}{(\rho g)}. \quad (7)$$

Substituting this expression for constant integration into formula (4), we get:

$$\frac{z_0+p_0}{(\rho g)} = \frac{z+p}{(\rho g)}. \quad (8)$$

Equation (8) is called the basic equation of hydrostatics.

It follows from equation (8):

$$p = p_0 + \rho g(z_0 - z), \quad (9)$$

that is, that the pressure in the liquid, which is in a state of equilibrium, is greater than the pressure on the surface by an amount equal to the weight of the column of liquid above this point. Since $z_0-z=h$, formula (9) will take the form:

$$p_{\text{abs}} = p_0 + \rho g h, \quad (10)$$

where p_{abs} is the absolute pressure at the point; p_0 – pressure on the free surface; h – is the immersion depth of the point in the liquid; ρ – water density; g – the acceleration of free fall.

Equation (10) is called the basic equation of hydrostatics for absolute pressure.

Thus, according to equation (10), the pressure at the point of the liquid, which is in a state of equilibrium at a depth h below the free surface, is equal to the sum of the pressure on the free surface p_0 (in open vessels it is equal to the atmospheric pressure) and the pressure due to the weight of the liquid column, located above the point, i.e. ρgh.

In open vessels, usually only the pressure ρgh is taken into account, and the atmospheric pressure is mutually balanced, and equation (10) will take the form:

$$p = \rho g h. \quad (11)$$

Equation (11) is the basic equation of hydrostatics for excess pressure. Thus, excess pressure at any point inside the liquid arises only from the weight of its column located above the point.

Given that $p_{abs}=p_a+p$, from where $p=p_{abs}-p_a$, and taking into account equation (10), we get:

$$p = p_0 + \rho g h - p_a = (p_0 - p_a) + \rho g h = \Delta p + \rho g h, \quad (12)$$

where $\Delta p=p_0-p_a$.

Thus, in this case, as well as for the proposed design solution of water-lifting equipment in the conditions of livestock farms, the excess pressure at any point of the liquid is created both by the weight of the liquid column and by the excess pressure on the free surface, the value of which is Δp.

According to the Boyle-Marriott law:

$$PV = const, \quad (13)$$

where P is the air pressure in the specified volume V, the conditions for obtaining the required degree of atmospheric air compression in the hermetic volume of the basic capacity of the proposed structural solution of the water-lifting equipment in the conditions of livestock farms (compressor) have been created.

The third law of the process of raising water in the proposed constructive solution of water lifting equipment in the conditions of livestock farms is the law of connected vessels with liquid, which provides a justification for the balance of liquids in connected vessels.

As you know, connected vessels are called vessels that are connected to each other by hydraulic lines or structural elements. Consider a system consisting of two connected vessels filled with two different liquids that do not mix, and pressures p_1 and p_2, which are not the same, act on the free surface of the liquid.

The specific gravity of liquids is also different - in the first vessel γ_1, and in the second γ_2.

Let's take the comparison area 0-0 at the level of the liquid interfaces, then the positions of the free liquid surfaces in the vessels relative to it will be h_1 and h_2.

According to the basic equation of hydrostatics, the pressure at any point of the liquid at the level of the plane of comparison in the first vessel will be $p=p_1+\gamma_1 h_1$, and in the second – $p=p_2+\gamma_2 h_2$. Since the system (liquid) is in equilibrium, these pressures will be the same, i.e

$$p_1 + \gamma_1 h_1 = p_2 + \gamma_2 h_2. \quad (14)$$

In the case of the proposed constructive solution of water-lifting equipment in the conditions of livestock farms, we are interested in the supply of liquid to a higher level. And for this, you need to consider the law of fluid movement in the gap from one transit container to another. For this purpose, the regularity of fluid movement is considered using the balance equation of the specific energy of the moving fluid in the pipe (D. Bernoulli's equation), so it is necessary to turn to the methods of physics and hydraulics. Solving the issue of moving flow in pipes, between transit containers, we determine, using known hydraulic dependencies, the amount of water consumed by the consumer and the speed of movement of the liquid flow. According to the theorem of mechanics, here we consider the equation about the change in the kinetic energy of a moving body, in which its difference is equal to the sum of the work of all forces acting on the moving body during this movement. At the same time, the equation for an ideal liquid is written as follows:

$$z + \frac{p}{\rho g} + \frac{U^2}{2g} = const, \quad (15)$$

where z is the specific energy of the liquid position; $\frac{p}{\rho g} = \frac{p}{\gamma}$ – specific pressure energy; $\frac{U^2}{2g}$ is the specific kinetic energy of a moving liquid.

So, let's apply the above equations to the proposed constructive solution of water lifting equipment in the conditions of livestock farms. To do this, let's consider a simple mathematical model in the form of a system consisting of the first and second transit containers, with a lower cross-section of 1-1 and a higher cross-section of 2-2.

For sections 1-1 and 2-2, apply the Bernoulli equation and get:

$$H_1 + \frac{P_1}{\gamma} + \frac{U_1^2}{2g} = H_2 + \frac{P_2}{\gamma} + \frac{U_2^2}{2g} + h_w, \quad (16)$$

where H_1=0 – pressure in section 1-1; H_2=H_1– pressure in section 2-2; since the distance between the transit containers is small, it can be neglected: H_1–H_2=0;$\frac{P_1}{\gamma} - \frac{P_2}{\gamma} = 0$. Since P_1=P_2=P_{atm}; $\frac{U_1^2}{2g} = 0$ is the specific kinetic energy in the section 1-1, since; U_1=0; $\frac{U_2^2}{2g} = \frac{U^2}{2g} = H_{distr}$ – pressure; h_w=h_l+$h_м$ – total head loss; h_l – head losses along the length; $h_м$ – local head losses. Then the liquid pressure in the pipeline between the transit containers will be found according to the formula:

$$H_{distr} = \frac{U^2}{2g} + h_w, \quad (17)$$

where, according to Bord's formula $h_w = \xi_w \cdot \frac{U^2}{2g}$ – pressure loss; ξ_w – drag coefficient of the system,

$$\xi_w = \xi_{in} + \xi_{out} + \lambda \frac{l}{d}, \quad (18)$$

here ξ_{in} is the input resistance coefficient; ξ_{out} – output resistance coefficient; $\lambda \frac{l}{d}$ – head loss along the length of the pipeline, where λ – coefficient of hydraulic friction

of the pipe; l – pipe length; d – pipe diameter. U is the average speed of fluid movement in the cross-section according to the local resistance.

Thus, for a sudden expansion of the pipeline, when a pipeline with a smaller diameter passes into a pipeline with a larger diameter, the head loss during a sudden expansion of the pipeline is determined by Bord's formula:

$$h_{se} = \frac{(U_1 - U_2)^2}{2g}, \quad (19)$$

where U_1 and U_2 are the average speeds of fluid movement in sections 1-1 and 2-2, respectively.

Let's find the coefficient of local resistance due to average speeds U_1 or U_2.

Taking into account the equation of flow continuity $U_1\omega_1$=$U_2\omega_2$, the head losses depending on the velocities are equal to:

$$h_{se1} = \left(1 - \frac{\omega_1}{\omega_2}\right)^2 \cdot \frac{U_1^2}{2g}; \quad h_{se2} = \left(\frac{\omega_2}{\omega_1} - 1\right)^2 \cdot \frac{U_2^2}{2g}. \quad (20)$$

Whence the coefficients of local resistance are equal to:

$$\xi_{se1} = \left(1 - \frac{\omega_1}{\omega_2}\right)^2; \quad \xi_{se2} = \left(\frac{\omega_2}{\omega_1} - 1\right)^2. \quad (21)$$

So for a sudden narrowing of the pipeline, while the pipeline with a larger diameter passes into a pipeline with a smaller diameter.

The coefficient of local resistance at $d_2 \lhd 0.5d_1$ is found by the formula:

$$\xi_{sn} = 0.5\left(1 - \frac{d_2^2}{d_1^2}\right). \quad (22)$$

The case of entering the pipe from the tank is similar to a sudden narrowing, and therefore formula (22) can be applied here d_2<<d_1 and at d_2≈0, ξ_{BX}=0.5.

Then the Bernoulli equation will take the form:

$$H_{distr} = \frac{U^2}{2g} \cdot (1 + \xi_w). \quad (23)$$

Solving this equation with respect to speed, we get:

$$U = \frac{1}{\sqrt{1+\xi_w}} \cdot \sqrt{2g \cdot H_{distr}}, \quad (24)$$

where $\frac{1}{\sqrt{1+\xi_w}} = \phi$ – is the speed coefficient (for pipes ϕ=μ=0.61).

Therefore, the equation for the speed will take the form:

$$U = \phi \cdot \sqrt{2g \cdot H_{distr}}. \quad (25)$$

Then from the continuity equation

$$U_1 \cdot \omega_1 = U_2 \cdot \omega_2 = Q = const; \quad (26)$$

We find the difference –

$$Q = U \cdot \omega. \quad (27)$$

Substituting Q into the value U we have:

$$Q = 0.61 \cdot \omega \cdot \sqrt{2g \cdot H_{distr}}, \quad (28)$$

where ω – is the cross-sectional area of the pipe.

The obtained equations are also used for all subsequent transit capacities of the gravity water lift system. As a result of the theoretical analysis of the process of raising water with the help of the proposed constructive solution of water lifting equipment in the conditions of livestock farms, it was substantiated that the process of raising water is based on the use of three laws in one process: the basic law of hydrostatics, the Boyle-Marriott law of gas dynamics and the law of connected vessels with liquid It was also established that the main optimization criteria used to assess the quality of the technological process were: the volume of water consumption and the speed of the liquid flow.

The principle of operation of the proposed constructive solution of water-lifting equipment in the conditions of livestock farms

The principle of operation of water-lifting equipment in the conditions of animal farms is based on increasing the necessary pressure for the water supply network due to the use of a column of liquid from the pressure, created naturally or artificially, using the forces of gravity. Artificial pressure can be obtained as a result of the use of a water supply network, which needs to meet the needs of consumers, while natural pressure is obtained due to the use of water column differences in reservoirs.

To explain the principle of operation of water-lifting equipment in the conditions of livestock farms, a drawing is attached (Fig. 1).

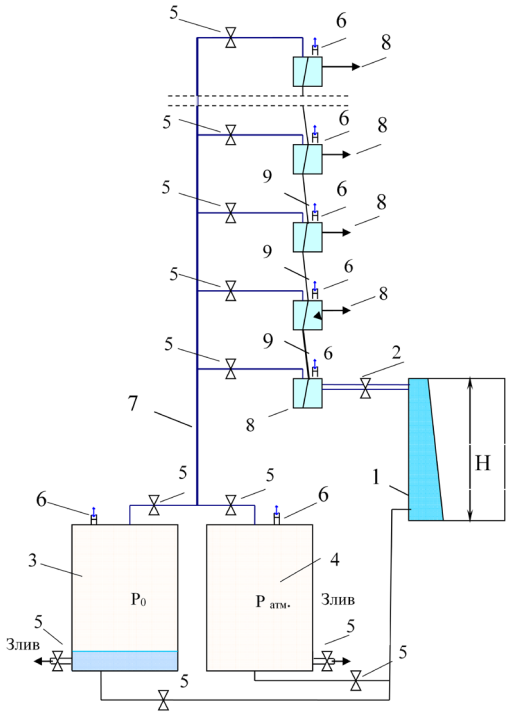

Figure 1. *Scheme of water-lifting equipment in the conditions of livestock farms*

Note: *1-pressure tank, 2-tap for filling the transit container with water, 3-base container right, 4-base container left, 5-ball or screw valve, 6-valve for pressurization or depressurization, 7-pipeline of compressed atmospheric air, 8-transit tanks, 9-pressure lines*

Source: *submitted by the author*

The process of operation of water-lifting equipment in the conditions of livestock farms in technological processes of agricultural production is carried out as follows. Through the tap to fill the transit tank 2 with water, the transit tank 8 is filled with water from the pressure tank 1 and sealed with the sealing or depressurizing valve 6. At the same time, the right base tank 3 is sealed and filled with water through the ball or screw valve 5, creating in it, the pressure of compressed air $P_0=P_{atm}+\gamma h$, where γ is the specific volumetric weight of water, and h is the height of the water column of the pressure H. Then, through the ball or screw valve 5, the compressed air from the right basic container 3 enters the pipeline of the compression atmospheric air 7, and then through the valve for sealing or depressurization 6 into the transit tank 8, from which water is pushed out by compressed air through the pressure line 9, into the transit tank 8 and fills it, and then the cycle of pushing water out of the transit tank 8 is repeated, i.e. after filling it with water, it is also sealed only with the help of a valve for sealing or depressurization 6. In n the process of filling and expelling water in the step-down transit tanks takes place according to the principle described above. At the same time, each passing capacity of the device for raising water, starting with the second one, ensures the amount of water pressure $H=\gamma h$ at a specific level of its elevation.

In order to ensure the stability and continuity of the supply of compressed air to the pipeline of compressed atmospheric air 7 of the device for raising water, the sequential and synchronous inclusion of two containers is provided: the right basic container 3 and the left basic container 4.

Thus, the process of increasing the pressure in water risers of this type can be implemented not only for the purpose of water supply, but also to use it for the purpose of obtaining ecologically clean and cheap energy due to the creation of high-pressure hydroelectric power plants of a wide range of capacities. Equipment for raising water of this type does not require the presence of a person due to the full automation of the process of increasing the gravitational pressure. The proposed equipment for lifting water can be widely used in the conditions of livestock farms, i.e. this branch of agriculture needs autonomy in the context of energy and water supply.

Mathematical model of the technological process of using the proposed constructive solution of water-lifting equipment in the conditions of livestock farms

The quality of the technological process of using the proposed constructive solution of water-lifting equipment in the conditions of livestock farms is evaluated by the amount of water consumption (*WC*) and the speed of the flow (*CRP*). These parameters (optimization criteria) depend on four main independent factors: the height of the liquid column – H, m (X_1); volume of transit tanks – V, m^3 (X_2); pipe diameter – d, m (X_3); pipe length – l, m (X_4). The independent factors listed above were chosen as the main ones in this technological process by conducting preliminary experiments and ranking them according to the degree of influence on the quality of work. The levels of setting independent variables (factors) and the range of their variation adopted during the experiments are shown in Table 1.

Table 1. *Levels and range of factor variation*

Factors	Variation levels			Variation interval	Dimensionality
	–1	0	+1		
X_1 (H)	3	6	9	3	m
X_2 (V)	2	4	6	2	m^3
X_3 (d)	0.02	0.04	0.06	0.02	m
X_4 (l)	3	6	9	3	m

Source: *calculated by the author based on the obtained experimental data*

The frequency of experiments for each of the optimization criteria was three times. For each line of the plan, the average value of *VCW, CRP* is calculated.

Mathematical models adequately describe the technological process of raising water in the conditions of livestock farms. Presented regression equations:

- by volume of consumption:

$$OSV = 12.5 + 0.58 \cdot X_1 + 5.4 \cdot X_2 + 2.1 \cdot X_3 - 2.6 \cdot X_4 + 0.63X_1 \cdot \cdot X_2 - 0.6X_1 \cdot X_3 - 1.3X_1 \cdot X_4 - 2.8X_2 \cdot \cdot X_3 - 1.06X_2 \cdot X_4 + 1.5 \cdot X_3 \cdot X_4 + 2.1 \cdot X_1^2 - 5.4 \cdot X_2^2 - 1X_3^2 + 1{,}8X_4^2; \quad (29)$$

- by speed of movement:

$$CRP = 0.83 - 0.025 \cdot X_1 - 0.017 \cdot X_2 + 0.020 \cdot X_3 - 0.011 \cdot X_4 - 0.012 \cdot X_1 \cdot X_2 + + 0.0056X_1 \cdot X_3 - 0.042X_1 \cdot X_4 + 0.048X_2 \cdot X_3 - 0.013X_2 \cdot X_4 + 0.0097 \cdot X_3 \cdot X_4 + 0.12 \cdot X_1^2 - -0.09 \cdot X_2^2 - -0.012 \cdot X_3^2 + 0.014 \cdot X_4^2. \quad (30)$$

Analysis of regression equations obtained after statistical processing is usually performed with coded values of factors [22]. The study of optimization criteria depending on the change of independent factors will be carried out by the method of two-dimensional intersections.

When replacing X_3=0 and X_4=0 the regression equations will have the form:

$$VCW = 12.5 + 0.58 \cdot X_1 + 5.4 \cdot X_2 + 0.63 \cdot X_1 \cdot X_2 + 2.1 \cdot X_1^2 - 5.4 \cdot X_2^2, \quad (31)$$

$$CRP = 0.83 - 0.025 \cdot X_1 - 0.017 \cdot X_2 - 0.012 \cdot X_1 \cdot X_2 + 0.12 \cdot X_1^2 - 0.09 \cdot X_2^2. \quad (32)$$

After calculations, the regression equation in the canonical form will take the form: for the volume of water consumption: $VCW - 17.218 = 2.183 \cdot X_1^2 - 5.493 \cdot X_2^2$; for the flow speed: $CRP - 0.8 = 0.119 \cdot X_1^2 - 0.093 \cdot X_2^2$.

The two-dimensional section of response surfaces is shown in Figure 2. Consistently fixing the other two factors at the level of 0 and performing calculations similar to the above, we obtain the regression equation in the usual form with a new combination of factors.

When substituting X_1=0 and X_2=0 the regression equation: for the volume of water consumption:

$$VCW = 12.5 + 2.1 \cdot X_3 - 2.6 \cdot X_4 + 1.5X_3 \cdot X_4 - 1X_3^2 + 1.8 \cdot X_4^2. \quad (33)$$

For the flow speed:

$$CRP = 0.83 + 0.020 \cdot X_3 - 0.011 \cdot X_4 - 0.0097 \cdot X_3 \cdot X_4 - 0.012 \cdot X_3^2 + 0.014X_4^2. \quad (34)$$

For the volume of water consumption: X_3=-1.23; X_4=0.27; for the flow speed: X_3= -1.153; X_4=0.795;

The regression equations in canonical form will have the form: for the volume of water consumption: $VCW-11.10=2.0032X_3^2-1.153\cdot X_4^2$; for the flow speed: $CRP-0.83=0.0179X_3^2+0.0805X_4^2$.

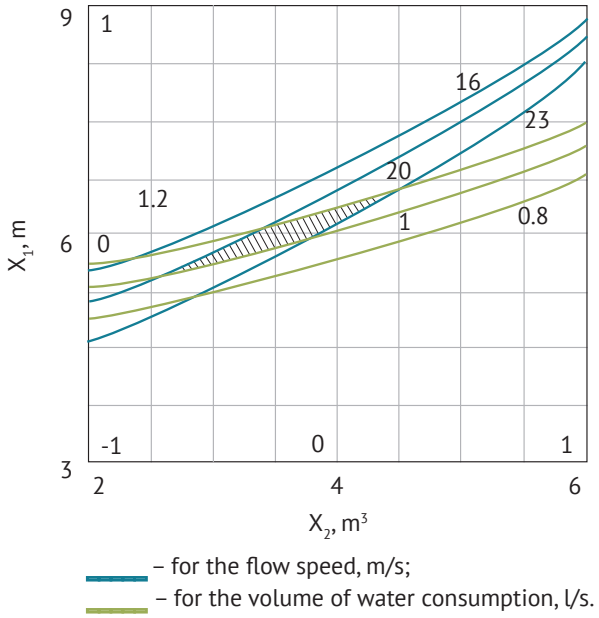

Figure 2. *Two-dimensional cross section of the response surfaces at X_3=0 and X_4=0.*
Source: *calculated and formed by the author using the data in Table 1*

After analyzing two-dimensional cross-sectional surfaces (Fig. 2), the following conclusions can be drawn. With an existing pressure value of 5.5-6.5 m and a volume of transit tanks of 3-4.5 m^3 the volume of water consumption will be within 20-23 l/s, and the speed of the flow will be 1-1.2 m/s (shaded area, Fig. 2).

When substituting X_2=0 and X_4=0, the regression equations have the form: for the volume of water consumption:

$$VCW = 12.5 + 0.58X_1 + 2.1X_3 - 0.6X_1 \cdot X_3 + 2.1X_1^2 - 1X_3^2. \quad (35)$$

For the flow speed:

$$CRP = 0.83 - 0.025X_1 + 0.020X_3 + 0.0056X_1 \cdot X_3 + 0.12X_1^2 - 0.012X_3^2 \quad (36)$$

In accordance: for the volume of water consumption: X_1=-0.427; X_3=-0.96; for flow speed: X_1=0.084; X_3=0.852; Regression equation in canonical form: for the volume of water consumption: VCW-12.5=2.2X_1^2–1.035X_3^2; for the flow speed: CRP-0.94=0.12X_1^2-0.0121X_3^2.

The two-dimensional section of response surfaces is shown in Figure 3.

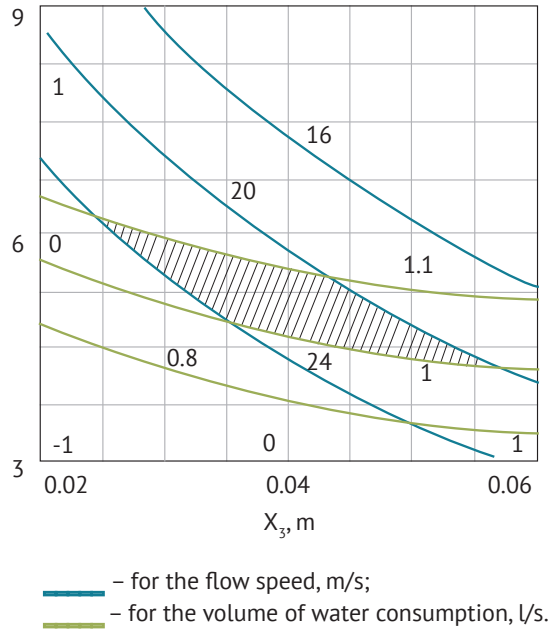

Figure 3. *Two-dimensional cross section of the response surfaces at X_2=0 and X_4=0*

Source: *calculated and formed by the author using the data in Table 1*

The diameter of the pipeline is 0.04 m, the length of the pipeline is 6 m. Moreover, with increasing pressure, the flow rate increases, and the speed also increases. And if the volume of transit tanks increases, the speed of the flow begins to increase, but the volume of water consumption decreases. With an existing pressure of 4.5-6 m and a pipeline diameter of 0.025-0.055 m, the volume of water consumption will be within 20-24 l/s, the flow speed will be 1.1 m/s. The volume of transit tanks will be 4 m^3, the length of the pipeline will be 6 m (shaded area, Fig. 3).

When substituting X_1=0 and X_3=0 the regression equations have the form: for the volume of water consumption:

$$VCW = 12.5 + 5.4X_2 - 2.6X_4 - 1.06X_2 \cdot X_4 - 5.4X_2^2 + 1.8X_4^2. \quad (37)$$

For the flow speed:

$$CRP = 0.83 - 0.017X_2 - 0.011X_4 - 0.013X_2 \cdot X_4 - 0.09X_2^2 + 0.014X_4^2. \quad (38)$$

In accordance: For the volume of water consumption: X_2=0.41; X_4=0.841; for the flow speed: X_2=-0.121; X_4=0.336; Regression equation in canonical form: for the volume of water consumption: $VCW-10.67=1.894X_2^2-5.51X_4^2$; for the flow speed: $CRP-0.709=0.0144X_2^2-0.0904X_4^2$.

X_2=0 and X_3=0 the regression equations have the form: for the volume of water consumption:

$$VCW = 12.5 + 0.58X_1 - 2.6X_4 - 1.3X_1 \cdot X_4 + 2.1X_1^2 + 1.8X_4^2; \quad (39)$$

for the flow speed:

$$CRP = 0.83 - 0.025X_1 - 0.011X_4 - 0.042X_1 \cdot X_4 + 0.12X_1^2 + 0.014X_4^2. \quad (40)$$

In accordance: for the volume of water consumption: X_1 = 0.098; X_4 = 0.757; for the flow speed: X_1=0.235; X_4=0.74;

Regression equation in canonical form: for the volume of water consumption: VCW–12.21=2.69X_1^2+1.32X_4^2; for the flow speed: CRP–0.87=0.12X_1^2+0.0099X_4^2.

When substituting X_1=0 and X_4=0 the regression equations have the form: for the volume of water consumption:

$$VCW = 12.5 + 5.4X_2 + 2.1X_3 - 2.8X_2 \cdot X_3 - 5.4X_2^2 - 1X_3^2 \quad (41)$$

For the flow speed:

$$CRP = 0.83 - 0.017X_2 + 0.020X_3 + 0.048X_2 \cdot X_3 - 0.09X_2^2 - 0.012X_3^2 \quad (42)$$

In accordance: for the volume of water consumption: X_2=1.225; X_3=-2.71; for the flow speed: X_2=0.273; X_3=1.38;

Regression equation in canonical form: for the volume of water consumption: VCW–12.86=-0,58X_2^2–5.89X_3^2; for the flow speed: CRP–0.78=-0.0052X_2^2–0.0968X_3^2.

The two-dimensional section of response surfaces is shown in Figure 4.

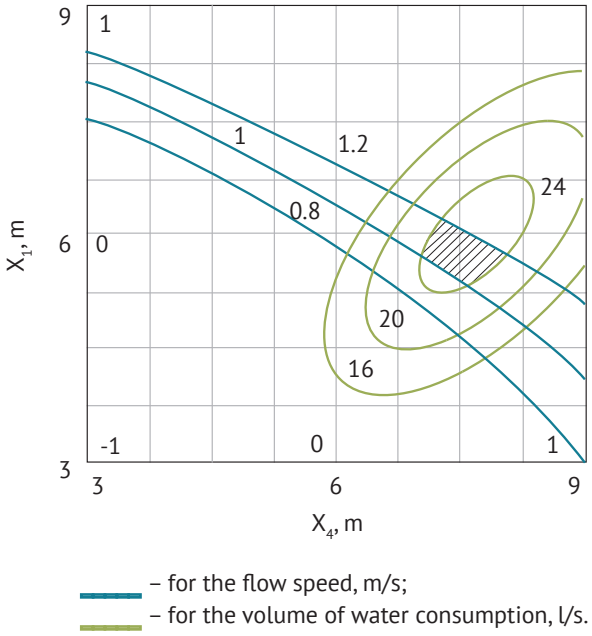

Figure 4. *Two-dimensional cross section of the response surfaces at X_2=0; X_3=0*

Source: *calculated and formed by the author using the data in Table 1*

With an existing pressure level of 6-6.5 m and a pipeline length of 7-8 m, the volume of water consumption will be 23-24 l/s with a flow speed of 1-1.2 m/s (shaded area, Fig. 4). At the same time, the diameter of the pipeline will be 0.04 m, and the volume of the transit tanks will be 4 m. But as the length of the pipeline increases, the volume of water flow and the speed of the flow decrease.

The optimal structural and technological parameters of water-lifting equipment can be considered: head height X_1=5… 6.5 m; volume of transit tanks X_2=4…4.5 m^3; pipeline diameter X_3=0.04…0.05 m; the length of the X_4 pipeline = 6…7 m. The optimization criteria are within the following limits: the volume of water consumption of the VCW=23-24 l/s; the speed of the flow of the CRP=1.1-1.2 m/s.

In the context of the discussion of the topic under investigation, it should be noted that water supply is one of the most important tasks in the field of animal husbandry. During the analysis of the current state of agricultural enterprises of the livestock profile in Ukraine, it was determined that one of the main development trends is the introduction of modernized equipment and modern technologies that save

resources and, accordingly, production costs [24]. The mechanization of animal husbandry and the use of separate technological lines or equipment is characterized by rather high complexity [25].

In the conditions of livestock farms, most technological operations require the use of water: watering of livestock, feed preparation, processing and further processing of milk, washing operations, etc. Surface sources can be used for water intake, namely: rivers, lakes, canals, other types of water bodies and groundwater. Water intake structures of the shore or channel type are used to take water from surface sources. If it is necessary to draw water from underground sources, mine or tube wells are used. In the case of water intake of the shore type, the following equipment is usually used: a water receiver, gravity pipes, a valve, a shore well, and a pumping station can be used. Mine wells are usually used for the purpose of taking water lying at a depth of 30-40 m. They include: a pipe for ventilation, a clay lock, a head, a mine, a part for receiving water, a filter or a sump [19]. A complex of elements for treatment, collection, delivery and distribution of water is combined into a water supply system, which can be gravity-fed or pressurized. Water supply systems of livestock enterprises in cases of pump shutdown in order to create the required pressure in the network use tower-type water-pressure structures designed by A.A. Rozhnovsky. Centrifugal or vane-type pumps are also used to raise and move water, but all of them require electricity consumption [26], which is minimized in the case of using the proposed constructive solution of water-lifting equipment in the conditions of livestock farms.

The application of modern approaches to the technological systems of water supply of livestock enterprises makes it necessary to introduce energy-efficient technical means for extracting, transporting, and delivering water to consumption points on farms and complexes. The use of pumping devices for water supply is effective, but at the same time energy-consuming, material-consuming and requires significant funds. Presented studies of the use of devices of this type and their modernization with the application of these measures can have a positive effect on the technical and economic indicators of water and heat supply equipment for buildings of the agro-industrial complex [27], but the use of a natural power source (rivers, lakes), as in the case of the proposed constructive solution was not considered. There are also known works related to water supply systems, the problems that exist in these systems, and the optimization of the operating modes of centralized water supply systems, which do not take into account the specifics of livestock farms with significant water consumption [28]. Solving the problem of water supply requires scientific and practical approaches in environmental, engineering, economic and other spheres [29]. Attention is paid to the use of domestic wastewater for the needs of technical water supply in order to reduce the intake of fresh water from natural reservoirs, which is a promising direction in reducing resources for water supply of livestock farms [30], as well as the use of energy-efficient equipment for raising water. Considering the fact that the known technical solutions for raising water in the conditions of livestock farms require significant energy consumption, they are also not always technological when increasing the pressure and maintaining it at the required level. Thus, there is a need to resolve the issue of improving the quality level of water supply for livestock enterprises, which can be implemented using the proposed constructive solution of water lifting equipment in the conditions of livestock farms. The process of increasing the pressure in water risers of this type can be implemented not only for the purpose of water supply, but also to use it to obtain sources of cheap, environmentally friendly energy. Such installations can be widely used in agriculture, namely in the conditions of livestock farms, which, like no other industry, needs autonomous water and energy supply. The implementation of installations of this type requires full automation of the process of increasing the gravitational pressure, which excludes the presence of a person.

However, modern achievements of science and technology, without a doubt, allow creating control systems equipped at a high technical level, including for the proposed constructive solution of water-lifting equipment in the conditions of livestock farms. And this, in turn, makes it possible to repeatedly use the same pressure drop in the same place of the flow of any water source. That is, in modern equipment for lifting the movement of water, the difference (pressure) performs the work only once, and in the proposed constructive solution this pressure can be used repeatedly, thereby increasing its value by the same number of times. Prospects for further investigations may be an increase in the volume of water consumption and research on the use of the proposed constructive solution in other enterprises of the agro-industrial complex.

CONCLUSIONS

A review of literary sources regarding the use of water lifting equipment made it possible to conclude that known structural and technical solutions in the field of water supply require significant costs in the process of operation and have a rather low coefficient of

effectiveness. Also, they do not always solve the issue of maintaining the required level and further increasing the pressure in the water supply network. Therefore, the issue of reducing energy consumption during the operation of the water supply system and improving the quality of water supply to consumers due to maintaining the necessary pressure in the water supply network by designing water lifting equipment in the conditions of livestock farms. The theoretical substantiation of the application of the proposed constructive solution of water-lifting equipment in the conditions of livestock farms has been carried out.

It was established that the main optimization criteria for assessing the quality of the technological process were: the amount of water consumption of the *WSW*=23-24 l/s and the speed of the flow of the *SRP*=1.1-1.2 m/s. On the basis of theoretical and experimental studies, it was established that these optimization criteria depend on four main independent factors: head height – H, m; volume of transit tanks – V, m; pipe diameter – d, m; the length of the pipe is l, m. The most advantageous structural and technological parameters of the water-lifting equipment are also established, namely: head height X_1=5-6.5 m; volume of transit tanks X_2=4-4.5 m; pipeline diameter X_3=0.04-0.05 m; pipeline length X_4=6-7 m.

On the basis of experimental studies of the process of raising water in laboratory conditions, a methodology for calculating and optimizing the structural and technological parameters of water-lifting equipment has been developed, which can be used during research and design work on the creation of a water-lifting equipment installation in the conditions of livestock farms in order to increase the pressure. The developed technology is expected to be implemented for water supply of agricultural facilities, including livestock farms.

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Визначення параметрів використання водопідйомного обладнання в умовах тваринницьких ферм

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Анотація. Основним завданням систем водопостачання є розширення технологічних можливостей процесу водопостачання, підвищення його надійності, зниження його капітальних і експлуатаційних витрат, спрощення проектування. Метою статті є визначення оптимальних параметрів використання запропонованого конструктивного рішення водопідйомного обладнання в умовах тваринницьких ферм. Дослідження проводилися в лабораторних умовах з подальшим використанням методів математичної статистики. До критеріїв оптимізації використання запропонованої конструкції водопідйомного обладнання в умовах тваринницьких ферм відносяться кількість витрати води та швидкість руху потоку. У статті встановлено найбільш оптимальні конструктивно-технологічні параметри водопідйомного обладнання, а саме: висота напору; об'єм транзитних резервуарів; діаметр трубопроводу; довжина трубопроводу. Принцип дії запропонованого конструктивного рішення водопідйомного обладнання для використання в умовах тваринницьких ферм заснований на підвищенні необхідного тиску для водопровідної мережі шляхом прямого багаторазового використання сил гравітації у вигляді ваги стовпа рідини від природного або штучного тиску. Визначено співвідношення критеріїв оптимізації процесу використання водопідйомного обладнання в умовах тваринницьких ферм та оптимальних конструктивно-технологічних параметрів запропонованого рішення. Використання технології із дотриманням рекомендованих конструктивно-технологічних параметрів вирішить проблему підвищення якості водопостачання споживачів в умовах тваринницьких ферм, зниження енерговитрат при роботі системи водопостачання та підтримання необхідного тиску у водопровідній мережі

Ключові слова: механізація господарств, ферми, оцінка якості технологічного процесу, тваринництво, конструктивно-технологічні параметри

UDC 631.46:631.8.022.3
DOI: 10.56407/2313-092X/2022-26(3)-4

Ukrainian Black Sea Region Agrarian Science
Vol. 26, No. 3

The influence of the stubble biodestroyer and the main tillage method on the nutrient regime of the soil

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Abstract. Annually, soil fertility indicators decrease in Ukraine. Therefore, to ensure a deficit-free soil balance, it is necessary to attract additional reserves of organic raw materials, in particular, post-harvest residues of agricultural crops, and to use biological preparations for their destructuring. To date, the effect of stubble biodestructors on the processes of mineralization of post-harvest plant residues has not yet been fully studied, especially under different methods of main tillage, therefore the purpose of our study was to determine the influence of the destructor Ecostern Classic and the method of main tillage on its nutritional regime in the conditions of southern Ukraine. Research methods: field, laboratory. Research has established that the amount of nitrates, mobile phosphorus and exchangeable potassium that remained on average over the years of research in the soil of the experimental site after harvesting winter wheat was 6.3, respectively; 47.5 and 208.8 mg/kg of soil, and after harvesting winter barley – 5.9; 42.8 and 202.4 mg/kg of soil. After partial mineralization of plant residues of winter crops, in three months, the content of nutrients in the soil increased, especially when treated with the Ecostern Classic biodestroyer. It was determined that the use of plowing contributed to the acceleration of the mineralization of plant residues of winter wheat and the greater accumulation of nutrients in the soil. Thus, during the treatment of post-harvest remains of winter wheat with a biodestructor using plowing, 11.3 mg/kg of soil nitrates, 53.9 mg/kg of soil of mobile phosphorus and 261.8 mg/kg of soil of exchangeable potassium were determined. For the processing of post-harvest remains of winter barley, the indicators were slightly lower – 10.5, respectively; 51.5 and 251.0 mg/kg of soil. The practical value of the research lies in the improvement of the processes associated with increasing the fertility of the soils of southern Ukraine due to the much more rational use of post-harvest remains of winter wheat and barley

Keywords: post-harvest residues, destructuring, plowing, tillage, soil fertility, nutrients

INTRODUCTION

Ukraine is one of the richest countries in the world, because it has highly fertile soils, in particular, it owns the largest share of the world fund of chernozems [1]. Soil is the main means of agricultural production, and therefore the success of the agricultural industry depends precisely on soil fertility [1]. However, in the conditions of modern agricultural production in Ukraine, there is an increase in anthropogenic influence on soils, their biological and humus state is changing. In this regard, it is becoming increasingly important to study the patterns of microbial, biochemical and chemical processes in soils depending on the applied fertilizers. The urgent need to restore natural ecosystems to maintain their biodiversity at levels that guarantee ecological stability poses new tasks for science to ensure urgent measures aimed at protecting the environment from pollution and destruction [2].

An ecologically safe factor for increasing fertility, improving the agrophysical properties of soils, and a source of organic matter are crushed and plowed into the soil post-harvest residues of agricultural crops, in particular cereals [3]. Plant residues of agricultural crops are the most important resource for the reproduction of organic matter and maintenance of the functional properties of the soil, and are a key component of the sustainable development of agricultural production [12]. They provide the soil with organic substances, which are transformed by microorganisms living in the soil. Therefore, it is common to apply straw as a biological fertilizer and energy material for soil formation [13]. Crop straw used to play a vital role in people's daily lives as well as in industry, with energy use and pulp and paper making being the most common methods. Previously, plant biomass was the most important source of energy in rural areas, accounting for more than 70% of total energy consumption [6]. Today, cereal straw is increasingly attracting attention as a globally available raw material that can be used for the production of biologically-based chemicals and fuels using various technical processes and ways of valorization [7; 8].

Article's History:
Received: 08.04.2022
Revised: 22.06.2022
Accepted: 26.08.2022

Suggested Citation:
Panfilova, A., & Byelov, Ya. (2022). The influence of the stubble biodestroyer and the main tillage method on the nutrient regime of the soil. *Ukrainian Black Sea Region Agrarian Science*, 26(3), 47-54.

Biochemical and fuel industry sustainability goals may lead to increased demand for cereal straw, which may negatively impact soil organic matter. Cereal straw is a common by-product of agriculture in the world and in Europe in particular. Currently, general restrictions on straw removal are applied in the EU in order to preserve soil organic matter [9]. But according to the assumptions of some scientists, compliance with restrictions on the removal of straw from the fields does not affect the content of organic matter in the soil [10; 11].

In Ukraine, wheat straw is one of the most common categories of agricultural waste, which is usually thrown away and burned every year, which creates environmental problems [12]. Research has established that plowing into the soil post-harvest residues of agricultural crops against the background of the use of modern biological preparations for their mineralization improves the nutrient regime of the soil, the work of beneficial soil microflora, which subsequently ensures an increase in the yield of agricultural crops [13]. To date, the effect of stubble biodestructors on the mineralization processes of post-harvest crop residues has not yet been fully studied, especially under different methods of main tillage, therefore the aim of the study was to determine the influence of the winter wheat stubble biodestructor and the method of tillage on the nutrient regime of the soil in the conditions of Southern Ukraine.

LITERATURE REVIEW

In modern agricultural production in the world, as noted by V. Sendetskyi, the priority for solving the problem of increasing soil fertility is the return of nutrients to the soil thanks to the plowing of plant residues and the use of biodestructors created on the basis of microorganisms that produce enzymes that decompose plant residues [14]. The author notes that their use contributes to the increase in the number and improvement of the life processes of beneficial microorganisms in the soil, as well as the suppression of pathogenic soil microflora. Simultaneously with the increase in fertility indicators, soil recovery is also observed [15]. E. Domaratskyi note that this is very relevant today, because it is soil fertility that determines the level of crop productivity and the ecological balance of the environment [16].

The nutrient regime of the soil is characterized by the content of macro- and microelements in it, it is one of the main factors affecting the yield of agricultural crops. According to V. Gamayunova's research, the higher the content of plant nutrients in the soil, the more fertile it is [1]. Soil fertility is determined by the amount of humus in it. Humus is an organic component of the soil, which is formed in the process of biological and chemical decomposition of the remains of animals and plants. The use of biodestructors accelerates these processes and accumulates nutrients in the soil. Scientists have proven that there is a dependence: the higher the percentage of humus in the soil, the more nutrients the plant receives and the higher the yield it forms [17].

According to researchers, modern farming conditions lead to a decrease in soil productivity due to the active use of nutrients from the soil and the lack of their replenishment, which leads to active soil degradation [18; 20]. It should be noted that a large proportion of nutrients is lost by the soil due to their accumulation and removal together with the marketable part of the harvest of agricultural crops, and without their compensation in the form of mineral fertilizers, modern bio- and restorative preparations, and crop residues, there is an increase in the deficiency of macro- and microelements in soil [19; 21]. That is why plowing into the soil post-harvest residues of agricultural crops, the use of modern biodestructors, as well as the study of the biological activity of soils is a crucial task at the current stage of the development of the agricultural sector. A deeper understanding of microbiological processes will reveal patterns of transformation of organic matter, consequences of anthropogenic impact on soils and ways to eliminate them. One of these measures is the use of biodestructors in modern agricultural technologies for effective decomposition of plant residues [22].

MATERIALS AND METHODS

Experimental research was conducted during 2019-2021 at the research field of the Educational-Scientific-Practical Center of Mykolaiv National Agrarian University. The farm is located in the third agro-climatic district, which is part of the Southern Steppe subzone of Ukraine. The climate of the area where the farm is located is temperate-continental, dry spells and droughts caused by low air humidity are often observed. The most characteristic feature of the area where the farm is located is a small amount of precipitation, which exceeds the moisture evaporation rate. Weather conditions during the years of research were typical for the area of the farm, but differed in terms of temperature and rainfall.

The soil of the experimental sites is represented by southern chernozem, residual-weakly saline heavy loam on loess. The reaction of the soil solution is neutral (pH – 6.8). The humus content in the 0-30 cm layer is 3.3%. Mobile forms of nutrients in the arable layer of the soil contain on average: nitrates (according to Grandval-Lyazh) – 18, mobile phosphorus (according to Machigin) – 49, exchangeable potassium (on a flame photometer) – 295 mg/kg of soil.

Research was conducted with wheat and barley of winter forms. The technology of growing crops in the experiment was generally accepted according to the existing zonal recommendations for the Southern Steppe of Ukraine. After harvesting winter wheat and winter barley, their post-harvest residues were processed with the Ecostern Classic stubble destructor in a dose of 2.0 liters of biological preparation with a consumption of 200 liters of working solution per 1 ha.

The following factors and options were studied in the experiment: Factor A is the method of basic soil cultivation: 1. Shelfless (chisel processing); 2. Plowing. Factor B – processing of post-harvest residues: 1. Water; 2. Ecostern Classic.

In the experiment, the biodestructor of stubble Ecostern Classic was used – it is a concentrated agent,

which includes fungi and bacteria that accelerate the decomposition of plant residues, in addition, the biological preparation contains antagonists of pathogenic microorganisms, living cells *of Bacillus subtilis, Paenibacillus, Azotobacter, Enterobacter, Enterococcus, Agrobacterium* and *fungi genus Trichoderma, in particular Trichoderma lignorum and Trichoderma viride*. The number of colony-forming units (CFU) is 3.5x109 per cm^3. The biopreparation is intended for the effective decomposition of plant residues, increasing the biological activity of the soil, improving it due to the introduction of useful microorganisms and, as a result, increasing the productivity of crops in crop rotation [22].

Research was conducted according to generally accepted methods. Thus, the content of nitrates in the soil was determined according to DSTU 4729:2007 with disulfophenolic acid according to the Grandval-Liajou method [23]. Nitrates with disulfophenolic acid form trinitrophenol, which in an alkaline environment forms ammonium trinitrophenolate of yellow color, the intensity of which color is proportional to the nitrogen content. By photometering the solution, the nitrate content in the soil was determined. Nitrates were extracted from the soil with water at a ratio of soil to water of 1:5. The content of mobile phosphorus and exchangeable potassium was determined by the modified Chirikov method according to DSTU 4115-2002 [24]. The method is based on the extraction of phosphorus and potassium from the soil with a 0.5 N solution of acetic acid at a ratio of soil: acid of 1:25 at a temperature of 18-20°C with subsequent determination of phosphorus on a photoelectrocolorimeter, and mobile potassium on a flame photometer. The soil was sampled after harvesting winter wheat and winter barley (before treatment with biopreparation) and three months after that.

RESULTS AND DISCUSSION

In recent years, the cultivation of agricultural crops in Ukraine has undergone excessive intensification, a lack of organic fertilizers, and the absence of leguminous crops in crop rotations, which contributes to an increase in the man-made load on the soil and its degradation. The most significant damage is caused by soil erosion, which covers up to 57.5% of the territory, soil pollution – up to 20%, and flooding – up to 12%. The consequence of excessive intensification of agricultural production is also a decrease in the content of nutrients in the soil and an annual loss of humus at the level of 0.065 t/ha. Preservation of soils and their properties can be facilitated by the use of plant residues of agricultural crops in agricultural technologies, because they replenish the soil with organic matter, macro- and microelements [4]. Thus, the straw of grain crops consists of organic substances (80%) and water (15%). Cellulose, hemicellulose and lignin are the energy material for the vital activity of soil microorganisms, and the products of their destruction serve as the material for the formation of humus.

On average, straw of grain crops contains 0.5% nitrogen, 0.25% phosphoric anhydride, 0.8% potassium oxide and 35-40% organic carbon. All these compounds can replenish the reserves of nutrients in the soil due to the destruction of plant residues of grain crops. The results of research by V.M. Sendetskyi [14] established that with one ton of straw, 4.8-5.6 t/ha remained on the field during the years of research, 15-20 kg of nitrogen, 8-10 kg of phosphorus, and 30-40 kg of potassium were returned to the soil . The content of nutrients in post-harvest crop residues depends on the elements of cultivation technology, as well as on climatic conditions during the growing season of plants. In turn, the amount of nutrients that return to the soil with plant remains depends on the degree of their decomposition. Under natural conditions, the decomposition of post-harvest plant residues and the release of nutrients from them in available forms takes place over several years. Biopreparations based on cellulose-destroying microorganisms are used precisely to accelerate the destructuring processes.

Previous studies have determined that hydrothermal conditions, the presence of moisture in the soil, and the culture, the remains of which were treated with a biodestroyer, have a great influence on the cellulolytic activity of the southern chernozem. The most intensive decomposition of plant residues 90 days after treatment with the biopreparation was noted in the pea treatment variant – 82.6%, which is 54.6% more compared to the control for treatment of residues with water only. A very effective effect of the stubble biodestroyer was found on barley, where 65.3% of the post-harvest residues were decomposed, while treatment with water alone provided decomposition of only 33.9% of the stubble [11]. The same dependence was observed in our research during 2019-2021. It was established that the vital activity of cellulose-degrading microorganisms is not constant over time and changes depending on the method of soil cultivation and the option of applying the treatment of post-harvest residues of the studied crops.

The activity of cellulose-destroying microorganisms is inhibited at high soil moisture and low temperatures. In the process of warming the soil, the intensity of cellulose decomposition increases, in addition, this indicator in our studies was influenced by the method of soil cultivation and the crop whose remains were processed. This indicator reached its maximum values when processing post-harvest remains of winter wheat with a biodestructor – 91.7-93.2%, depending on the studied method of main soil cultivation (Table 1).

Table 1. *The degree of destruction of post-harvest residues of winter wheat and barley after treatment with Ecostern Classic, % (average for 2019-2021)*

Culture is a precursor	The method of basic soil cultivation	Processing of post-harvest residues	
		water	Ecostern Classic
Winter wheat	Policeless (chisel processing)	76.5	91.7
	Plowing	79.1	93.2

Table 1, Continued

Culture is a precursor	The method of basic soil cultivation	Processing of post-harvest residues	
		water	Ecostern Classic
Winter barley	Shelfless (chisel processing)	75.2	90.4
	Plowing	77.4	92.7

Source: *developed by the authors*

At the same time, the highest degree of destruction of post-harvest residues was determined for the use of plowing and the use of Ecostern Classic – 93.2%, which exceeded the indicators of the option of combining tillage without plowing and water treatment of plant residues by 17.9 percentage points.

The same dependence of the decomposition of cellulose in the soil depending on the studied factors was observed during the processing of post-harvest remains of winter barley, but the indicators were lower. So, on average, according to the experimental variants, decomposition of 83.9% of the post-harvest winter barley residues was observed, which is less than the processing of winter wheat residues by 1.4 percentage points. It should be noted that the use of Ecostern Classic ensured a slightly greater destruction of the remains of winter barley plants compared to the option of treatment with water only. So, on average, 91.6% of the residues were decomposed by the tillage factor, which exceeded the indicators of the water-only treatment option by 16.7 percentage points.

The effect of tillage was also noted in our research. An increase in cellulolytic activity with the use of plowing was determined on all studied precursor cultures. So, on average, according to options for processing post-harvest residues, in this option, the degree of destruction of post-harvest residues of winter wheat was 86.2%, and winter barley – 85.1%, which, respectively, exceeded the indicators for no-till tillage respectively by 2.4 and 2.7 percentage points.

The researches of V. Sendetskyi [15] established that the use of the drug Vermystim-D contributed to the acceleration of the destruction of straw and the destruction of pathogenic soil microflora. Due to the accumulation of nitrogen-fixing, phosphate-mobilizing, bactericidal and fungicidal microorganisms in the soil, as well as the products of their vital activity, soil fertility is improved. Due to the treatment of plant residues with Vermistym-D, the processes of growth and development of soil microorganisms, which fed on them, that is, destroyed them, were activated. During such destruction, macro- and microelements were released into the soil in a form available to plants. This is confirmed by our research. The use of Ecostern Classic ensured the destruction of post-harvest residues of winter wheat at the level of 91.7-93.2%, and winter barley – 90.4-92.7%, while nutrients were released from plant residues in a form available to plants.

Research has determined that after harvesting winter wheat and winter barley, before applying the biodestructor, the soil contained, respectively, 6.3 and 5.9 mg/kg of soil nitrates, 47.5 and 42.8 mg/kg of soil mobile phosphorus and 208.8 and 202.4 mg/kg of exchangeable potassium soil (Fig. 1).

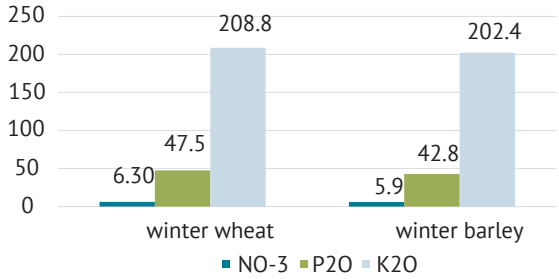

Figure 1. *The content of nitrates, mobile phosphorus and exchangeable potassium in the 0-30 cm layer of the soil before processing the post-harvest remains of winter wheat and barley with a destructor, mg/kg of soil (average for 2019-2021)*

Source: *developed by the authors*

With the intensification of agricultural production, it is possible to restore the consumption of nutrients for the formation of crop yields through the use of mineral fertilizers, but the importance of biopreparations, in particular biodestructors of stubble, is no less important, because they contribute to the mineralization of post-harvest remains of agricultural crops and the release of nutrients that accumulate in the plant body Microorganisms, in particular actinomycetes and fungi, affect the rate of decomposition of organic substances and the cycling of nutrients. Their influence on the transformation and circulation of carbon, nitrogen, phosphorus, potassium, sulfur and iron consists in the mineralization of organic compounds or the transformation of forms inaccessible to plants into accessible compounds. Treatment of winter wheat stubble with the biopreparation Ecostern Classic helped to increase the nitrate content in the soil, compared to their content before treatment, by 4.3-5.0 mg/kg of soil or 40.6-44.2% (Table 2).

Table 2. *NPK content in the 0-30 cm soil layer depending on the methods of soil cultivation and the use of Ecostern Classic, mg/kg of soil (average for 2019-2021)*

The method of basic soil cultivation	Processing of post-harvest residues	Contents		
		NO_{3-}	P_2O	K_2O
	Winter wheat			
Shelfless (chisel processing)	water	8.5	48.3	220.2
	Ecostern Classic	10.6	51.4	242.7
Plowing	water	9.6	50.2	235.1
	Ecostern Classic	11.3	53.9	261.8

Table 2, Continued

The method of basic soil cultivation	Processing of post-harvest residues	Contents NO_{3-}	P_2O	K_2O
	Winter barley			
Shelfless (chisel processing)	water	7.8	47.5	217.9
	Ecostern Classic	9.1	48.7	225.3
Plowing	water	8.4	49.4	224.9
	Ecostern Classic	10.5	51.5	251.0

Source: *developed by the authors*

It should be noted that the amount of nitrates in the soil also increased, but was somewhat smaller, in the options for processing winter wheat plant residues with only water. Depending on the soil treatment option, the indicators were 8.5-9.6 mg/kg of soil, or were lower compared to their initial value by 25.9-34.4%.

The positive effect of stubble biodestructors on the nitrate content in the soil was also noted in the studies of Yu.O. Sergeeva [25]. Thus, at the beginning of the sorghum growing season, the content of nitrates in the arable layer of the soil was higher after processing post-harvest residues with the cellulose destructor biopreparation – by 20.4 mg/kg more than the control version of the experiment. In the flowering phase of sorghum, the nitrate content in the soil increased by 74.4 mg/kg due to the use of the Stubble biodestroyer. Before the end of the growth and development of sorghum plants, a significant advantage was observed in the variant using the cellulose destructor biological preparation – 32.1 mg/kg of soil.

The content of mobile phosphorus and exchangeable potassium in the soil after processing the post-harvest remains of winter wheat with a biodestructor also increased compared to the initial value. On average, according to the variants of the main tillage, the amount of mobile phosphorus in the arable layer of the soil under the action of Ecostern Classic slightly increased – by 9.9%. At the same time, due to the natural mineralization of winter wheat stubble, the amount of the studied nutrient increased by 3.6%.

The same trend was noted with regard to the content of exchangeable potassium in the 0-30 cm soil layer. After the use of the biopreparation Ecostern Classic on plant residues of winter wheat, on average over the years of research, 242.7-261.8 mg/kg of exchangeable potassium was determined, while 220.2-235.1 mg/kg of soil was determined for the water-only treatment option. At the same time, the amount of exchangeable potassium increased compared to its value before the application of the option of processing plant residues, respectively, by 14.0-20.2 and 5.1-11.2%, depending on the option of processing post-harvest residues.

Studies have established that, on average, according to soil treatment options, the content of nutrients in the option of using Ecostern Classic exceeded the option of treating winter wheat residues with water only by 1.9-24.6 mg/kg of soil or 6.5-17.3%, depending on element.

The same trend was observed during the processing of plant residues of winter barley. Thus, on average over the years and variants of the experiment, the content of nitrates in the soil increased by 3.1 mg/kg of soil or 34.1%, mobile phosphorus by 6.5 mg/kg of soil or 13.2%, and exchangeable potassium by 27.4 mg/kg soil or 11.9% compared to their initial values.

Research has determined that the use of the modern Ecostern Classic stubble biodestroyer contributed to better mineralization of plant residues of winter barley, release from them and return of nutrients to the soil. Thus, depending on the variant of the method of the main tillage, after processing the post-harvest remains of winter barley with a biopreparation in the soil layer of 0-30 cm, 9.1-10.5 mg/kg of soil nitrates, 48.7-51.5 mg/kg of mobile soil were determined of phosphorus and 225.3-251.0 mg/kg of exchangeable potassium soil, which exceeded the indicators of processing crop residues with water alone by 14.3-20.0; 2.5-4.1 and 3.3-10.4%, respectively.

At the same time, it should be noted that there was an increase in the content of nutrients in the soil compared to their initial values, regardless of the option of using the biodestructor. Thus, with the use of plowing and the use of winter water for processing post-harvest remains of barley, the content of nitrate nitrogen, mobile phosphorus and exchangeable potassium increased by 2.5; 6.6 and 22.5 mg/kg of soil or 29.8; 13.4 and 10.0%, and from the use of Ecosterne Classic by 4.6, respectively; 8.7 and 48.6 mg/kg of soil or 43.8; 16.9 and 19.4%. The same tendency was observed for the use of tillage without a shelf (chisel), but the indicators were somewhat lower.

In the studies of O.V. Humenyuk [26], using a biodestroyer at a dose of 10 l/ha in combination with the application of mineral fertilizers at a dose of N120P100K160, the maximum content of mineral nitrogen, mobile phosphorus and exchangeable potassium in the studied soil was noted. Research by A. Panfilova [27] showed that the amount of mobile macroelements in the soil significantly increased when the Biodestructor treatment of stubble combined with nitrogen fertilizer (N30) of the post-harvest remains of spring barley and peas increased. Thus, on average, the use of the biopreparation contributed to an increase in nitrates in the soil by 32.6%, mobile phosphorus by 13.4%, and exchangeable potassium by 13.3%, compared to their initial content (after harvesting the crops). The species composition of predecessor cultures also affected the content of nutrients. Thus, on average over the years of research, three months after the treatment of post-harvest remains of spring barley with the Stubble Biodestructor, 12.6 mg/kg soil nitrates, 53.8 mg/kg soil mobile phosphorus and 253.0 mg/kg soil exchangeable potassium accumulated in the soil, which is less

compared to the indicators for peas, respectively, by 8.7; 12.2 and 11.8%.

The strategic task of modern intensive and energy-saving technologies for growing agricultural crops is to increase the breathability of plants, as well as to preserve soil fertility and improve its agrophysical and agrochemical indicators. An important role in this belongs to the rational cultivation of the soil, with the help of which it is possible to purposefully influence the preservation and increase of soil fertility, as well as the realization of the potential yield of agricultural plants [28]. Studies have determined that the method of main tillage also influenced the decomposition of winter wheat straw. On average, over three years and options for processing post-harvest residues, when plowing was used, the soil contained more nitrates by 0.9 mg/kg of soil or 8.6%, mobile phosphorus by 2.2 mg/kg of soil or 4.2%, and by 17.0 mg/kg of soil or 6.8% exchangeable potassium compared to the option of no-shelf (chisel) tillage.

The same dependence was observed in the experiment with the post-harvest remains of winter barley. So, on average, over the years of research and by the factor of crop stubble treatment, under plowless (chisel) tillage, 8.5 mg/kg of soil nitrates, 48.1 mg/kg of soil of mobile phosphorus and 221.6 mg/kg of soil were determined in it of exchangeable potassium soil, which was less than the indicators of plowing for the main tillage, respectively, by 1.0; 2.4 and 16.4 mg/kg of soil or 10.5; 4.8 and 6.9%.

The researches of I. Garo & V. Gamayunova [29] established that tillage methods had little effect on the content of nitrates in the soil, the difference between disking and plowing was only 0.2-0.3 mg/kg of soil (it was within the error of the experiment) with a slight tendency of the preference of plowing. To an even lesser extent, the content of mobile phosphorus in the soil layers changed depending on the method of main tillage. Thus, during the period of milk maturity of winter rape seeds, the 0-50 cm layer of this element contained 29.0 mg/kg for disking and 31.5 mg/kg for plowing.

V. Gangur [28] established that the content of mobile phosphorus was higher in traditional tillage, which creates more favorable conditions for the transformation of this element of mineral nutrition. The use of the No-till system for the cultivation of grain crops helps to increase the content of easily hydrolyzed nitrogen and exchangeable potassium in the soil layer (0-20 cm) compared to other methods of soil cultivation.

According to Nze Memiaghe [30], in order to reduce soil erosion, improve water conservation and prevent soil degradation, zero tillage is increasingly used, compared to the classical system of tillage. At the same time, it was established that zero tillage increases the use of phosphorus from the soil. Research by P. Jha *et al.* [31] established a significant effect of the combined application of zero tillage and stubble preservation in the field on the rate of mineralization of plant residues, as well as increasing the accumulation of nitrogen in the soil due to the improvement of the biological functioning of the soil.

Agricultural practices, including tillage systems and post-harvest residue management, strongly influence a wide range of soil properties. Depending on the application of these factors, both negative and favorable changes in its structure, chemical composition, and biological activity may occur. Research by K. Kotwica *et al.* [32] established that the use of methods of basic tillage for the cultivation of winter wheat contributed to changes in the basic biological and chemical properties of the soil. But the differences observed between different tillage methods indicate that the addition of organic matter is a more important factor influencing the values of biological and chemical parameters of the soil. This is also confirmed by our research – the use of post-harvest remains of winter wheat and barley, especially against the background of the use of Ecostern Classic stubble biodestroyer, ensured an increase in the content of plant nutrients in the soil, especially when plowing was used as the main tillage.

CONCLUSIONS

On the basis of three-year data, it can be concluded that the treatment of post-harvest residues of winter wheat and winter barley with a biodestructor ensured an increase in the content of nutrients in the soil. So, on average, over the years of research, during the processing of post-harvest remains of winter wheat, the content of nitrates in the 0-30 cm soil layer increased by 40.6-44.2%, mobile phosphorus – by 7.6-11.9%, and exchangeable potassium – by 14.2-20.2% compared to their initial value. Treatment of winter wheat stubble with only water provided lower indicators. Thus, depending on the method of the main tillage, the content of nitrates in the 0-30 cm bent layer compared to the option of using a biodestructor was lower by 15.0-19.8%, mobile phosphorus by 6.0-6.9%, exchangeable potassium by by 9.3-10.2%.

The use of Ecostern Classic stubble biodestructor contributed to better mineralization of plant residues of winter barley. So, depending on the variant of the method of basic soil cultivation, 9.1-10.5 mg/kg of soil nitrates, 48.7-51.5 mg/kg of mobile phosphorus and 225.3-251.0 mg/kg of exchangeable potassium soil, which exceeded the indicators of processing crop residues with water alone by 14.3-20.0; 2.5-4.1 and 3.3-10.4%, respectively.

Studies have established a positive influence of the method of main tillage on the nutritional regime already from the initial stage of decomposition of post-harvest residues. The soil with the use of plowing was characterized by the best indicators. Thus, in an experiment with the treatment of post-harvest residues of winter wheat with a biopreparation, the content of nitrates increased by 8.6%, mobile phosphorus by 4.2%, and exchangeable potassium by 6.8% compared to the option of no-till tillage, and winter barley, respectively by 10.5; 4.8 and 6.9%.

Practical aspects and conclusions of our research can be used by agricultural producers to improve soil fertility indicators, in particular, to increase the content of plant nutrients in it. It should be noted that the topic

of the scientific article requires further research, taking into account modern stubble biodestructors and their processing of post-harvest residues not only of winter wheat, but also of other agricultural crops.

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Вплив біодеструктора стерні та способу основного обробітку на поживний режим ґрунту

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Анотація. Щорічно в Україні відбувається зниження показників родючості ґрунтів. Тому, для забезпечення бездефіцитного балансу ґрунту необхідно залучати додаткові резерви органічної сировини, зокрема післяжнивні рештки сільськогосподарських культур, а для їх деструктиризації використовувати біопрепарати. На сьогодні ще не зовсім повно вивчено дію біодеструторів стерні на процеси мінералізації післяжнивних решток рослин, особливо за різних способів основного обробітку ґрунту, тому метою нашого дослідження було визначити вплив деструктора Екостерн Класичний та способу основного обробітку ґрунту на його поживний режим в умовах півдня України. Методи досліджень: польовий, лабораторний. Дослідженнями встановлено кількість нітратів, рухомого фосфору та обмінного калію, що залишилася в середньому за роки досліджень у ґрунті дослідної ділянки після збирання пшениці озимої склала відповідно 6,3; 47,5 та 208,8 мг/кг ґрунту, а після збирання ячменю озимого – 5,9; 42,8 та 202,4 мг/кг ґрунту. Після часткової мінералізації рослинних решток озимих культур, за три місяці, вміст елементів живлення у ґрунті зростав, особливо за обробки біодеструктором Екостерн Класичний. Визначено, що застосування оранки сприяло пришвидшенню мінералізації рослинних решток пшениці озимої та більшому нагромадженню у ґрунті елементів живлення. Так, за обробки післяжнивних решток пшениці озимої біодеструктором за використання оранки у ґрунті було визначено 11,3 мг/кг ґрунту нітратів, 53,9 мг/кг ґрунту рухомого фосфору та 261,8 мг/кг ґрунту – обмінного калію. За обробки післяжнивних решток ячменю озимого показники були дещо меншими – відповідно 10,5; 51,5 та 251,0 мг/кг ґрунту. Практична цінність досліджень полягає у вдосконаленні процесів, пов'язаних із підвищенням родючості ґрунтів півдня України за рахунок значно раціональнішого використання післяжнивних решток пшениці та ячменю озимих форм

Ключові слова: післяжнивні рештки, деструктиризація, оранка, безполицевий обробіток ґрунту, родючість ґрунту, елементи живлення

UDC 631.52:633:114(477.72)
DOI: 10.56407/2313-092X/2022-26(3)-5

Ukrainian Black Sea Region Agrarian Science
Vol. 26, No. 3

Influence of irrigation and weather conditions on the duration of interphase periods of winter wheat varieties

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Abstract. The autumn growth and development of plants depend on a complex of external factors: the average daily air temperature, the amount of precipitation, the humidity of the seed layer of the soil, nutrients, light, etc. If winter wheat is sown at a later date, there are risks that the plants will enter the winter not well developed. It is possible to accelerate the passage of interphase periods with the help of irrigation, which is a necessary agrotechnical measure in the Southern Steppe of Ukraine. The purpose of the research is to establish the influence of varietal characteristics, irrigation and weather conditions on the duration of interphase periods of winter wheat in the autumn period on an international scale. Experimental research was carried out during 2020-2021 on southern chernozem, on the basis of the Educational Scientific and Practical Center of the Mykolaiv NAU with two varieties of winter wheat. Field, laboratory and comparative calculation methods were used during the research. The establishment and conduct of experiments were carried out according to the methodology of the research case. Soil moisture was determined by the thermogravimetric method, and phenophases were determined simultaneously throughout the experiment. It was determined that irrigation for 1-2 days reduces the duration of the interphase period of BBCH 00-09; for 3 days – BBCH 10-12; for 11 days – BBCH 13-19; for 5-7 days – BBCH 20-22. In natural conditions (without irrigation), the duration of the interphase periods (from BBCH 00-09 to 20-22) of the growth and development of plants of the studied varieties of winter wheat in 2020 was 93-96 days, which is 23-25 days more than in 2021. In plants of the Ovid variety under conditions of natural moisture (without irrigation), the interphase periods came 1-3 days later than in the Duma Odeska variety, while under irrigation conditions there was no significant difference. The obtained scientific results of the research will contribute to the wider implementation of irrigation, which will ensure the rapid and full growth and development of winter wheat plants in the autumn period, which will further contribute to increasing the yield and gross harvest of grain

Keywords: irrigation, sum of effective temperatures, sum of precipitation, soil moisture, Triticum aestivum

INTRODUCTION

The steppe region of Ukraine is the center of food production, mainly winter wheat and other food crops. The climatic conditions of the region are characterized by a high degree of aridity with an insufficient amount of precipitation and an uneven distribution during the growing seasons, which is often complicated by an increase in temperature. That is, the productivity of winter wheat largely depends on agroclimatic conditions in the year of sowing [1].

Wheat is the main crop in many countries of the world, as well as the main food crop in the Steppe zone, so the system of agrotechnical measures should be aimed at creating more favorable conditions for obtaining high productivity [2; 3]. Its growth characteristics at different phases of development, especially in autumn, are of great importance for the formation of the productivity of winter wheat plants [4].

One of the diagnostic signs that indicate growing conditions is plant growth. Growth processes, development of vegetative and reproductive organs are largely determined by providing plants with moisture

Article's History:
Received: 02.04.2022
Revised: 16.06.2022
Accepted: 26.08.2022

Suggested Citation:
Korkhova, M., Smirnova, I., & Drobitko, A. (2022). Influence of irrigation and weather conditions on the duration of interphase periods of winter wheat varieties. *Ukrainian Black Sea Region Agrarian Science*, 26(3), 55-65.

and nutrients. It is known that there is a direct relationship between the yield, vegetative mass and height of plants, since stems and leaves are organs of transportation of mineral and organic substances [5].

Optimal growth and development of winter wheat plants depends on the combination of hydrothermal and soil conditions, the individual response of the crop to environmental factors, as well as the proper condition of the seed layer in autumn [6].

In the Steppe of Ukraine, almost every year during the sowing of winter wheat seeds, it is negatively affected by the lack of moisture. Often, sowing has to be done in semi-moist soil, which is the reason for low field seed germination. In addition, seedlings exhausted by drought suffer more from diseases, which constantly becomes crucial for successful overwintering of plants and obtaining a stable harvest [7].

With economic growth, continuous global environmental degradation, and increasing scarcity of water resources, droughts are becoming more frequent and have a significant impact on both regional ecology and sustainable economic development [8]. Water is a key limiting factor in agriculture. The shortage of water resources has become a serious threat to global food security [9].

Limited rainfall and water shortage are the main problems for winter wheat production in arid and semi-arid areas of northwestern China [9]. The North China Plain is the dominant winter wheat production area and the main grain production area in China. As a result of the shortage of water resources, the inconsistency of the spatial arrangement of water and land resources, the gap between the growth period of wheat plants and the time of precipitation, irrigation became the key to the development of agriculture in the region [10].

During abiotic stresses, physiological and biochemical changes in cells suppress plant growth and development, which ultimately reduces wheat yield. To ensure the food and nutritional security of the ever-growing world population, new approaches are needed for sustainable wheat production in the face of climate change, one of which is the creation of wheat varieties resistant to abiotic stress through molecular selection, rapid selection, genetic engineering, and improvement of existing technologies [11].

Therefore, irrigation itself, especially in the South of Ukraine, can neutralize the negative impact of the autumn drought on the rapid and friendly germination of seeds and obtaining full-fledged seedlings of winter wheat, which is a necessary condition for the formation of highly productive crops.

The main goal of the research is to determine the influence of irrigation and weather conditions on the duration of interphase periods of winter wheat varieties according to the VVSN scale in the autumn period.

LITERATURE REVIEW

A significant amount of research has been devoted to the question of the influence of irrigation and weather conditions on the duration of interphase periods for the cultivation of winter wheat varieties in the conditions of Southern Ukraine.

Breeding achievements of recent decades have significantly increased the genetic level of productivity of modern winter wheat varieties [12]. However, the issue of adaptation and stability of the yield level remains one of the biggest problems of increasing the level of realization of the biological potential of the created varieties in different climatic zones [13]. The determining criterion for the selection of modern varieties of winter wheat is the degree of intensity and response to growing conditions. Each variety has certain morpho-agrobiological features and properties, thanks to which it is able to realize its genetic potential if a favorable environment is created for it [14].

The yield of wheat varies depending on the year of cultivation, the influence of climatic conditions, the variety, applied nutrients, the presence of pests and pathogens [15-17].

In the south of Ukraine, agricultural producers should pay more attention to the accumulation of moisture in the soil and better use it as a factor that most affects the yield of agricultural crops, including winter cereals. All life processes are connected with the movement of water in plant organs. In addition, soil moisture determines the level of vital activity of not only plants, but also microorganisms, ensures the intensity of many physical and chemical processes. Due to global warming and climate change, moisture becomes the main limiting factor in the productivity of agricultural crops [18].

O. Lavrynenko *et al.* [19] determined that in the steppe zone of Ukraine, against the background of general climate change, the realization of the potential productivity of common wheat varieties may be limited by various limiting factors, and one of the main ones is moisture availability. Adaptability to the soil and climatic conditions of the Steppe zone, which is characterized by an acute moisture deficit, high temperatures in summer, and a long frost-free period, is the main requirement for winter wheat varieties *Triticum aestivum* L. of the steppe ecological group. Artificial irrigation prevents the increase of production processes, improves the microclimate of phytocenosis, but in the south of Ukraine it does not completely solve the problem of grain formation due to high temperatures and low relative humidity.

Research by B.V. Blyznyuk *et al.* [20] it was determined that the duration of the growing season as an important biological feature of winter wheat depends on both the genotype and the growing conditions of the variety. During the growing season, plants go through

the corresponding phases of development associated with the formation of new organs. Depending on the temperature, moisture, lighting, availability of nutrients, the time required for the formation and ripening of the crop is different. The vegetation cycle of winter wheat is divided into two main periods: germination-earing and earing-ripening. In the creation of a winter wheat crop, the main thing is the period of seedling-earing, during which the plants go through 8 out of 11 stages of organogenesis and on which the future productivity and precocity of the variety depends.

According to the results of research conducted in 2016/2017 in Kazakhstan, it was determined that the duration of the phenological phases of growth and development of winter wheat has a significant impact on air temperature and soil moisture. In irrigated areas, wheat seedlings appeared earlier than in non-irrigated ones [21].

As you can see, many scientists have been studying this topic, but varieties and weather conditions change. In addition, scientists determined the interphase periods without using the BBCH international scale, thanks to which it is possible to follow the growth and development of plants in more detail.

MATERIALS AND METHODS

The research was conducted during 2020-2021 at the research field of the Educational-Scientific-Practical Center of the Ukrainian National Academy of Sciences (Bladhorivka village, Mykolaiv district, Mykolaiv region). The object of research was winter wheat: Ovidii and Duma Odeska varieties.

The soil is represented by southern chernozem, residual-slightly saline heavy loam on loess with humus content in the 0-30 cm layer from 3.1 to 3.3%. The reaction of the soil solution is neutral (pH – 6.8-7.2). Mobile forms of nutrients in the arable layer of the soil contained on average: nitrates (according to Grandval Lazhe) – 15-25, mobile phosphorus (according to Machigin) – 41-46, exchangeable potassium (on a flame photometer) – 389-425 mg/kg of soil.

Experiments were carried out according to the following schemes: varieties of winter wheat (factor A) – Ovid and Duma Odesa; irrigation (factor B) – without irrigation (control) and under irrigation conditions.

The total area of the plot is 50 m^2, the registered area is 26 m^2. The experiment was repeated three times. Placement of experimental plots is consistent. Sowing of winter wheat was carried out on October 1 with a sowing rate of 4.5 million units/ha. Agricultural machinery in the experiment was generally accepted for the Steppe zone of Ukraine, except for the agricultural measures taken for research.

The material for the research was two varieties of soft winter wheat, the owners of which are the leading scientific institutions of Ukraine: Duma Odesa and Ovidy (Breeding and Genetic Institute – National Center for Seed Science and Varietal Research of the Ukrainian Academy of Agrarian Sciences), which are registered in the State Register of Plant Varieties Suitable to distribution in Ukraine in 2017.

Field and comparative calculation methods were used to conduct experimental work. Establishment and conduct of experiments, selection of soil samples, and their preparation for analysis were carried out in accordance with the methodology of the research case, methodological instructions and DSTU [22]. Soil moisture was determined by the thermogravimetric method – in the 0-100 cm layer every 10 cm [22]. Samples were taken before sowing and during the vegetation phase of the crop. Definitions are repeated twice.

Data from the Austrian-made Pessl Instruments Weather Station (iMETOS), which not only provides highly accurate local weather data, but also provides a 6-day weather forecast, was used to analyze agroclimatic conditions. The weather station is equipped with sensors that determine the following parameters: precipitation, air and soil temperature, humidity level of air, soil and leaves, wind speed and others.

In the main phases of growth and development of plants, phenological observations were carried out in accordance with the "Methodology of state variety testing of crops" [23]. The beginning of the phase was recorded when it occurred in 10% of the plants, and the complete phase was recorded in 75% of the plants. Phenophases were determined simultaneously throughout the experiment.

Harvest accounting is carried out continuously from the entire accounting area. Harvesting of winter wheat was carried out with a SAMPO-500 combine. After threshing, the thresher of the grain harvester is closed at each point, the collected grain is weighed and brought to standard humidity (14%) and purity (100%).

Research results obtained in the form of analysis of digital materials are processed by the statistical and mathematical method of dispersion and variation analyzes using Microsoft Excel and Agrostat computer programs.

RESULTS AND DISCUSSION

Researching the topic, the authors determined that the interphase period "Macrostage 0: Germination (VVSH 00-09) Dry seed – seedling, emergence of the cotyledon to the soil surface" of winter wheat lasted longer in 2021 and amounted to 13-17 days depending on the variety and moisture conditions, which by 1-6 days more than in 2020 (Table 1).

Table 1. *Characteristics of the interphase period "Macrostage 0: Germination of VVSH 00-09" of winter wheat depending on the variety and moisture conditions*

Indexes	Without irrigation (factor B)		Under irrigation conditions (factor B)	
	Variety (factor A)			
	Ovid	Duma of Odesa	Ovid	Duma of Odesa
2020 year				
Duration of the interphase period, days	11	10	9	9
Average air temperature, °C	17.3	17.2	17.1	17.1
Minimum air temperature, °C	6.5	6.5	6.5	6.5
Maximum temperature, air, °C	25.7	25.7	25.7	25.7
Sum of effective temperatures, °C	135.4	122.2	109.0	109.0
Amount of precipitation, mm	0.8	0.6	0.4	0.4
Soil moisture, %	23.2	23.4	46.5	46.5
Average soil temperature, °C	17.6	17.6	18.5	18.5
2021 year				
Duration of the interphase period, days	17	16	13	13
Average air temperature, °C	9.8	9.6	9.2	9.2
Minimum air temperature, °C	-0.4	-0.4	0.2	0.2
Maximum temperature, air, °C	23.3	23.3	16.8	16.8
Sum of effective temperatures, °C	84.0	74.3	47.5	47.5
Amount of precipitation, mm	48.2	47.4	47.0	47.0
Soil moisture, %	21.5	21.2	47.1	47.1
Average soil temperature, °C	11.4	11.3	14.8	14.8

Source: *developed by the authors*

This can be explained by the fact that productive precipitation fell only on October 13, that is, 7 days after sowing, which affected the duration of seed germination.

Thus, the duration of the interphase period of VVSH 00-09 winter wheat plants ranged from 10 days in the Duma Odeska variety (2020) to 17 days in the Ovid variety in the version without irrigation.

The weather conditions of 2020 were more favorable for the germination of winter wheat seeds. So, the average daily air temperature was 17.1-17.3°C, minimum – 6.5°C, maximum – 25.7°C. The plants managed to accumulate the sum of effective temperatures from 109.0°C (Ovidii and Duma Odeska varieties under irrigation conditions) to 135.4°C (Ovidii variety in the version without irrigation).

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It was determined that the moisture content of the seed layer of the soil has a greater effect on the germination rate of winter wheat seeds when grown without irrigation than the amount of precipitation during the reporting period. Thus, in 2020, during the interphase period Macro stage 0: Germination of VVSH 00-09, 0.6-0.8 mm of precipitation fell, and the soil moisture was 23.2-23.4%, while in 2021 – 47.4-48.2 mm and 21.2-21.5%.

It was determined that the soil temperature during the studied interphase period under irrigation conditions was higher and amounted to 14.8°C (2021) and 18.5°C (2020), which is 5.1% and 23.6% higher, than without irrigation.

Soil moisture was higher in 2021 – 47.1% (under irrigation conditions), which is 25.6% more than in the case without irrigation.

Therefore, it can be concluded that the weather conditions for the initial growth and development of winter wheat seeds of the studied varieties were favorable, which made it possible to obtain full-fledged seedlings.

The interphase period of winter wheat according to the VVSH 10-12 scale in 2021 was characterized by a sufficient amount of precipitation and its uniform fall with a total amount of 17.8 mm in the non-irrigated version and 13.6 mm in the irrigation conditions. The duration of the reported interphase period ranged from 16 (under irrigation conditions) to 19 days (without irrigation) (Table 2).

Table 2. *Characteristics of the interphase period "Macrostage 1: Development of leaves VVSH 10-12" of winter wheat depending on the variety and moisture conditions*

Indexes	Without irrigation(factor B)		Under irrigation conditions (factor B)	
	Variety (factor A)			
	Ovid	Duma of Odesa	Ovid	Duma of Odesa
2020 year				
Duration of the interphase period, days	17	17	14	14
Average air temperature, °C	11.3	11.8	11.6	11.6
Minimum air temperature, °C	0.1	0.1	0.1	0.1
Maximum temperature, air, °C	21.7	21.7	21.7	21.7
Sum of effective temperatures, °C	106.6	116.0	91.8	91.8
Amount of precipitation, mm	3.8	4.0	3.8	3.8
Soil moisture, %	18.0	18.2	45.9	45.9
Average soil temperature, °C	13.3	13.7	16.5	16.5
2021 year				
Duration of the interphase period, days	18	19	16	16
Average air temperature, °C	8.2	7.8	9.1	9.1
Minimum air temperature, °C	-2.0	-3.0	-1.6	-1.6
Maximum temperature, air, °C	18.6	18.6	18.6	18.6
Sum of effective temperatures, °C	61.3	68.2	71.2	71.2
Amount of precipitation, mm	17.8	17.8	13.6	13.6
Soil moisture, %	26.6	26.7	46.6	46.6
Average soil temperature, °C	9.8	9.5	12.9	12.9

Source: *developed by the authors*

The interphase period of VVSH 10-12 in 2020 was shorter (14 days) in winter wheat varieties under irrigation conditions, which is 3 days less than in non-irrigated options and 2-5 days less than in 2021. Average air temperature ranged from 7.8°C (2021) to 13.2°C (2020) in the version without irrigation. The minimum air temperature for the reporting period ranged from minus 1.6-3.0°C (2021) to 0.1°C (2020), and the maximum – 18.6 (2021) and 21.7°C (2020), respectively.

It should be noted that winter wheat plants under irrigation reached the sum of effective temperatures from 71.2°C (2021) to 115.3°C (2020), while without irrigation – 61.3-68.2°C (2021) and 106.6-116.0°C (2020) depending on the variety.

Soil moisture in non-irrigated areas ranged from 18.0 to 26.7%, while in irrigated areas it was 46.1-46.6%, which contributed to better development of winter wheat plants.

A research group of scientists from the Department of Earth Observation of Agriculture Canada [24] claim that knowing what happens to plants at a certain stage of growth, you can correctly plan their further development. It is at stage VVSN 13-19 that the plant switches from nutrition due to nutrient reserves in seeds to nutrition due to its own root system. If wheat overwinters at this stage, its sensitivity to low temperatures, stagnant moisture, and soil changes increases significantly.

Over the years of our research, the interphase period of VVSH 13-19 (phase 3 leaf – phase 4 and subsequent leaves) was from 15 to 35 days, depending on the moisture conditions (Table 3).

Table 3. *Characteristics of the interphase period "Macrostage 1: Development of leaves BVSH 13-19" of winter wheat depending on the variety and moisture conditions*

Indexes	Without irrigation(factor B)		Under irrigation conditions (factor B)	
	Variety (factor A)			
	Ovid	Duma of Odesa	Ovid	Duma of Odesa
2020 year				
Duration of the interphase period, days	35	35	15	15
Average air temperature, °C	2.9	3.0	7.9	7.9
Minimum air temperature, °C	-0.1	-0.1	-4.0	-4.0
Maximum temperature, air, °C	6.1	6.1	16.4	16.4

Table 3, Continued

Indexes	Without irrigation(factor B)		Under irrigation conditions (factor B)	
	Variety (factor A)			
	Ovid	Duma of Odesa	Ovid	Duma of Odesa
Sum of effective temperatures, °C	48.8	52.6	47.3	47.3
Amount of precipitation, mm	18.2	18.2	1.4	1.4
Soil moisture, %	17.8	17.8	45.3	45.3
Average soil temperature, °C	4.8	5.0	14.5	14.5
2021 year				
Duration of the interphase period, days	18	18	17	17
Average air temperature, °C	4.0	4.3	5.0	5.0
Minimum air temperature, °C	-6.6	-6.6	-6.6	-6.6
Maximum temperature, air, °C	14.2	14.2	14.2	14.2
Sum of effective temperatures, °C	12.7	11.8	23.1	23.1
Amount of precipitation, mm	16.4	17.0	6.6	6.6
Soil moisture, %	27.4	27.5	46.0	46.0
Average soil temperature, °C	5.1	5.1	10.6	10.6

Source: *developed by the authors*

Under irrigation conditions, the reporting period was shorter and lasted 15 (2020) and 17 days (2021), while without irrigation – 18 (2021) and 35 days (2020).

It was determined that the duration of the interphase period "Macrostage 1: Development of leaves of VVSH 13-19" of winter wheat was significantly influenced by the average daily air temperature and soil moisture. Thus, in 2020, the average air temperature during the growth and development of plants without irrigation was 2.9-3.0°C, the moisture content of the seed layer of the soil was 17.8 mm, which delayed the onset of the 13-19 phases of BVSH up to 35 days, while in 2021, in the same version of the experiment, this interphase period lasted 18 days. At the same time, the average daily air temperature was 4.0-4.3°C, and soil moisture was 27.4-27.5%, which is 1.1-1.3°C and 4.6-4.7%, respectively more than in 2020. These conditions contributed to better rooting of plants and their intensive growth and development.

Hydrothermal indicators in the interphase period of VVSH 13-19 under irrigation conditions differed significantly from the sum of effective temperatures under non-irrigation conditions and depended on the conditions of the year. Thus, in the dry year of 2020, winter wheat plants of the studied varieties gained a greater amount of effective temperatures (48.8-52.6°C) in the non-irrigated variants, which is 21.0-24.3°C more than in the irrigation conditions . On the contrary, the sum of the effective temperatures of winter wheat plants in 2021 was lower (23.1°C) under irrigation conditions, while without irrigation – 11.8-12.7°C depending on the variety.

After the formation of 3-4 leaves, wheat plants move to the tillering stage – from VVSN 13-14 to VVSN 21. The interphase period "Macrostages 2: Tending II Lateral shoot in the sheath of a leaf - the 2nd bud of the tufting appears" VVSH 20-22 in 2020 was characterized with a significant amount of precipitation – from 22.8 mm (Duma Odeska and Ovid varieties under irrigation conditions) to 54.8 mm (Ovid varieties) under growing conditions without irrigation (Table 4).

Table 4. *Characteristics of the interphase period "Macrostage 2: Bushing II VVSH 20-22" of winter wheat depending on the variety and moisture conditions*

Indexes	Without irrigation(factor B)		Under irrigation conditions (factor B)	
	Variety (factor A)			
	Ovid	Duma of Odesa	Ovid	Duma of Odesa
2020 year				
Duration of the interphase period, days	33	31	21	21
Average air temperature, °C	0.4	0.4	2.9	2.9
Minimum air temperature, °C	-22.0	-22.0	-6.2	-6.2
Maximum temperature, air, °C	20.3	20.3	20.3	20.3
Sum of effective temperatures, °C	37.4	37.4	35.9	35.9
Amount of precipitation, mm	54.8	31.2	22.8	22.8
Soil moisture, %	39.8	40.6	41.8	41.8

Table 4, Continued

Indexes	Without irrigation(factor B)		Under irrigation conditions (factor B)	
	Variety (factor A)			
	Ovid	Duma of Odesa	Ovid	Duma of Odesa
Average soil temperature, °C	2.2	2.3	7.2	7.2
2021 year				
Duration of the interphase period, days	18	17	17	17
Average air temperature, °C	5.5	5.3	5.5	5.5
Minimum air temperature, °C	-3.4	-3.4	-3.4	-3.4
Maximum temperature, air, °C	14.4	14.4	14.4	14.4
Sum of effective temperatures, °C	28.6	25.9	28.9	28.9
Amount of precipitation, mm	47.0	46.4	37.6	37.6
Soil moisture, %	34.0	34.1	45.4	45.4
Average soil temperature, °C	5.9	5.9	8.7	8.7

Source: *developed by the authors*

It should be noted that in the variants without irrigation, the duration of the interphase period VVSH 20-22 differed between the varieties by 2 days, and the shortest (31 days) was in the Duma Odeska variety, which may indicate its greater resistance to drought and less water consumption. In 2021, the difference in the duration of the reported interphase period between varieties was less noticeable (1 day). Under irrigation conditions, the plants of both studied varieties developed almost identically.

During our research, the weather conditions in the interphase period of VBSN 20-22 were favorable for the growth and development of winter wheat plants in 2021 compared to 2020. Thus, the average daily air temperature during the growth and development of plants in 2021 was 5.3 -5.5°C, while in 2020 – 0.4-2.9°C, depending on the variety and moisture conditions. However, in 2020, the air temperature rose to 20.3°C during the studied period, while in 2021 – to 14.4°C.

It was determined that under irrigation conditions the soil temperature is 2.8-5.1°C (47.5-227.3%) higher, depending on the variety and year of research, than without irrigation.

Plants gained the sum of effective temperatures of 35.9-37.4°C (2020) and 25.9-28.9°C (2021) with soil moisture of 39.8-41.8% and 34.0-45.4% depending on the studied factors. Therefore, hydrothermal conditions of winter wheat plants differed significantly in terms of soil moisture, which was 1.2-2.0% and 11.3-11.4% more than under conditions of natural moisture.

Thus, on average in 2020-2021, the duration of the interphase periods of winter wheat plants of the Ovid variety depended significantly on moisture conditions (Fig. 1).

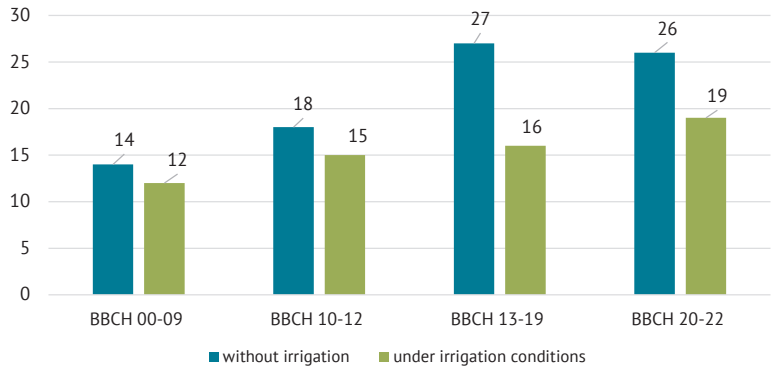

Figure 1. *The duration of the interphase periods of growth and development of winter wheat plants of the Ovid variety depending on moisture conditions (average for 2020-2021)*

Source: *developed by the authors*

The interphase periods (BBCH 00-09, BBCH 10-12, BBCH 13-19 and BBCH 20-22) in irrigated conditions were 1-11 days shorter than in non-irrigated areas.

In plants of the Duma Odeska variety, the duration of the studied interphase periods was shorter only in areas without irrigation compared to the Ovid variety. Under irrigation conditions, the duration of interphase periods did not differ between varieties (Fig. 2).

It was determined that irrigation led to a reduction of the interphase periods of BBCH 10-12, BBCH 13-19 and BBCH 20-22 by 3-11 days compared to plants in non-irrigated areas.

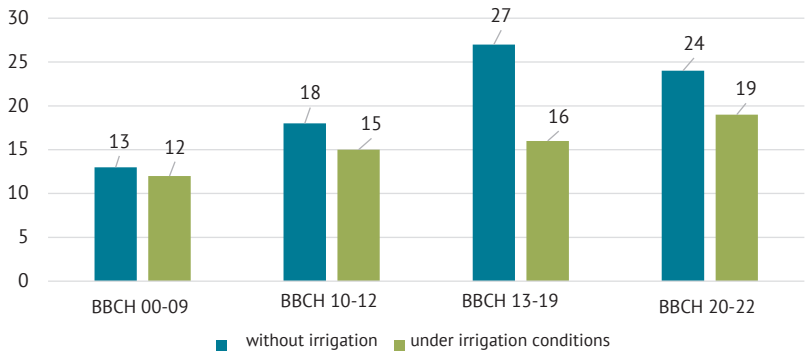

Figure 2. *Duration of interphase periods of growth and development of winter wheat plants of the Duma Odesa variety depending on moisture conditions (average for 2020-2021)*

Source: *developed by the authors*

The results of research conducted in 2020-2021 make it possible to state that the rate of emergence of seedlings is influenced by many factors: the average daily air temperature, the amount of precipitation, soil moisture and temperature, biological characteristics of the variety, etc. It was determined that from the beginning of the germination of winter wheat seeds to the appearance of seedlings, the sum of average daily temperatures averaged from 78.3 to 109.7°C, while V.A. Mazur *et al.* [25] claim that plants should gain the sum of effective temperatures from 60 to 90°C.

The average daily air temperature during the two years of research (2020-2021) during seed germination ranged from 13.2 to 13.6°C, which according to V. Gamayunova *et al.* [26] are the optimal parameters under which germination occurs intensively. However, the above-mentioned scientists did not take into account the influence of temperature and soil moisture on the intensity of seed germination.

Research conducted by M. Korkhova & V. Mykolaichuk [27] established that weather conditions during the vegetation phases of plants had a significant impact on the duration of interphase periods and crop formation in the conditions of the Southern Steppe of Ukraine of durum winter wheat varieties during 2014-2020. the duration of the "sowing-planting" period has the amount of precipitation. The duration of the period "seedlings-termination of vegetation", "emergence into the tube-beginning of earing" and "milk-wax maturity" depended to a greater extent on the sum of effective temperature and precipitation. The average daily air temperature has a greater effect on the duration of the rest period and the "restoration of spring bushing – exit to the tube".

The research of Yu.Yu. Chuprina *et al.* [28] found that the duration of the interphase period "sowing-seedling" of winter wheat was more influenced by the amount of precipitation, but the scientists did not take into account the moisture of the seed layer of the soil, which is a more important indicator. It was determined that, on average, over the years of research, the interphase period of BBCH 00-09 lasted from 13 to 14 days at a moisture content of the seed layer of the soil of 22.2-22.4 mm, while it lasted 11 days at a moisture content of 46.8 mm.

The results of the research conducted by M. Mostipan *et al.* [7] it was established that the productive reserves of water in the soil during spring renewal are critical for the formation of the winter wheat crop, and the later the spring renewal of winter wheat, the lower the productivity of the crop. The shorter the time between average daily temperatures above 0°C and the beginning of vegetative activity of plants, the greater the yield of winter wheat. Therefore, it is necessary to adjust agricultural techniques for growing winter wheat in spring and summer in accordance with the weather conditions of early spring and the time of plant vegetation recovery in spring.

Research conducted by K.A. Kazi also established that the germination rate of winter wheat seeds is affected by the moisture of the seed layer of the soil and the air temperature [21], the results showed that the optimal soil moisture should be 48%, and the air temperature should be 21.9°C under irrigation conditions, which is higher than with the results of our research, on average over two years by 1.2% and 5.2°C, respectively.

Soil temperature is also important for the germination of winter wheat seeds, the seed germination period was shorter (16 days) when the average soil temperature was 12.9-16.5°C. Research by V.P. Tkachuk & T.M. Tymoshchuk [29] this regularity is confirmed. On average, over 20 years of research, the duration of the interphase period of "Sivba-seedling" winter wheat was 16 days, and the soil temperature at a depth of 5 cm was 14.9°C.

Based on the results of three-year (2015/2016-2017/2018) research by T. Kolev *et al.* [30], carried out in the Experimental and Implementation Base of the Agrarian University (Plovdiv, Bulgaria) determined that the duration of the interphase period "Macrostage 1: Development of leaves of VVSH 10-12" of winter wheat

was 19 days and did not significantly depend on the average daily air temperature and the amount of precipitation. However, the above-mentioned scientists did not study other equally important meteorological factors that have a greater influence on the shortening or lengthening of this period. It was established that the duration of the interphase period of VVSH 10-12 was significantly influenced by soil moisture and temperature, and the amount of precipitation and air temperature was insignificant.

It was determined that the duration of the BBCH 20-22 interphase period of winter wheat of the studied varieties was 19-26 days depending on the moisture conditions. Research by A. Esaulko and others. [31] studied changes in the duration of interphase periods of winter wheat plant development in the arid zone of the Central Transcaucasia, which depended more on the sum of positive temperatures. It was established that positive temperature changes and drought lead to an increase in the length of growing seasons, a thinning of plant density and a decrease in the productivity of drought-resistant varieties.

Research conducted by V.V. Bezpalko *et al*. [32] and S. Turebayeva *et al*. [33] established that one of the most important periods of winter grain vegetation is the "trubbing" phase. During this period, lateral shoots and a secondary root system are formed from the underground nodes of the stem, that is, the organs that determine the yield of the crop are laid. Indicators of productive weeding depend on the conditions of the autumn-winter period. During the conducted studies, the interphase period of "seedlings-tillering" fell on the third decade of September and the first decade of October, the duration of the period ranged from 13 to 19 days, which was also confirmed by our research under irrigation conditions, but in variants without irrigation, the passage of this vegetation period increases to 25 days on average for the studied varieties.

Therefore, the studies of the above-mentioned scientists established a significant influence of weather conditions on the duration of interphase periods of autumn vegetation of plants of winter wheat varieties, but this issue has not been sufficiently studied under irrigation conditions. The effect of soil temperature and humidity on the length of reporting periods was almost not taken into account. Therefore, it is the new results of research with winter wheat varieties common in the South of Ukraine under conditions of irrigation and natural humidification that are relevant, especially under conditions of climate change.

CONCLUSIONS

As a result of field research conducted in 2020-2021, it was determined that the duration of the interphase period of BBCH 00-09 winter wheat plants was more influenced by the moisture content of the seed layer, which under irrigation was 46.5-47.1%, which by 23.1-25.9% more than without irrigation.

Under irrigation conditions, the interphase period of winter wheat (BBCH 10-12) was reduced by 2-3 days, compared to the same variants without irrigation. The development of leaves (BBCH 13-19) under irrigation conditions for 1-20 days, depending on the year of research, occurred faster than without irrigation. In 2021, the duration of the BBCH 20-22 interphase period did not differ significantly in the non-irrigated and irrigated options, while in 2020 it was 10-12 days longer than in the irrigated options. Interphase periods in winter wheat plants of the Ovid variety were 1-3 days longer than those of the Duma Odeska variety when grown without irrigation.

In connection with the increase of the average daily air temperature in the Steppe of Ukraine by 1-2°C, which leads to the shift of sowing dates to later dates (1st decade of October), the obtained scientific results should be taken into account by the product manufacturers at the sowing company, namely: start sowing winter wheat without irrigation follows the Ovid variety, which has a longer development period than the Duma Odeska variety, while under irrigation conditions this difference is less noticeable. Taking into account the scientific achievements of other researchers of the topic, further research is needed to study the influence of irrigation and weather conditions on the duration of interphase periods according to the BBCH scale and the productivity of the investigated winter wheat varieties.

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Вплив зрошення та погодних умов на тривалість міжфазних періодів сортів пшениці озимої

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Анотація. Осінній ріст і розвиток рослин залежать від комплексу зовнішніх факторів: середньодобової температури повітря, кількості опадів, вологості посівного шару ґрунту, поживних речовин, світла тощо. За сівби пшениці озимої у більш пізні строки є ризики, що рослини увійдуть в зиму не добре розвиненими. Прискорити проходження міжфазних періодів можна за допомогою зрошення, що є необхідним агротехнічним заходом в Південному Степу України. Мета досліджень – встановити вплив сортових особливостей, зрошення та погодних умов на тривалість міжфазних періодів пшениці озимої в осінній період за міжнародною шкалою. Експериментальні дослідження проводилися впродовж 2020-2021 рр. на чорноземі південному, на базі Навчального науково-практичного центру Миколаївського НАУ з двома сортами пшениці озимої. Під час дослідження використано польовий, лабораторний та порівняльно-розрахунковий методи. Закладання та проведення дослідів проводили згідно методики дослідної справи. Вологість ґрунту визначали термостатно-ваговим методом, а фенофази – окомірним одночасно у всьому досліді. Визначено, що зрошення на 1-2 доби скорочує тривалість міжфазного періоду ВВСН 00-09; на 3 доби – ВВСН 10-12; на 11 діб – ВВСН 13-19; на 5-7 діб – ВВСН 20-22. В природних умовах (без зрошення) тривалість міжфазних періодів (від ВВСН 00-09 до 20-22) росту та розвитку рослин досліджуваних сортів пшениці озимої у 2020 р. становила 93-96 діб, що на 23-25 діб більше, ніж у 2021 р. У рослин сорту Овідій в умовах природного зволоження (без зрошення) міжфазні періоди наставали на 1-3 доби пізніше, ніж у сорту Дума одеська, тоді як в умовах зрошення – без істотної різниці. Отримані наукові результати досліджень сприятимуть ширшому впровадженню зрошення, яке забезпечить швидкий та повноцінний ріст і розвиток рослин пшениці озимої в осінній період, що в подальшому сприятиме підвищенню врожайності та валових зборів зерна

Ключові слова: зрошення, сума ефективних температур, сума опадів, вологість ґрунту, *Triticum aestivum*

UDC 633.16:631.526.32:631.53.04:631.811.98
DOI: 10.56407/2313-092X/2022-26(3)-6

Ukrainian Black Sea Region Agrarian Science
Vol. 26, No. 3

Dynamics of the content of nutrients in winter barley plants depending on the variety, sowing dates and plant growth regulators

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Abstract. The problem of increasing the production of winter barley grain on irrigated lands can be solved thanks to the improvement of the varietal composition, optimization of sowing dates and improvement of the nutrition system, in particular through the use of drugs with growth-regulating properties. Taking into account the important biological role of growth regulators in the plant nutrition system, the aim was to determine the influence of Gummifield Forte brix, MIR and PROLIS on the content of nitrogen, phosphorus and potassium in the main phases of plant development of different varieties of winter barley at optimal and late sowing dates. The research was conducted at the Institute of Irrigated Agriculture (now the Institute of Climate-Oriented Agriculture) of the National Academy of Sciences according to methodological recommendations for conducting field tests under irrigation conditions. In the above-ground mass of plants, straw and grain, the total content was determined: nitrogen – according to Kjeldahl, phosphorus – according to Murphy-Reilly, potassium – using a flame photometer. It was determined that on the irrigated lands of the South of Ukraine, the use of growth regulators Gumifield Forte brix, MIR and PROLIS had a significant effect on the accumulation of the main nutrients (especially nitrogen) by plants and winter barley grains. The highest content of basic nutrients in plants was at the early stages of development (spring tillering), after which their amount decreased until the end of the growing season of the crop. The maximum nitrogen content of 2.02% on dry matter on the Dev'iatyi val variety and 1.85% on the Academichnyi variety was provided by the use of Gummifield Forte Brix.Among the varieties, the Dev'iatyi val, on average, accumulated nitrogen in the grain for sowing on October 1 and 20 by 9.1 and 9.5 percentage points more than Akademichnyi, according to the plant growth regulator factor. Thanks to the treatment of winter barley seeds with plant growth regulators Gumifield Forte Brix and PROLIS and sowing the crop at the optimal time, it is possible to increase the nitrogen content in plants and grain by 6.0-15.1 and 9.3-22.5 percentage points, respectively, which will have a positive effect on grain formation and its quality. In further studies, it is necessary to optimize the application doses of mineral fertilizers using new multi-component growth regulators of winter barley plants under irrigation conditions in the South of Ukraine

Keywords: nitrogen, phosphorus and potassium content, biomass, sowing dates, multi-component preparations, irrigation

INTRODUCTION

The latest projections from the United Nations suggest that the world's population could grow to approximately 8.5 billion in 2030 and 9.7 billion in 2050, reach a peak of 10.4 billion people in the 2080s [1-3]. Considering that the population will increase by 1.7 billion people by 2050, and another 0.7 billion by 2080, there is a serious problem of providing them with food, a problem that will only worsen with time. Such an increase in the global population will occur under global climate change [4-6], from the adverse consequences of which vulnerable population groups will suffer the most [7; 8], which will require new methods of stabilizing and increasing the production of agricultural products. It is important to do this in an environmentally sound way

Article's History:
Received: 09.04.2022
Revised: 23.06.2022
Accepted: 26.08.2022

Suggested Citation:
Zaiets, S., Onufran, L., Fundirat, K., Yuzyuk, S., & Kisil, L. (2022). Dynamics of the content of nutrients in winter barley plants depending on the variety, sowing dates and plant growth regulators. *Ukrainian Black Sea Region Agrarian Science*, 26(3), 66-76.

by reviewing many existing approaches to agriculture, including plant nutrition, variety policies and sowing timing.

Barley is one of the most widespread grain crops in the world [9-11]. Its grain is widely used for fodder, food and technical purposes [12-14]. Considering the national economic importance of this crop, barley requires considerable attention and a careful technological approach.

In recent years, the areas of winter barley sowing have expanded significantly, both in the EU countries and in Ukraine. If at the beginning of the 21st century it was sown in Ukraine on an area of 300-500 thousand hectares, then in the last ten years – 0.9-1.5 million hectares [15; 16]. Mainly, its areas increase due to the decrease in spring barley crops. The main factors that give it an advantage over spring barley are high potential productivity, more efficient use of moisture and precipitation of the autumn-winter period, and early ripening [17], which allows growing agricultural crops in repeated crops under irrigation.

In recent years, the yield of winter barley in Ukraine has increased from 2.0 t/ha to 3.4 t/ha, or 1.7 times, but, unfortunately, it is two times lower than the indicator in the EU countries – 7.0 t/ha [18; 19]. That is, domestic agricultural producers are faced with the task of further increasing its yield.

Increasing and stabilizing the production of winter barley grain is possible only with clear and maximally effective implementation of all elements of growing technology. Among the most important and reliable factors for increasing the yield and quality of barley grain are the use of high-yielding varieties, their sowing at the optimal time and the use of biological growth regulators.

Varieties and hybrids of foreign selection can ensure the yield of winter barley at the level of 9-10 t/ha [20]. Currently, domestic breeders have also created new varieties of winter barley, the yield potential of which reaches 8-9 t/ha and more [21]. The use of these varieties can significantly increase the level of competitiveness of grain production of this valuable crop.

Global changes in climatic conditions that have occurred in recent decades require a certain correction in the technology of growing most agricultural crops, its adaptation to adverse abiotic factors. The first changes in the sowing dates of winter grain crops have already been made towards later dates [22-24].

It is known that the use of metabolites and phytohormones in crop production contributed to the development of the industry by stimulating growth processes and optimizing the ripening of agricultural crops [25-27], as well as influencing the formation of the root meristem [28; 29].

In the coming years, among the most priority directions is the increase in the production of high-quality grain, where plant growth regulators and microbiological preparations with growth-regulating properties can play an important role [30-32]. There are known types of biostimulants, including amino acids, humic substances, algae extracts, preparations based on microbes and others [33-35]. However, how plant growth regulators change the absorption of winter barley biomass of the main nutrients: nitrogen, phosphorus and potassium during irrigation has not been sufficiently studied.

Therefore, the purpose of the research was to determine the parameters of the accumulation of nutrients by plants in the main phases of the development of winter barley, depending on the varieties, sowing dates and multicomponent growth regulators in the conditions of irrigation in the south of Ukraine.

LITERATURE REVIEW

During an active physiological process, the plant absorbs nutrients, the content of which depends on both direct and indirect factors [36; 37]. It is believed that in order to obtain a higher yield, field crops must absorb a large amount of nutrients from the soil [38; 39]. However, the reaction of plants to nutritional conditions in different periods of vegetation is different, and the absorption of elements, due to the change in the nature and orientation of biochemical processes, is uneven.

According to the researches of V.V. Zerling, in the budding phase of plants, the optimal content of mineral nutrients in above-ground biomass should be 4.7-5.3% nitrogen, 0.55-0.65% phosphorus, and 4.2-4.2% potassium [40]. Due to the improvement of mineral nutrition, the content of these elements in the plant increases [41; 42].

A number of researchers also believe that the maximum amount of the main nutritional elements of the winter barley plant is accumulated at the beginning of spring tillering, and then their content gradually decreases and reaches the lowest values at the end of the growing season of the crop [43-45]. Having data on the actual content of nutrients at the beginning of spring bushing, it is possible to adjust the doses of fertilizers in the subsequent phases of plant development.

Among the main elements of plant nutrition necessary for the formation of grain yield, nitrogen occupies the most important place, since it plays a decisive role in almost all metabolic processes of plants, and its deficiency leads to a decrease in grain production [46; 47]. In almost all agricultural soils, including in Ukraine, nitrogen is at a minimum, or is a universal deficiency [48]. Therefore, when growing agricultural crops, nitrogen fertilizers should be used in the first place. On the dark chestnut soils of the south of Ukraine, under the condition of growing winter barley on irrigated lands, the optimal application rate should be N90 [49].

Scientists of the EU, USA and other countries of the world believe that, along with fertilizers and pesticides, plant growth regulators should occupy an important place in the technology of production of plant products. The use in the production of biological preparations improves the use of nutrients by plants, promotes the development of the root system and the

resistance of the culture to adverse climatic conditions, as a result of which the condition of plants improves and their productivity increases [50-52]. Research conducted in EU countries [53; 54], Japan [55] and Ukraine [56] on grain crops, their influence on plant growth and development has also been documented. Therefore, the wide use in the production of growth regulators, which contain a balanced complex of phytoregulators, biologically active substances and microelements, is one of the possible factors in the regulation of plant growth processes and crop formation.

A number of researchers showed the mechanisms of the positive effect of phytohormones on cell division, the processes of photosynthesis and respiration, assimilation of nutrients by grain crops [57-59]. It was also established that the use of growth regulators contributes to the increase of nitrogen absorption by winter crops [60]. At the same time, the accumulation of nitrogen and phosphorus in plants was lower than in the later sowing period [61]. That is, due to late sowing dates, incorrectly formed sowing parameters have a negative effect on the growth and development of plants [62; 63], and therefore on the absorption of nutrients.

In addition, the background of plant nutrition is determined by varietal characteristics, since varieties react differently to the main elements of technology [64; 65].

That is, increasing the yield of agricultural crops with the use of growth regulators largely depends on sufficient provision of the nutritional background in combination with optimal sowing dates, as well as on the biological properties of the variety.

However, the influence of new multicomponent plant growth regulators on the accumulation of the main macronutrients during the growing season of winter barley, sown at different times on irrigated lands, has not been investigated before.

The relevance of conducting this research and summarizing the experimental material is due to the importance of the biological role of growth regulators and the limitation of scientific data on their influence on the content of nitrogen, phosphorus and potassium in plants of modern varieties of winter barley grown under irrigation conditions.

MATERIALS AND METHODS

To assess the potential ability of winter barley to accumulate nitrogen, phosphorus and potassium and spend them during the growing season of plants, the results of field and laboratory studies of the Department of Agricultural Technologies and the Laboratory of Analytical Research of the Institute of Irrigated Agriculture (now the Institute of Climate-Oriented Agriculture) of the National Academy of Sciences were used.

The research was carried out under irrigation conditions during 2016-2019 on a dark chestnut medium loamy slightly saline soil characterized by the following agrochemical and agrophysical parameters: humus content in the arable layer – 2.3%, density – 1.37 g/cm^3, moisture in humidity – 9.1%, the lowest moisture content – 20.3%; nitrates (according to Grandval-Liage) 7.9-24.2 mg/ha, mobile phosphorus (according to Machigin) – 53.8-83.9 mg/kg and exchangeable potassium (on a flame photometer) – 231-281 mg/kg of soil; the reaction of the soil solution is close to neutral, the pH of the salt extract is 7.1. Taking into account the low content of nitrogen in the soil and the high content of phosphorus and potassium, only ammonium nitrate in the dose of N45 was used for pre-sowing cultivation and in early spring, N45 was added.

The predecessor was soybeans harvested for grain. The technology of growing winter barley is generally accepted for the zone under irrigation conditions (except for the elements that were studied).

The experiment is three-factor: Factor A (barley varieties): Academichnyi and Dev'iatyi val, which have been included in the state register of plant varieties suitable for distribution in Ukraine since 2011 and 2014. Factor B (sowing dates): optimal (October 1) and late (October 20). Factor C (growth regulators): control (without treatment); Gumifield Forte Brix (seed treatment 0.8 l/t); MIR (seed treatment 6 g/t); PROLIS (seed treatment 5 g/t).

Features of the components and characteristics of the investigated plant growth regulators:

Gumifield Forte Brix, v.s. – highly effective, water-soluble, universal growth regulator, adaptogen and anti-stressor based on ammonium humate, the most active form of humate, contains 60 g/l of seaweed extract, which includes a complex of phytohormones and physiologically active substances, 135 g/l of humic acid salts, in h.: amino acids – 20 g/l, potassium (K2O) – 20 g/l and trace elements – 5 g/l, pH – 10-11 [66].

The drug MIR MARKA Z is a multi-purpose plant growth regulator created on the basis of synthetic compounds, contains heteroauxin – 10-20%, humic acids – 70-80% and a full range of trace elements useful for plants in chelated form: Fe – 0.6-0.8%, Mg – 3.6-5.3%, Mn – 0.7-2.6%, Zn – 1.1-5.0%, Mo – 0.2-1.0%, Cu – 0.6-0.8%, B – 0.5-1.2%) [67].

Plant growth regulator PROLIS TM – L-α proline heterocyclic amino acid (pyrrolidine-α-carboxylic acid), 995 g/kg, C5H9NO2, water-soluble powder, intended for biotic and abiotic stress reduction of plants, regulates the assimilation of macro- and microelements, and also stimulates immune system of plants [68].

Repeatability in experiments is three times. Variants were placed by the method of randomization. The sown area of the plots was 38.8, accounting – 28.6 m^2.

In the above-ground mass of plants, straw and grain, the total content was determined: nitrogen – according to Kjeldahl, phosphorus – according to Murphy-Reilly, potassium – using a flame photometer.

RESULTS AND DISCUSSION

The obtained data indicate that the treatment of winter barley seeds with multi-component plant growth regulators Gumifield Forte Brix, MIR and PROLIS increased the nitrogen content in plants. Thus, in the phase of spring bushing in the plants of the Akademichnyi variety after sowing on October 1 and 20 without the use of plant growth regulators, nitrogen was contained on average 3.14% and 3.17% on dry matter, respectively, and when they were applied it was significantly more – 3.34 -4.10% and 3.36-3.65% (Table 1).

Table 1. *Dynamics of nitrogen content in winter barley plants depending on the variety, sowing dates and plant growth regulators, % (average for 2017-2019)*

Variety	Sowing dates	Background of nutrition and plant growth regulators	Phases of plant development			
			Tillering	Launch into the tube	Earing	Full ripeness
		Nitrogen				
Akademichny	1 October	N_{90}	3.14	2.05	1.21	0.38
		N_{90} + Gumifield	3.34	1.88	1.16	0.39
		N_{90} + MIR	3.42	2.19	1.23	0.41
		N_{90} + PROLIS	4.10	1.73	1.49	0.38
	20 October	N_{90}	3.17	2.37	1.01	0.35
		N_{90} + Gumifield	3.43	2.29	1.19	0.36
		N_{90} + MIR	3.36	2.03	1.21	0.35
		N_{90} + PROLIS	3.65	2.50	1.44	0.33
Dev'iatyi val	1 October	tilleringN_{90}	4.11	2.57	1.47	0.43
		N_{90} + Gumifield	4.31	2.63	1.51	0.44
		N_{90} + MIR	4.15	2.65	1.45	0.45
		N_{90} + PROLIS	4,24	2.39	1.32	0.44
	20 October	N_{90}	3.82	2.57	1.32	0.35
		N_{90} + Gumifield	4.43	2.58	1.49	0.41
		N_{90} + MIR	4.05	2.72	1.42	0.47
		N_{90} + PROLIS	4.18	2.05	1.21	0.43

Source: *developed by the authors*

A similar pattern was also observed in the two-handed variety Dvyatiy val, but with a slightly higher nitrogen content in the plants. When sowing this variety on October 1 and 20 without the use of plant growth regulators, the nitrogen content was 4.11-3.82% on dry matter, respectively, and when they were applied – 4.15-4.31 and 4.05-4.43%, or by 0.04-0.20 and 0.23-0.61% more. At the same time, regardless of the timing of sowing, the Academichnyi variety provided the largest amount of this element in plants with the use of the PROLIS drug, and the Dev'iatyi val – Gummifield Forte Brix.

The data in Table 1 show that the most nitrogen in winter barley plants was contained in the tillering phase, after which its amount sharply decreased until the grain was fully ripe. Thus, during the period of tillering, the nitrogen content in plants was 3.14-4.43%, in the phase of emergence into the tube, its amount decreased to 1.73-2.72%, during earing – to 1.01-1.51%, and at full ripeness – up to 0.33-0.47%, which is due to its gradual consumption for growth processes and grain formation. The minimum nitrogen content in relation to the mass of dry matter was found in the phase of full ripeness of the grain, which is 88-91% less, compared to the tillering phase.

This can be explained by the anticipatory consumption of nitrogen by plants for the synthesis of organic matter in the second half of the growing season over the arrival of this nutrient through the root system.

It has been established that the process of phosphorus accumulation by winter barley plants also takes place more intensively at the beginning of spring bushing. Thus, in the indicated phase of development, the content of this element in plants of the Academichnyi variety, depending on the research options, ranged from 1.05 to 1.32%, and in the two-armed variety, Dev'iatyi val, 1.14 to 1.28% (Table 2).

Table 2. *Dynamics of phosphorus content in winter barley plants depending on the variety, sowing dates and plant growth regulators, % (average for 2017-2019)*

Variety	Sowing dates	Background of nutrition and plant growth regulators	Phases of plant development			
			Tillering	Launch into the tube	Earing	Full ripeness
		Phosphorus				
Akademichnyi	1 October	N_{90}	1.31	0.87	0.63	0.21
		N_{90} + Gumifield	1.31	0.92	0.55	0.17

Table 2, Continued

Variety	Sowing dates	Background of nutrition and plant growth regulators	Phases of plant development			
			Tillering	Launch into the tube	Earing	Full ripeness
		Phosphorus				
Akademichnyi	1 October	N_{90} + MIR	1.32	0.85	0.58	0.17
		N_{90} + PROLIS	1.27	0.86	0.65	0.16
	20 October	N_{90}	1.09	0.81	0.57	0.18
		N_{90} + Gumifield	1.07	0.80	0.56	0.19
		N_{90} + MIR	1.05	0.75	0.57	0.17
		N_{90} + PROLIS	1.08	0.80	0.56	0.19
Dev'iatyi val	1 October	N_{90}	1.14	0.82	0.65	0.22
		N_{90} + Gumifield	1.25	0.80	0.62	0.21
		N_{90} + MIR	1.23	0.82	0.59	0.20
		N_{90} + PROLIS	1,27	0.87	0.60	0.23
	20 October	N_{90}	1,27	0.82	0.55	0.22
		N_{90} + Gumifield	1.28	0.83	0.57	0.21
		N_{90} + MIR	1.28	0.76	0.59	0.17
		N_{90} + PROLIS	1.18	0.79	0.56	0.22

Source: *developed by the authors*

If in plants of the Akademichnyi variety, a greater amount of phosphorus was accumulated during sowing on October 1, then in the two-handed variety Dev'iatyi val, no difference between the sowing dates was observed. Also, there were no changes in the phosphorus content in plants after seed treatment with growth regulators Gumifield Forte Brix, MIR and PROLIS, which is explained by its rather high content in the dark chestnut soil.

When the plants entered the tube, compared to the beginning of spring bushing, the phosphorus content decreased by 25-41 percentage points and ranged between 0.75-0.92%. The minimum amount of phosphorus in the vegetative organs of plants is noted when the grain is fully ripe (0.16-0.23%). There was no significant difference between the experimental variants in the accumulation of winter phosphorus by barley plants.

Therefore, it can be assumed that the largest part of phosphorus accumulates in plants at the early stages of organogenesis (spring tillering) and is sufficient to provide barley plants until the end of the growing season.

The maximum content of total potassium in winter barley plants of both varieties was also noted during spring tillering – 3.15-3.71% (Table 3).

Table 3. *Dynamics of potassium content in winter barley plants depending on the variety, sowing dates and plant growth regulators, % (average for 2017-2019)*

Variety	Sowing dates	Background of nutrition and plant growth regulators	Phases of plant development			
			Tillering	Launch into the tube	Earing	Full ripeness
Akademichnyi	1 October	N_{90}	3.48	2.98	1.93	1.62
		N_{90} + Gumifield	3.15	3.11	2.08	1.72
		N_{90} + MIR	3.50	3.20	1.92	1.66
		N_{90} + PROLIS	3.25	2.90	2.07	1.58
	20 October	N_{90}	3.37	3.30	2.10	1.51
		N_{90} + Gumifield	3.32	3.23	2.06	1.52
		N_{90} + MIR	3.42	2.95	1.79	1.46
		N_{90} + PROLIS	3.34	2.86	1.95	1.66
Dev'iatyi val	1 October	N_{90}	3.29	3.34	1.93	1.33
		N_{90} + Gumifield	3.26	3.08	2.04	1.43
		N_{90} + MIR	3.47	3.30	2.10	1.44
		N_{90} + PROLIS	3.55	3.31	2.07	1.44
	20 October	N_{90}	3.51	3.37	1.95	1.52
		N_{90} + Gumifield	3.71	3.32	2.05	1.60
		N_{90} + MIR	3.63	3.38	1.92	1.67
		N_{90} + PROLIS	3.33	3.01	2.10	1.56

Source: *developed by the authors*

Starting with spring bushing and before the plants emerge into the tube, the content of this element almost does not change. During the following periods, a gradual decrease in the amount of potassium in plants is noted: in the interphase period, "exiting the tube-earing" – up to 1.79-2.10%, and "earing – full grain maturity" – up to 1.33-1.72% depending on the options of the experiment.

It should be noted that there was no significant difference in the content of potassium in the plants in the experimental variants, due to its high content in the soil.

It was established that on the dark chestnut soil under irrigation, the highest content of nitrogen, phosphorus and potassium in plants was at the early stages of development (spring bushing), after which their amount decreased until the end of the growing season. These data indicate that in the early stages of winter barley vegetation, nitrogen, phosphorus and potassium accumulate in plants, creating a reserve of them, due to which later, in the process of reutilization, the vital activity of plants is ensured.

A.H. Musatov [69] pointed out that pointed out that thanks to the repeated use of plants, for some time, they ensure the growth of new tissues due to the internal reserves of nutrients formed earlier in the stems, if they do not come from the outside.

The obtained data on the content of nitrogen, phosphorus and potassium in the biomass of plants during the spring tillering of winter barley can serve as a basis for diagnosing and correcting the main macronutrient nutrition of the crop, as well as assessing the quality of agricultural products.

It was found that the growth and development of plants of the Academichnyi and Dev'iatyi val varieties was best when the content of nutrients in plants in the budding phase was: nitrogen 4.10-4.43%, phosphorus 1.23-1.32 and potassium 1.44-1.72% on dry matter.

There was no significant difference in the content of nutrients in plants and the dynamics of their content by development phase between the Academichnyiian and Dev'iatyi val varieties. Only in terms of nitrogen content, it was slightly higher in all phases of development on the Dev'iatyi val variety. On the other hand, according to the indicator of phosphorus and potassium in plants, the varieties are quite close.

Seed treatment with complex plant growth regulators and sowing dates affected the content of total nitrogen, phosphorus and potassium in winter barley grains. If during the cultivation of winter barley during irrigation, the content of potassium in the by-products (straw) significantly outweighed the values of nitrogen and phosphorus, then the grain contained the most nitrogen, then phosphorus, and the least - potassium.

The lower content of phosphorus and potassium in winter barley grains compared to nitrogen can be explained by the lack of application of these elements with fertilizers and their washing out from the arable layer of the soil due to vegetation irrigation.

The data shown in Figure 1 show that in winter barley of the Akademichnyi and Dev'iatyi Val varieties for sowing on October 1, the nitrogen content with the use of plant growth regulators exceeded the control options by 9.3-22.5 and 9.4-18.1 relative points depending on the drug.

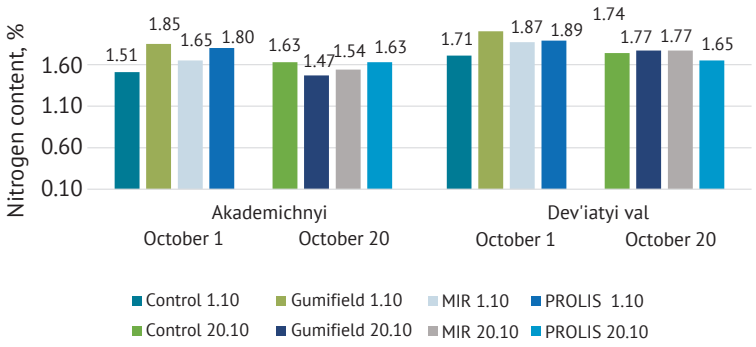

Figure 1. *Nitrogen content in winter barley grains depending on the variety, sowing dates and plant growth regulators, % on dry matter (average for 2016-2019)*

Source: *developed by the authors*

That is, during the specified sowing period, seed treatment with plant growth regulators of both varieties of winter barley had a positive effect on the nitrogen content in the grain. The use of Gumifield Forte Brix provided the maximum nitrogen content of 2.02% on dry matter in the Dev'iatyi val variety and 1.85% in the Academichnyi variety.

Another regularity was observed for sowing at a later date, on October 20. No advantages of using plant growth regulators over variants without them have been established on the Akademichnyi variety, and on the Dev'iatyi val variety – an excess of 3.5 relative points was provided only by the preparations Gumifield Forte Brix and MIR.

Among the "two-handed" varieties, the Dev'iatyi val, on average, accumulated nitrogen in the grain for sowing on October 1 and 20 by 9.1 and 9.5 relative points more than the typical winter Akademichnyi, according to the factor of plant growth regulators. This indicates that plants of the alternative dicot variety accumulated more nitrogen during the formation of more developed biomass.

Phosphorus content in winter barley grain compared to nitrogen had the opposite relationship, i.e. treatment of seeds with growth regulators did not lead to an increase in this nutrient, but on the contrary – in most cases to its decrease by 1.2-32.5 relative points (Fig. 2).

The largest difference between variants with plant growth regulators and without them in terms of the content of the specified nutrient in the grain was observed in the Academichnyi variety for sowing in the later period of October 20 and was 25.0-32.5 relative points. In the other studied options, varietal traits, sowing dates and biological preparations did not affect the accumulation of phosphorus.

The potassium content in the grain was also almost unaffected by varietal characteristics. Whereas during sowing on October 1, treatment of seeds with plant growth regulators in most cases led to its decrease by 2.2-6.8 percentage points (Fig. 3).

With the sowing of the Academichnyi grade in the later period of October 20 and thanks to the use of preparations, there was an increase in potassium content by 2.2-4.1 percentage points, while without them, on the contrary, a decrease by 8.2.

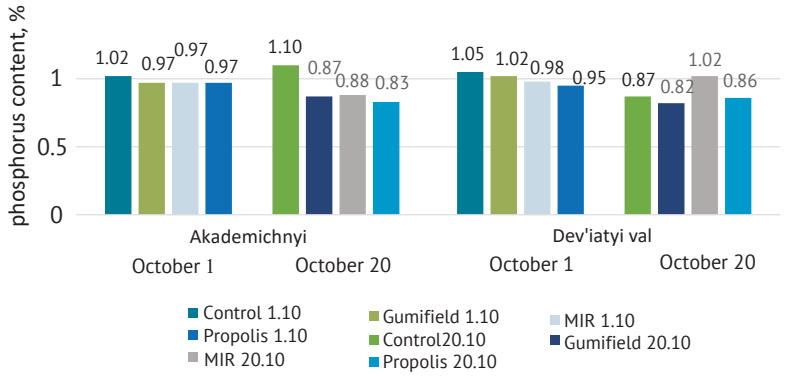

Figure 2. *Phosphorus content in winter barley grains depending on the variety, sowing dates and plant growth regulators, % on dry matter (average for 2016-2019)*

Source: *developed by the authors*

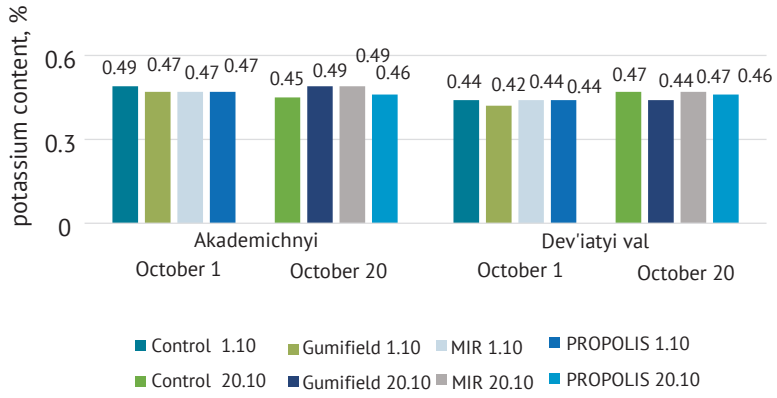

Figure 3. *Potassium content in winter barley grains depending on the variety, sowing dates and plant growth regulators, % on dry matter (average for 2016-2019)*

Source: *developed by the authors*

Sowing the two-handed variety Vyatiay val in the specified period, compared to October 1, with the application of growth regulators, increased the accumulation of potassium in the grain by 4.3-6.4, and also without them – by 6.4 percentage points. However, such differences in grain potassium accumulation between the investigated variants are not significant.

Experimental data show that the use of growth regulators improved, first of all, nitrogen nutrition of winter barley and almost did not affect the accumulation of phosphorus and potassium, both in plants and in grain. It was found that seed treatment with plant growth regulators can improve the accumulation of nutrients in winter barley after earing and increase the transition, mainly nitrogen, from vegetative organs to grain, thereby creating a favorable basis for crop formation.

Based on the results of research, we believe that the use of drugs with growth-regulatory properties for the

cultivation of agricultural crops has a perspective, as it solves the problems of plant nutrition and environmental protection by reducing the use of mineral compounds.

CONCLUSIONS

The scientific novelty of this study is that, for the first time, experimental data were obtained on dark chestnut medium loamy soil under irrigation conditions in the south of Ukraine, which testifies to the significant influence of the multi-component plant growth regulators Gumifield Forte Brix, MIR and PROLIS on the variability of the content of the main nutrients in the biomass, and also in grain of various varieties of winter barley.

With a low content of nitrogen in the soil and increased phosphorus and potassium, against the background of the application of N90, the treatment of winter barley seeds with the indicated preparations, both at the optimal and late sowing times, increased the nitrogen content in plants and grain and practically did not affect the accumulation of phosphorus and potassium.

The two-handed variety Dev'iatyi val accumulated more nitrogen in all phases of plant development than the typical winter Akademichnyi, but they are quite close in terms of phosphorus and potassium content.

Regardless of the timing of sowing, the Academichnyi grade accumulated the largest amount of nitrogen in plants and grain with the use of PROLIS and Gumifield Forte Brix preparations, and the Dev'iatyi val – Gumifield Forte Brix.

The practical value of these studies lies in the fact that the use of multicomponent growth regulators in the treatment of winter barley seeds will contribute to the increase of nitrogen content in biomass, as one of the most important elements necessary for plant nutrition, their growth and development, and the formation of grain yield.

In the further scientific plans on the irrigated lands of the south of Ukraine, research should be provided to determine the optimal doses of mineral fertilizers for the use of new multicomponent plant growth regulators of winter barley.

ACKNOWLEDGMENTS

The author expresses his sincere gratitude to the scientific and methodological council of the Institute of Irrigated Agriculture (now the Institute of Climate-oriented Agriculture) of the National Academy of Sciences for the opportunity to conduct research on the topic of the article and to include the task in the thematic plan of the institute for the implementation of the State program of scientific research "Scientific foundations of the formation of agricultural systems on irrigated lands" ("Irrigated Agriculture"), as well as to the staff of the Analytical Research Laboratory of the Institute of Irrigated Agriculture of the National Academy of Sciences under the leadership of Candidate of Agricultural Sciences Olena Volodymyrivna Shkoda for determining the content of nitrogen, phosphorus and potassium nutrients in plants and winter barley grains.

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Динаміка вмісту елементів живлення в рослинах ячменю озимого залежно від сорту, строків сівби та регуляторів росту рослин

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Анотація. Проблему зі збільшення виробництва зерна ячменю озимого на зрошуваних землях можна вирішити завдяки покращенню сортового складу, оптимізації строків сівби та поліпшенню системи живлення, зокрема через застосування препаратів із росторегулюючими властивостями. Враховуючи важливу біологічну роль регуляторів росту в системі живлення рослин, ставилось за мету визначити вплив Гуміфілд Форте брікс, МИР і PROLIS на вміст азоту, фосфору й калію в основні фази розвитку рослин різних сортів ячменю озимого за оптимального та пізнього строків сівби. Дослідження проводилися в Інституті зрошуваного землеробства (нині Інститут кліматично орієнтованого сільського господарства) НААН за методичними рекомендаціями щодо проведення польових випробувань в умовах зрошення. У надземній масі рослин, соломі і зерні визначали вміст загальний: азоту – за К'єльдалем, фосфору – за Мерфі-Рейлі, калію – на полум'яному фотометрі. Визначено, що на зрошуваних землях Півдня України застосування регуляторів росту Гуміфілд Форте брікс, МИР і PROLIS істотно впливало на акумуляцію основних елементів живлення (особливо азоту) рослинами та зерном ячменю озимого. Найбільший вміст основних елементів живлення в рослинах був на ранніх етапах розвитку (весняне кущення), після чого їх кількість зменшувалась до кінця вегетації культури. Максимальний вміст азоту 2,02 % на суху речовину на сорті Дев'ятий вал та 1,85 % на сорті Академічний забезпечило використання препарату Гуміфілд Форте Брікс. Серед сортів Дев'ятий вал у середньому за фактором регулятора росту рослин акумулював азоту в зерні за сівби 1 і 20 жовтня на 9,1 та 9,5 відсоткових пункти більше, ніж Академічний. Завдяки обробці насіння ячменю озимого регуляторами росту рослин Гуміфілд Форте Брікс і PROLIS та сівби культури в оптимальні терміни можна підвищити вміст азоту в рослинах і зерні відповідно на 6,0-15,1 та 9,3-22,5 відсоткових пункти, що позитивно позначиться на формуванні зерна та його якості. У подальших дослідженнях необхідно оптимізувати дози внесення мінеральних добрив за використання нових багатокомпонентних регуляторів росту рослин ячменю озимого в умовах зрошення Півдня України

Ключові слова: вміст азоту, фосфору і калію, біомаса, терміни висіву, багатокомпонентні препарати, зрошення

UDC 336.76
DOI: 10.56407/2313-092X/2022-26(3)-7

Ukrainian Black Sea Region Agrarian Science
Vol. 26, No. 3

Introduction of the ombudsman institute in the insurance market of Ukraine

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Abstract. The insurance industry plays an important role in the economy, contributing to the intermediation and risk-bearing mechanism. At the same time, the insurance industry contributes to socio-economic growth due to accumulated long-term financial resources that can be directly used in the economy. The purpose of the article is to develop recommendations on the possibility of creating an insurance ombudsman institute in Ukraine based on international experience. The set goal determined the solution of the following tasks: to investigate the legal aspects of the activity of the financial ombudsman in different countries and provide their comparative characteristics; to determine the specifics of the implementation in Ukraine of the alternative dispute resolution mechanism on the insurance market; justify the benefits of activating the activity of the insurance ombudsman institute in Ukraine. In the process of carrying out a scientific search, such general scientific methods as: abstract-logical; monographic; comparative; graphic; dialectical method; comparative legal method; structural-functional method. The peculiarities of the functioning of the relevant alternative mechanisms for resolving insurance disputes in different countries, the mechanisms for dealing with customer complaints, and the resolution of disputes with the participation of a professional mediator were studied. It was determined that in world practice, two main models of financial ombudsmen are usually distinguished: British and German. It is substantiated that the introduction of the insurance ombudsman institute in Ukraine as an alternative platform for considering complaints will have advantages for all participants of the insurance market. It has been proven that the activities of such an institution can consider disputes related to settlement of claims, wrongful sale, payment of insurance premiums, legal registration of the policy, delay of settlements, failure to issue insurance documents, etc. Such an insurance ombudsman institution will be responsible for protecting the interests and handling policyholder complaints, and the main purpose of the ombudsman's activities is to handle policyholder complaints outside the court system in a cost-effective and impartial manner

Keywords: insurance companies, insurance market, dispute resolution, protection of consumer rights, consumers of insurance services

INTRODUCTION

The insurance industry is a major component of the economy due to the amount of premiums it collects, the scale of its investments and, more importantly, the social and economic role it plays in covering personal and business risks. In 2021, insurance companies experienced a slowdown in gross premiums, particularly in the life sector, due to COVID-19 and falling interest rates. However, premium growth remained positive in the non-life insurance sector, while claims declined, particularly in motor insurance, due to reduced car use and fewer accidents following the mobility restrictions associated with COVID-19. This, in turn, contributed to the improvement of underwriting indicators of insurers in the non-life sector [1].

The increase in the volume of the insurance market and the spread of insurance services has an impact on the increase in the number of disputes between market participants. The disputes that arise are related to both the quality of the services provided and the violation of the terms of insurance contracts. Thus, in 2021, the Unified State Register of Court Decisions based on the contextual search for "insurance" includes 431,983

Article's History:
Received: 11.05.2022
Revised: 29.07.2022
Accepted: 06.08.2022

Suggested Citation:
Allakhverdiyeva, I. (2022). Introduction of the ombudsman institute in the insurance market of Ukraine. *Ukrainian Black Sea Region Agrarian Science*, 26(3), 77-86.

court acts related to insurance disputes [2]. According to the annual report "On the state of observance and protection of human and citizen rights and freedoms in Ukraine" [3], during 2019, the Authorized Body received 948 reports from citizens regarding violations of consumer rights, a significant number of which related to violations in the spheres of financial and transport services. At the same time, according to research by the United States Agency for International Development, almost 50% of people do not know where to turn when their rights and interests as consumers of financial services are violated. 80% of people do not want to go anywhere to solve their financial disputes at all, because they do not trust existing channels or consider them ineffective [4]. According to data [5], in the 1st quarter of 2021, 497 appeals (46.4% of the total number) related to the work of insurance companies and contained signs of violation of consumer rights. The given statistics and an imperfect system of resolving disputes related to the receipt of financial services in general and insurance services in particular, the lack of effective consumer protection mechanisms, the low level of financial literacy of the population lead to the need to introduce an institution of alternative dispute resolution between insurance market participants. Attempts to solve these problems have always been fragmentary, and there is no possibility of resolving disputes between insurance companies and consumers in a pre-trial procedure [6]. That is why consideration of the introduction of the insurance ombudsman institute in Ukraine is relevant and necessary. The ombudsman institute can better promote transparency, honesty, accountability and participation of interested parties, contribute to improving the quality of insurance services.

In their research, Per Echeverria & Nicklas Salomonson [7], using a qualitative individual case and ethnographically inspired methodology, explore vulnerability and coping strategies during interaction with the services provided, from the consumer's point of view. This study focuses on understanding the forms of vulnerability consumers experience during service delivery and how consumers use active coping strategies that help them in such situations of vulnerability.

The authors [8] studied the impact of consumer protection policies of financial services on the cost of financial intermediation and found that the presence of internal complaint handling mechanisms, fair treatment requirements, supervisory powers related to consumer protection, and various information disclosure requirements reduce the cost of financial intermediation in developed countries. Similar studies were conducted by scientists [9]. The authors investigate the form of a balanced relationship between clients of financial services and financial institutions. It has been proven that it is the regulators who must better understand and balance the interests of clients and the rights and obligations of financial institutions.

Much attention has been paid by scientists to the consideration of the state of the legislative and regulatory framework for the protection of consumer rights. So, H. Ahmed & I.R. Ibrahim [10] examine the state of the legislative and regulatory framework for consumer protection in Malaysia, a country with a developing economy. Using leximetrics, the authors investigate the regime of protection of the rights of consumers of financial services in the country by studying two aspects of the legal framework: the legal infrastructure and the typology of laws. Malaysia's legal framework for the protection of the rights of consumers of financial services is evaluated in the light of good practice as defined in the international guidelines issued on these topics by the OECD and the World Bank. The results of the study emphasize the complementary nature and different roles that laws, regulations and supporting institutions play in creating a comprehensive system of protection for consumers of financial services.

The purpose of the article is to develop recommendations on the possibility of creating an insurance ombudsman institute in Ukraine based on international experience. The set goal determined the solution of the following tasks: to investigate the legal aspects of the activity of the financial ombudsman in England, France, Germany, Belgium, Switzerland, Poland and provide their comparative characteristics; to determine the specifics of the implementation in Ukraine of the alternative dispute resolution mechanism on the insurance market; justify the benefits of activating the activity of the insurance ombudsman institute in Ukraine.

LITERATURE REVIEW

Proposals regarding the expediency of implementation and the possibility of functioning of appropriate alternative mechanisms for resolving insurance disputes in Ukraine are reflected in the works of scientists. In particular, O.I. Pozniakova & N.M. Dobosh [11] presents the digitization mechanism of the financial ombudsman institute. According to the authors, the implementation of such a mechanism will help resolve insurance disputes or prevent their occurrence with the help of a special electronic platform of the financial ombudsman, which facilitates the cooperation of consumers of financial services with the ombudsman himself. The authors believe that the mediator's active participation is important not only at the stage of resolving disputes, but also to prevent them in the form of dialogue with the consumer and implementation of the rights and obligations of both parties. This will help ensure a high level of participation in insurance and increase the level of public trust in the financial sector.

The work of I.H. Britchenko & V.S. Stand [12] is devoted to the problems of the establishment of the financial ombudsman institute in Ukraine based on the study of international experience. The authors pointed out the importance and necessity of creating an institution

of out-of-court dispute resolution in Ukraine in the form of a financial ombudsman. Scientists have substantiated that the activities of the financial ombudsman will contribute to improving the quality of regulation in the financial market, increasing the level of trust of citizens in financial institutions, and ensuring transparency and openness in the market.

European models of financial ombudsman functioning are considered in the work of I.V. Bassists & A.O. Gorbova [13]. Scientists drew attention to the fact that in the European Union, the institution of out-of-court dispute resolution between financial market participants functions in accordance with regulations or relevant advisory documents, among which Commission Recommendation 98/257/EC of March 30, 1998, developed by the European Commission, occupies an important place [14] on principles applicable to bodies responsible for out-of-court settlement of consumer disputes. In particular, in order to improve the functioning of the system of ombudsmen responsible for handling disputes with consumers, their activities must comply with the principles of independence, transparency, competition, efficiency, legality and freedom of representation.

The scientific work [15] reveals the peculiarities of the activity of the institute for out-of-court settlement of disputes – the financial ombudsman in Poland. The genesis of the establishment of the institution, the peculiarities of the institution's financing, modern trends in dealing with appeals from clients of insurance companies, statistical data on the level of satisfaction of complaints were analyzed, and a number of proposals for improving the regulatory regulation of the financial ombudsman in Ukraine were substantiated based on the positive Polish experience.

Scientists [16] suggested using a systematic approach in the field of protecting the rights of consumers of insurance services. It is substantiated that one of the main foundations of the development of the insurance market is the trust of consumers in the activities of insurance companies.

Studies [17] indicated that it cannot be denied that insurance companies worldwide operate with the primary purpose of making a profit, and it becomes important to ensure that such profit motives do not interfere with the satisfaction of claims made by individuals. To ensure that the claims process is smooth and hassle-free, the Government of India has created the Insurance Ombudsman. This is to speed up the processing of any claims the buyer may have against the insurer. Both private and public insurance are within the competence of the Insurance Ombudsman. Having such a system ensures a fair place for everyone and that people can fully trust the system and receive the benefits it is meant to provide. Thus, the insurance sector also sees optimal growth and it is a win-win situation for all.

Legal and organizational aspects of the ombudsman in insurance were studied in the paper [18]. Based on the study of the European Union's regulatory acts, the main criteria that must be met by the institution providing alternative dispute resolution (ombudsman), namely: accessibility; professionalism, independence, impartiality; transparency; efficiency; fairness (impartiality); freedom.

Studies [19] are devoted to the analysis of the legal framework for regulating the activities of non-banking financial institutions. In particular, the author carried out a critical analysis of the Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine on Improving the Functions of State Regulation of Financial Services Markets" regarding the introduced novelties, as well as identifying positive and negative aspects of these changes. The work [20] emphasizes the important points of the introduction of the institute of alternative methods of dispute settlement in the financial market of Ukraine through the application of the mediation procedure.

Studies [19] are devoted to issues of improvement of the legal framework regulating the activities of non-banking financial institutions. In particular, the author analyzed the novelties introduced by the Law of Ukraine "On Amendments to Certain Legislative Acts of Ukraine Regarding the Improvement of Functions of the State Regulation of Financial Services Markets", investigated the positive and negative aspects of these changes.

The importance of introducing in Ukraine the institute of alternative methods of dispute settlement through the application of the mediation procedure in solving the problem of realizing the rights of each person is emphasized in the work [20].

Despite the significant interest of economists in the study of the institution of the financial ombudsman, the study of the activity of the ombudsman in the insurance market is insignificant. That is why there is an urgent need for a detailed study of world experience regarding the peculiarities of the functioning of this structure, as well as the possibility of implementing its activities in Ukraine.

MATERIALS AND METHODS

The article is aimed at consolidating and conducting a literature review with the aim of summarizing the theoretical foundations of the insurance ombudsman's activities and substantiating practical recommendations regarding the possibility of creating an insurance ombudsman institute in Ukraine based on international experience.

In the process of carrying out a scientific search, the following general scientific methods were used to achieve the specified goal: abstract-logical for substantiating the purpose of the research and for formulating conclusions and recommendations; determining the benefits of the insurance ombudsman's activities for consumers, for insurance companies and for the state as a whole; monographic – to systematize the scientific approaches of scientists to the theoretical aspects of the insurance ombudsman's activities and provide

a comparative description of the two main models of the financial ombudsman: British and German; dialectical method – to study the essence of the concept of the financial ombudsman as an independent person in resolving disputes between financial institutions and their clients (consumers of financial services); comparative legal method – to determine the specifics of the legal framework of the financial ombudsman institute in developed countries and to consider individual provisions of the Ukrainian legislation on establishing the legal status of the insurance ombudsman; comparative method – to carry out a comparative characterization of the main models of the financial ombudsman of different countries, such as England, France, Germany, Belgium, Switzerland, Poland.

The information provision was made up of normative and legal acts of Ukraine, in particular the Laws of Ukraine "On Insurance" [21], "On Financial Services and State Regulation of Financial Services Markets"[22], the Annual Report of the Commissioner of the Verkhovna Rada of Ukraine on Human Rights "On the State of Compliance and Protection rights and freedoms of a person and a citizen in Ukraine" [3]. The OECD report "Global insurance market trends 2021" [1] provides an overview of market trends to better understand the overall performance and state of the insurance industry. This monitoring report was compiled using data from the OECD's global insurance statistics. This edition covers 38 OECD countries, a number of non-OECD Latin American countries through collaboration with the Association of Latin American Insurance Supervisors (ASSAL), as well as selected non-OECD jurisdictions in the Asian region and elsewhere. Official websites of the financial ombudsman of France, Belgium, Germany, Poland, Switzerland.

In accordance with the formulated goal, the stages of the research were: the study of legal aspects of the activity of the financial ombudsman in England, France, Germany, Belgium, Switzerland, Poland and providing their comparative characteristics; determination of the peculiarities of the implementation in Ukraine of the alternative dispute resolution mechanism on the insurance market; justification of the advantages of activating the activity of the insurance ombudsman institute in Ukraine.

The used methodology contributed to solving the task and substantiating practical recommendations regarding the possibility of creating an insurance ombudsman institute in Ukraine based on the study of international experience. The advantages of the introduction of the insurance ombudsman institute in Ukraine as an alternative platform for considering complaints, which will have advantages for all insurance market participants, are substantiated, as well as the principles that should be followed in the activities of the insurance ombudsman institute are determined.

RESULTS AND DISCUSSION

An important role in the settlement of disputes between financial market participants and the protection of consumer rights in France, Belgium, Switzerland, and England is played by the state in the form of bodies that regulate insurance markets or specialized independent state institutions financed by state funds that have a wide range of regulatory, control and law enforcement powers to protect the interests of consumers. In addition to these powers, such state institutions also perform the functions of considering consumer appeals and complaints. The world's leading countries actively involve not only state bodies in the regulation of these issues, but also strengthen the role of institutions engaged in alternative dispute resolution between consumers and insurance companies.

International acts emphasize the need to create a system to protect consumer rights. In particular, the resolution of disputes with the participation of a professional mediator is based on the provisions of Directive 2013/11/EU of the European Parliament and the Council of 21.05.2013 on alternative dispute resolution with the participation of consumers [23], an important place is occupied by Commission Recommendation 98/257/EU developed by the European Commission dated March 30, 1998 [14] on principles applicable to bodies responsible for out-of-court settlement of consumer disputes.

The existence of such an institute is a common practice. The essence and purpose of such an institution is solely to resolve disputes between consumers and financial service providers to improve the quality of consumer trust in the financial services market. The tasks of the Financial Ombudsman of Poland [24] include, in particular, consideration of reports on individual cases submitted due to the rejection of customer claims by financial service providers within the framework of the appeal procedure, as well as reports on the failure to take action on the basis of complaints considered in accordance with the wishes of the customer. The Financial Ombudsman can file lawsuits on behalf of customers of financial service providers in cases of unfair market practices related to the activities of such entities, as well as participate in pending cases with the consent of the plaintiff. The Financial Ombudsman can impose a financial fine of up to PLN 100,000 on a financial service provider who violates the obligation to provide information regarding the complaint handling procedure or fails to meet the deadlines for handling complaints.

La Médiation de l'Assurance [25] of France is formed within the French Insurance Federation (FFA) and deals with disputes between an individual and an insurance or brokerage company with the aim of securing an amicable settlement. Anyone can contact Mediation directly and free of charge in full confidentiality as soon as they first try to resolve their dispute

with a specialist (insurer or mediator). The purpose of the Association La Médiation de l'Assurance is to provide the consumer with a free mechanism for resolving disputes that may arise between individuals and insurance companies or insurance intermediaries in order to find amicable solutions to the dispute between the consumer and the insurer or intermediary relating to the subscription, application or interpretation of the concluded contract insurance.

The Insurance Ombudsman of Switzerland [26] provides resolution-oriented mediation in conflict situations and answers questions related to insurance law. The independent insurance ombudsman offers impartial help with private insurance and related issues such as cover issues, contract adjustments, claims, daily sickness benefits and more. He also assists in disputes involving accident insurance, occupational pension plans through life insurers and mortgage contracts with personal home ownership insurance companies. Within the limits of their competence, lawyers of the ombudsman consider complaints about written disagreements between insured persons and insurers. The goal is to help acknowledge the legitimate concerns of those seeking advice. In the case of unfounded claims, the legal situation is explained in accessible language. Disputes often arise due to unclear language or misunderstandings. The ombudsman legally classifies the problem and provides additional information to clarify open questions and ambiguities. If the ombudsman needs additional information to form his own opinion and find a solution, he can get it from the insurance company. She can also contact the insurer to clarify issues related to the procedures. If the complaint belongs to the ombudsman's area of responsibility and concerns issues related to insurance, he applies to the insurance company. She sends the submitted complaint and documents with her intervention to the insurer and asks him to comment. As a result, the person making the complaint and the insurance company will reach an agreement during the procedure or adopt a proposed decision. If an agreement can be reached, the parties can equally pursue their claims in another way (for example, in court).

The Insurance Ombudsman Service of Belgium [27] is recognized as a qualified organization by FPS Economy. This quality mark is a guarantee that the service meets the requirements necessary to fulfill the mission of out-of-court resolution of consumer disputes. This institution is the only one recognized as competent for insurance disputes in Belgium. Every year, the organization publishes a report on its activities. It contains an overview of requests submitted during the reporting year. Based on the results of the analysis of all complaints, recommendations are provided to both industry players and competent authorities. Yes, according to the report for 2021. [28] of the 7,299 complaints of intervention registered in 2021, the Ombudsman analyzed 3,467, of which 3,241 were closed on 15 February 2022. In 59% of the analyzed cases, the consumer received a decision. In 41% of cases, the request is unfounded. As of February 15, 2022, 227 files from 2021 (3%) were still in reconciliation. The ombudsman referred the consumer to the complaint handling services of insurance companies and intermediaries in 2,428 cases (33%) and to another intermediary service in 509 cases (7%). In 663 cases (9%), the consumer turned to the Ombudsman for information and information. Thanks to the neutral and objective opinion of the ombudsman, these inquiries did not lead to complaints. Ultimately, only 6 cases (<1%) were closed against the Ombudsman's opinion.

In India, the Insurance Ombudsman Board can remove an ombudsman from office on the basis of gross misconduct during his term of office. The word gross misconduct includes (physical disability, or mental disorder, or insolvency, or conviction for an offense involving moral turpitude, or engaging in any other gainful employment, or conflict of interest, or providing false information for a selection process or lack of specification material facts) [17]. During 2021, insurance ombudsmen in India handled 40,527 complaints against insurance companies across the country compared to 30,596 complaints in 2020 [29]. The Ombudsman can resolve complaints through conciliation or adjudication. The decision is binding only for the insurance company and not for consumers. This means that the consumer can appeal the decision in court.

Therefore, there are various options for the formation and operation of organizations that take care of the protection of consumer rights in the field of insurance. There are also various mechanisms for dealing with customer complaints, which have become widespread in the world. In world practice, the following systems of financial ombudsmen are usually distinguished: British and German [13] (Table 1). However, a necessary condition for the ombudsman's activity is his political neutrality. The lack of political affiliation of the ombudsman is a mandatory electoral feature in all countries of the world, regardless of the specific model [30].

Table 1. *The main models of the financial ombudsman: comparative characteristics*

Characteristics	British model	German model
Founder	an independent state institution financed by state funds	non-governmental, Association of Community Banks of Germany
Ownership	state	private

Table 1, Continued

Characteristics	British model	German model
Legal basis	is created at the initiative of the state and carries out its activities in accordance with legislation	
Sources of funding of the ombudsman institute	deposits of banks depending on the jurisdiction, sphere and type of activity of the organization	deposits of banks, members of the Association of Public Banks of Germany
Institutional structure	network of financial ombudsmen	one financial ombudsman
Dispute settlement method	reconciliation of the parties	reconciliation of the parties
A person who has the right to file a complaint with the ombudsman	natural and legal persons, in particular, organizations and charitable foundations, the annual turnover of which is less than 1 million pounds sterling	an individual
Limitation of the amount of the complaint	16.6 thousand euros	5 thousand euros
The term of consideration of the case	6 months	2-3 months
Terms of application	voluntarily	voluntarily

Source: *systematized by the author based on [31; 33]*

The German model of the institution of the financial ombudsman provides for his appointment by the Board of the Association of Public Banks of Germany at the request of the Association's management. Thus, according to the German model, the activity of the financial ombudsman is related to the alternative or out-of-court resolution of disputes through a neutral third party, the result of which is: adoption of a binding decision for one or both parties; provision of non-binding offers for both parties; giving the parties the opportunity to make their own decisions. As noted by Gorbova [13], the Association covers the expenses related to the consideration of the complaint by the Ombudsman.

In Great Britain, the ombudsman institute is an independent public institution funded by public funds; this is a difference from the German model. It is important to emphasize that the right to use the services of the British financial ombudsman is granted not only to individuals, but also to legal entities, in particular, organizations and charitable foundations, the annual turnover of which is less than 1 million pounds. It is also necessary to determine the nature of the decision of the financial ombudsman for the applicant and the person against whom the complaint is made. Thus, the decision of the financial ombudsman is not binding for the applicant. In case of dissatisfaction with the decision, the applicant can inform the ombudsman about it and resort to consideration of the disputed issue in another way. In turn, for the person against whom a complaint is filed, the decision of the financial ombudsman can be either binding or advisory, depending on which decision the applicant made: to agree or refuse to resolve the issue by the ombudsman [31].

It should be noted that the International Association of Insurance Supervisors (IAIS) is the global standard-setting body responsible for developing and assisting in the implementation of principles, standards and guidelines, as well as supporting materials for supervision in the insurance sector. The association is founded in a voluntary membership organization of insurance supervisory bodies from more than 200 jurisdictions, which accounts for 97% of world insurance premiums [32]. The IAIS also provides a forum for members to share experience and understanding of insurance supervision and insurance markets. In addition, IAIS performs a predictive role in identifying key trends and events that may change the structure of the insurance business. This helps the members of the Association to overcome new risks and challenges. The IAIS coordinates its work with other international financial policymakers and associations of supervisory or regulatory authorities, and helps shape financial systems around the world.

In Ukraine, the legal framework for the application of an out-of-court model of dispute resolution between an insurer and a consumer is gradually being formed. Thus, according to the Law of Ukraine "On Financial Services and State Regulation of Financial Services Markets" [22], the creation and implementation of a mechanism for pre-trial dispute resolution is one of the principles on which the protection of the rights of consumers of financial services is based.

As the author of the publication [4] notes, the beginning of the practical use of the mechanism of out-of-court settlement of consumer disputes in the insurance market in Ukraine is connected with the implementation of the USAID Project "Transformation of the Financial Sector" thanks to the support of the United States Agency for International Development.

The analysis of world practice regarding alternative dispute resolution in the financial sphere makes it possible to note that the ombudsman's actions are much more flexible than official court procedures, so he can resolve conflicts informally. The Ombudsman Institute listens impartially to both customers and businesses, deciding what is fair and reasonable in the circumstances. The introduction of the institute of the insurance ombudsman in Ukraine as an alternative platform for handling complaints, which will be created

for the purpose of quick and economical consideration of the cases of injured policyholders against insurance companies and their intermediaries or insurance brokers, will have advantages for all participants of the insurance market. The advantages of intensifying the activities of the insurance ombudsman are shown in Figure 1.

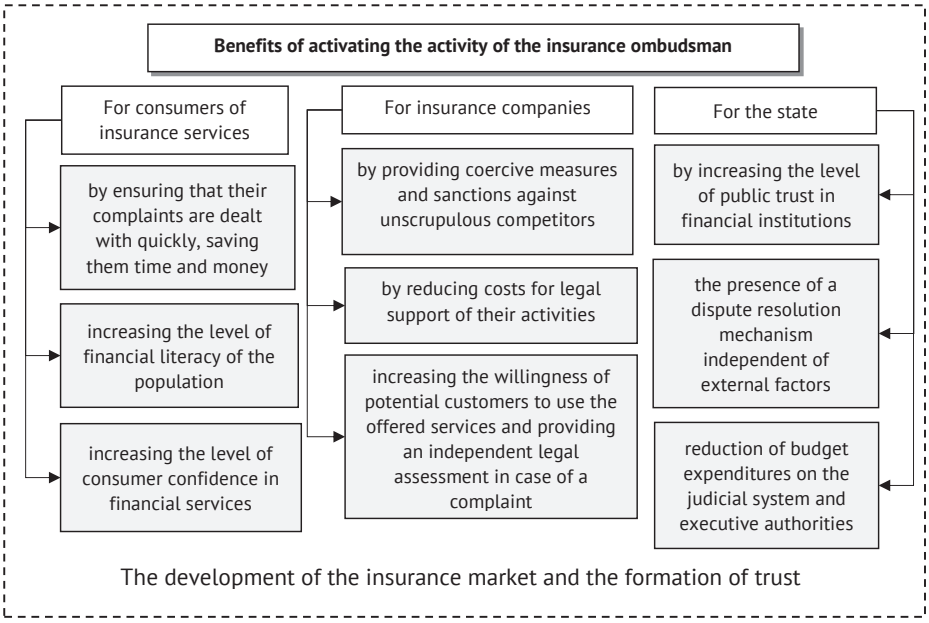

Figure 1. *Advantages of activating the activity of the insurance ombudsman*

Source: *developed by the author based on his own research*

Thus, it is possible to talk about the expediency of creating an institute of alternative resolution of insurance disputes in Ukraine in the form of a private insurance ombudsman. Emphasis is placed on the important points of the introduction of the institute of alternative methods of dispute resolution on the financial market of Ukraine through the application of the mediation procedure [20]. We are convinced that this will contribute to the formation of justice in the financial market, reduce the burden on the courts and the duration of cases and the percentage of contested decisions. reducing court costs, improving the quality of court decisions and achieving reconciliation between the parties. The same opinion is supported by [33], which points to the need for a new model of regulation of the financial market as a whole, which will be adapted to the realities of the country and will be able to combine the functions of the supervisory authority in a single organization on issues of regulation, control and supervision of financial institutions. However, in our opinion, it should not be created by the state, but by insurance companies that are interested in the development of the insurance market and its high standards. The institute of the insurance ombudsman should be officially established, and its activities should be independent of financial organizations, the state and consumers. The expediency of introducing the institute of the financial ombudsman in Ukraine as such a mechanism that can make decisions regarding the resolution of disputes between financial institutions and their clients in an extrajudicial manner has also been determined in studies [13].In turn, the authors [15] emphasize that the presence of an insurance institute in Ukraine, the presence of an insurance ombudsman institute in Ukraine will contribute to the formation of insurance culture and awareness in Ukrainian society, reduce the burden on the judicial system, relieve the NBU of the functions of protecting the rights of consumers of financial services that do not belong to it, will establish a communication link between all participants of the market of insurance services, the formation of an insurance culture in Ukrainian society. The authors [34] emphasize that at the level of state regulators of financial services markets, active financial involvement will mean the need to modernize traditional approaches to regulating the state of the financial market and the activities of professional financial intermediaries. This, in turn, will require an increase in the resource base of guaranteeing the clients of financial institutions the conscientious attitude of the latter to the provision of their financial needs and interests. Thus, it is emphasized the need to develop innovative approaches to state regulation of the financial market in the context of increasing trends towards financial inclusion.

As a result of the research [30], it was determined that the main essence of the ombudsman's activity as a system component among the guarantees of rights and freedoms is to help ensure human rights and improve the efficiency of the activities of state authorities and their officials.

However, our research proves that the institute of the insurance ombudsman should advise consumers of insurance services, offer alternatives and mediate disputes between insurance market participants, and take a neutral position.

Peculiarities of information interaction between financial institutions and consumers of financial services are presented in the study [35]. The basic causes of information asymmetry in the financial services market of Ukraine are revealed and a number of measures aimed at the development of the information component in mechanisms for protecting the rights of consumers of financial services in Ukraine are substantiated. We believe that in the current conditions of economic development, information is an important economic resource. However, for the use of information in the alternative resolution of insurance disputes, it must be reliable, complete and acceptable. Scientists [36] have a similar opinion, noting that the presence of information asymmetry and power imbalance has a number of consequences for clients of financial institutions.

On-line insurance contributes to the entry of the insurance market into a qualitatively new stage of its development. According to the authors [37], both policyholders and insurers receive a positive result in the possibility of online operations in the field of insurance, the advantages will be an increase in sales volumes and, as a result, in an increase in the amount of financial income from the conclusion of insurance policies. The authors [8] have developed a mechanism for digitalization of the financial ombudsman institute, which will help in resolving disputes and preventing them through a special electronic platform of the financial ombudsman, which optimizes the cooperation of consumers of financial services with the ombudsman. It is important that the mediator takes an active part not only at the stage of appealing disputes, but also in preventing them in the form of a dialogue with the consumer and the realization of the rights and obligations of both parties. The insurance ombudsman can consider disputes related to the settlement of claims, wrongful selling, payment of insurance premiums, legal registration of the policy, delay in settlements, failure to issue insurance documents, etc. Such an insurance ombudsman institution will be responsible for protecting the interests and handling policyholder complaints, and the main purpose of the ombudsman's activities is to handle policyholder complaints outside the court system in a cost-effective and impartial manner.

The conducted research made it possible to draw conclusions that the following principles should be followed in the activities of the insurance ombudsman institute:

1. Neutrality. Neutrality is essential to the work of ombudsmen as it demonstrates the avoidance of bias. Bias is an obstacle to conflict resolution and prevents the ombudsman from making fair proposals. The neutrality of the ombudsman will also influence the growth of trust on the part of consumers.

2. Trust. The goal of the ombudsman is to establish a certain level of comfort and trust with the visitor, after which the parties involved can reach a mutually beneficial solution.

3. Coaching competencies. The ombudsman must be an open and fair listener, demonstrate diplomacy and mediation.

CONCLUSIONS

The article examines the organizational and legal aspects of the activity of the financial ombudsman in different countries and provides their comparative characteristics. It has been studied that in world practice there are two models of the organization of the work of the ombudsman in the financial market, including the insurance one: British and German.

World experience shows that the number of insurance companies participating in the insurance ombudsman institute is constantly increasing, and the role of the insurance ombudsman in the management of complaints is very important, and the constant increase in the number of complaints received by the ombudsman shows that policyholders have confidence in the insurance ombudsman institute ombudsman The creation of an institute for alternative resolution of insurance disputes in Ukraine in the form of an insurance ombudsman will improve the quality of insurance market regulation, increase the level of public trust in insurance companies, strengthen financial discipline, reduce the burden on judicial authorities, and increase the transparency and openness of the insurance market.

It is substantiated that the introduction of the insurance ombudsman institute in Ukraine as an alternative platform for handling complaints, which will be created for the purpose of quick and economical consideration of the cases of injured policyholders against insurance companies and their intermediaries or insurance brokers, will have advantages for all participants in the insurance market. The conducted research made it possible to draw conclusions that in the activities of the insurance ombudsman institute, it is necessary to adhere to such principles as neutrality, trust and coaching competences.

Prospects for further research consist in a detailed study of the specifics of the activity of the insurance ombudsman institute in the insurance market of Ukraine with the aim of developing recommendations on the legislative regulation of its functioning.

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Запровадження інституту омбудсмена на страховому ринку України

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Анотація. Страхова галузь відіграє важливу роль в економіці, сприяючи посередництву та механізму несення ризику. Разом з тим, галузь страхування сприяє соціально-економічному зростанню за рахунок акумульованих довгострокових фінансових ресурсів, які безпосередньо можуть бути використані в економіці. Метою статті є розробка рекомендацій щодо можливості створення інституту страхового омбудсмена в Україні на основі міжнародного досвіду. Поставлена мета обумовила вирішення таких завдань: дослідити правові аспекти діяльності фінансового омбудсмена у різних країнах та надати їх порівняльну характеристику; визначити особливості впровадження в Україні механізму альтернативного вирішення спорів на страховому ринку; обґрунтувати переваги активізації діяльності інституту страхового омбудсмена в Україні. У процесі здійснення наукового пошуку, для досягнення визначеної мети було використано такі загальнонаукові методи, як: абстрактно-логічний; монографічний; порівняльний; графічний; діалектичний метод; порівняльно-правовий метод; структурно-функціональний метод. Досліджено особливості функціонування відповідних альтернативних механізмів вирішення страхових спорів в різних країнах, механізми роботи зі скаргами клієнтів, вирішення спорів за участі професійного мирового посередника. Визначено, що у світовій практиці зазвичай виділяють дві основні моделі фінансових омбудсменів: британську та німецьку. Обґрунтовано, що при впровадженні інституту страхового омбудсмена в Україні як альтернативної платформи для розгляду скарг буде мати переваги для всіх учасників страхового ринку. Доведено, що діяльність такої інституції може розглядати спори, пов'язані з врегулюванням претензій, неправомірним продажем, сплатою страхових премій, юридичним оформленням полісу, затримкою розрахунків, невидачею страхових документів тощо. Такий інститут страхового омбудсмену буде нести відповідальність за захист інтересів і розгляд скарг страхувальників, а основна мета діяльності омбудсмена полягає в тому, щоб розглядати скарги страхувальників поза судовою системою економічно ефективним і неупередженим способом

Ключові слова: страхові компанії, страховий ринок, вирішення спорів, захист прав споживачів, споживачі страхових послуг

UDC 351:502
DOI: 10.56407/2313-092X/2022-26(3)-8

Ukrainian Black Sea Region Agrarian Science
Vol. 26, No. 3

Implementation of environmental policy of Ukraine in the context of circular economy

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Abstract. European practice has proven that all EU member states are responsible for the implementation of adopted European environmental agreements. Since 1992, the countries of the European Union have identified environmental protection as a priority for their own development. The study of the process of implementing Ukraine's environmental policy in the context of the circular economy is gaining relevance. The purpose of the article is to study the processes of implementation of the environmental policy of Ukraine in the context of the circular economy. In the process of writing a scientific article, general scientific research methods were used: the method of theoretical generalization; categorical analysis; method of comparison; method of abstraction; grouping method; forecasting method. In the process of research, the key directions of implementation of environmental policy at the state level are given. The main aspects of the implementation of the circular economy at the regional level have been established. Three levels of formation and implementation of environmental policy in Ukraine are defined. Various tools for implementing environmental policy in the context of the circular economy are presented. It was established that in Ukraine today there is practically no development and implementation of effective mechanisms for the implementation of the state environmental policy, there are no tools for eliminating the causes of environmental problems and reducing the negative impact on the ecological sphere during the implementation of economic activities. It has been established that in the process of implementation of environmental policy, the state may have an appropriate role, either promoter, facilitator, or catalyst. Conclusions have been made regarding the importance of implementing the circular economy. The study of the implementation of the environmental policy of Ukraine in the context of the circular economy gained further development in terms of taking into account the components of the environmental policy, aspects of the circular economy and the comprehensive implementation of the environmental policy at the international, state, regional and local levels. The practical value of scientific research lies in the theoretical justification of the process of implementing environmental policy in the context of the circular economy, taking into account international experience and tools for implementing environmental policy at all levels

Keywords: strategy, tasks, economic conditions, implementation tools, international practice

INTRODUCTION

World trends in the economic development of both the territory and the country as a whole dictate new rules of responsibility for environmental protection. To achieve these rules, the UN Summit on Sustainable Development was held in New York in September 2015 as part of the 70th session of the UN General Assembly, the result of which was the adoption of the document: "Transforming our world: an agenda in the field of sustainable development until 2030". which consisted of 17 Sustainable Development Goals (hereinafter SDGs) and 169 tasks [1].

As a founding country and member of the UN, Ukraine also joined the global process of environmental protection. In order to realize full-fledged

Article's History:
Received: 29.04.2022
Revised: 12.07.2022
Accepted: 26.08.2022

Suggested Citation:
Reshetilov, G. (2022). Implementation of environmental policy of Ukraine in the context of circular economy. *Ukrainian Black Sea Region Agrarian Science*, 26(3), 87-96.

sustainable development and taking into account the Ukrainian context, the National System of Sustainable Development Goals (SDGs) [1] was developed, which consists of 17 UN SDGs and 86 national development tasks. Along with this, the Law of Ukraine "On the Basic Principles (Strategy) of the State Environmental Policy of Ukraine for the Period Until 2030" [2] (hereinafter the Strategy), adopted in February 2019, confirmed the priority of achieving the global Sustainable Development Goals and their implementation taking into account the specifics of Ukraine's development.

The main goals of the Ecostrategy-2030 provide for the application of measures and tools for the formation of ecological values, sustainable energy saving and improvement of state management of environmental protection activities [2]. To achieve these goals, the Strategy was based on tasks related to raising the environmental awareness of citizens, popularizing environmental education, introducing the principles of ecological governance, ecological production and consumption, measures to reduce the level of pollution of the ecosystem, etc. [2].

Having considered the main tasks and goals of the Strategy, we can state that it was developed taking into account European practice and is aimed not only at overcoming environmental problems, but also at providing opportunities to adapt to modern environmental challenges.

We note that among the main environmental problems in Ukraine in 2021, water pollution, clogging with household waste and excessive consumption of chemical fertilizers were recognized. So, as the indicators of anthropogenic and man-made load showed, deterioration of the ecological system is noted in Ukraine.

It is worth noting that in Ukraine today there is practically no development and implementation of mechanisms for the implementation of state environmental policy, there are no tools for eliminating the causes of environmental problems and reducing the negative impact on the ecological sphere during the implementation of economic activities, etc.

European practice has shown that all EU member states (27 countries) are responsible for implementing the adopted European environmental agreements. Since 1992, the countries of the European Union have identified environmental protection as a priority for their own development. The process of environmental protection in the EU began in 1992 with the signing of the Maastricht Treaty, which gave environmental protection the status of policy and became one of the first documents of the European Union [3]. In particular, three environmental declarations were adopted in its annexes: directives on harmful substances, on animal protection, and on the impact of European Union measures on environmental protection.

In the USA, the issue of environmental policy implementation in the 21st century. Became a tool of political games in the fight for the electorate. Thus, during the election campaign, former US President Donald Trump told voters that he would decide on the country's withdrawal from the Paris Climate Agreement (2015), the main purpose of which is to combat global warming, which is caused by the increase in greenhouse gas emissions into the atmosphere. According to Donald Trump, there is no global warming, and the terms of the Agreement are not very favorable for the American oil and coal industry.

Joe Biden, on the contrary, promised that the USA will rejoin the Paris Climate Agreement and thereby become a world leader in efforts to mitigate the factors that provoke climate change and negative consequences for the ecology of the planet and humanity. In his opinion, the fight against global warming (or the so-called climate crisis) should become a matter of national security and one of the priorities of the country's foreign policy development.

To study the process of implementing the environmental policy of Ukraine, it is necessary to reveal the essence of the circular and environmental policy, to investigate the peculiarities of the implementation of the environmental policy at all levels of its management, and to determine the tools for the implementation of the environmental policy at the regional level in the context of the circular economy.

The purpose of the article is to study the processes of implementation of the environmental policy of Ukraine in the context of the circular economy. The goal of the article provided for the need to formulate and solve the following tasks: to investigate the essence of the concepts "state environmental policy" and "circular economy"; determine the main aspects of the implementation of the circular economy at the regional level; outline the main tasks of the circular economy; determine the components of environmental policy in the context of the circular economy; to single out the tools for implementing the environmental policy of the state; to analyze the foreign experience of environmental policy implementation in the context of the circular economy; justification of the need to transition to a circular economy in solving environmental problems.

LITERATURE REVIEW

The study of various aspects of sustainable development and the implementation of environmental policy have become the object of research by various foreign and Ukrainian scientists, in particular: the theoretical and practical principles of public administration and the mechanism of its implementation were studied by O. Amosov & N. Havkalova [4], V.D. Bakumenko & S.A. Popov [5], O. Mashkov & N. Nyzhnyk [6], and others. Scholars consider the influence of the international context on domestic environmental policy and explore some of the powerful instruments and institutional

forces that contribute to the emergence of environmental problems in countries. Along with this, they indicate the main obstacles to both a well-developed environmental policy and its effective implementation.

Contributed to the study of environmental policy as a tool for ensuring the sustainable development of the state M.V. Andrienko & V.S. Shako [7], D.O. Vetvytskyi [8], O.Ya. Lazor [9], N.A. Malysh [10] and others. In their works, the authors note that the implementation of environmental policy is a component of national policy, which will be aimed at protecting the vital interests of people, society, and the state and preserving natural resources.

N. Avramenko & A. Tovstenko [11], I. Zvarych [12], V. Loyko [13] studied the issue of revealing the meaning of the concept of "sustainable development", the need to implement a circular economy, and a review of existing tools for ensuring a circular economy. D. Pierce & R. Turner [14], etc. In economic literature, the concept of "circular economy" was first mentioned in 1990 by American scientists D. Pierce & R.Turner, because they meant that the Earth is a closed economic system in which there are circular relationships between the economy and the environment. In their opinion, the introduction of a closed-loop economy will help achieve efficiency for both the economy and the environment in such relationships [13].

In other words, the circular economy is a process characterized by a restorative and closed nature. In the circular economy, waste is an incentive for the reuse of products, and the circular economy itself has become the basis of Revolution 4.0 (Industry 4.0).

It should be noted that certain issues related to the implementation of the state environmental policy, in particular, the formation of a safe natural environment and the stimulation of the implementation of the circular economy, are considered in the scientific works of V. Andreytsev [15], O. Zarzhytskyi [16], O. Kalashnyk [17], I.Kononenko [18], V. Sakhaev & V. Shevchuk [19] and others. For the circular economy implementation process to be effective, the authors concluded that central authorities should offer incentives to ensure increased attention to environmental protection tasks in the process of sustainable development.

According to T. Knyazeva [20], M. Khvesyk *et al.* [21], ensuring rational nature management and international environmental policy occurs through the implementation of environmental policy at the national, regional and local levels. The authors also note that environmental crises are mostly of a transboundary nature, the tool for overcoming them can be international cooperation in the field of environmental protection and the implementation of the mechanism of state management within the framework of international agreements, etc.

The analysis of international experience [22-24] on the implementation of the state environmental policy shows the lack of a unified opinion regarding the directions of environmental reforms, their content and measures for the implementation of the state environmental policy at all levels of management, effective tools that would in practice stimulate the implementation of the circular economy. Directly, many authors point out that state bodies often fail to implement environmental policy, mainly due to lack of political support, insufficient resources, insufficiently developed institutional capacity and a tendency to neglect the importance of cooperation at the local level.

However, the issue of the implementation of Ukraine's environmental policy in the context of the circular economy remains insufficiently researched, both scientifically and practically.

MATERIALS AND METHODS

This scientific article is a theoretical study in the process of writing of which general scientific methods of research were used: the method of theoretical generalization was used to consider theoretical provisions regarding the essence of environmental policy, circular economy; categorical analysis – to substantiate the theoretical aspects of the implementation of the circular economy at the regional level, etc.; comparison method – for research and comparison of goals, directions and tools for the implementation of Ukraine's environmental policy in the context of the circular economy, when considering the work of the UN Summit on Sustainable Development; the method of abstraction – to determine the components of environmental policy in the context of the circular economy and outline the main tasks of the circular economy; the grouping method – for the study of the implementation of environmental problems at the level of international organizations and during the study of the "State Environmental Policy Strategy for the period until 2030"; forecasting method – to justify the need to transition to a circular economy in solving environmental problems.

The source of information for conducting the research was: the legislative and regulatory framework of Ukraine regarding the implementation of environmental policy in the context of the circular economy; scientific monographic literature on the implementation of environmental policy and circular economy and means of its implementation; scientific articles by Ukrainian and foreign authors in periodicals on environmental policy and implementation of the circular economy; materials of scientific conferences dedicated to solving environmental problems and international organizations whose activities are aimed at solving environmental problems. The source of the data for this study is the Ministry of Environmental Protection and Natural Resources of Ukraine, materials of the author's own research, and information from the international INTERNET network.

The main stages of work on a scientific article were: the preparatory stage, at which the topic of the article was chosen, its understanding and justification of relevance. The choice of the topic of the article was carried out taking into account personal previous work, interest in the problem and the possibility of selecting practical material on the implementation of environmental policy at the local level; the stage of work on the content involved drawing up the plan and structure of the scientific article, conducting research and summarizing its results. On the basis of the review of information sources and literature, tasks characterizing the state of the investigated problem were determined. During the work on the material, notes were made of what interested us the most and can be a tool for a deeper disclosure of the purpose of the article; at the final stage, there is processing and analysis of the results of the research, which was carried out according to the tasks, as well as the formulation of conclusions and the design of the literature list. The correctness of the design of the article and the list of used sources is checked according to the requirements of the publishing house.

RESULTS AND DISCUSSION

The concept of circular economy, which ensures optimal use of resources, reduces the burden on the environment, and forms balanced consumer behavior, became a tool for anti-crisis development of the world's leading countries.

Given the set of components that determine the process of the emergence and implementation of the closed-loop economy as a whole, the circular economy is defined as "a concept aimed at eliminating the material loop and extending the service life of materials through longer use and increased use of secondary raw materials" [25, p. 4].

The circular economy is based on the application of a set of cyclical principles, in particular 3R (Reduce, Reuse, Recycle), 9R (3R+ Refuse, Rethink, Repair, Refurbish, Remanufacture, Repurpose), 10R (9R + Recover). Based on the concept and principles of the circular economy, we note that the benefits of its implementation are a reduction in the use of non-renewable resources, the introduction of a zero-waste production model, a reduction in carbon emissions and the creation of new business opportunities for profit.

In the process of researching scientific literature [8; 13; 21] it was established that the main aspects of the implementation of the circular economy at the regional level include:

1) level restructuring of the circular economy, which involves the implementation of the principles of circularity at the level of the enterprise, community, region, and ending at the state level. According to the author, the environmental awareness of entrepreneurs does not arise as a result of legal acts, but in the process of determining the business goals of the enterprise or developing a strategy for its development. At the same time, the development and implementation by the state of effective regulatory and legal acts regarding the application of the principles of the circular economy will become a solid foundation for promising productive changes in the state environmental policy. It can also be noted that the more efforts entrepreneurs spend on environmental awareness, the greater the chances that in the long run they will receive positive results in terms of environmental protection.

2) the informational and educational component, which is an integral tool in the process of implementing the circular economy. This component involves familiarizing the population with changes in environmental legislation and carrying out educational and informational work to increase their environmental awareness. As a result, the population will begin to recycle less and use used things more, and will increase their own responsibility for environmental protection.

3) negative consequences for resource-extracting countries. Note that, along with the positive consequences, the worldwide implementation of the principles of circularity will affect the reduction of incomes in countries where the main item of export is resources, the demand for which will gradually decrease. But if you weigh all the positive effects of the circular economy, they are much greater than the negative ones (from saving resources and energy to generating income for the economy).

4) the transition to a circular economy is a step-by-step process with a clearly defined subject, content of goals and means of achieving them. Each stage will require the introduction of legislative and non-legislative tools for the implementation of cyclical innovations and raising the environmental awareness of the population of communities and the country as a whole. In the author's opinion, even at the stage of development of new products, it is worth considering how it will contribute to the implementation of the circular economy, how it will encourage sustainable consumption in order to avoid the generation of waste from its use.

The importance of implementing a circular economy was also discussed at the UN Summit on Sustainable Development, as a result of which the Global Sustainable Development Goals were approved [1]. First of all, the emphasis was placed on rational consumption and production, which was mentioned in the twelve goals of "Responsible production and consumption", which clarify the main tasks of the circular economy, in particular [1]:

- ensure effective development and use of natural resources;
- within the next ten years, achieve a reduction in the amount of food waste and a reduction in the level of food costs throughout the chain of production and

consumption of products, which will be of crucial importance for tracking the progress of the implementation of the circular economy;

- within the next five years, to significantly reduce the anthropogenic pressure on the environment, which will ultimately affect the reduction of emissions of chemical waste into the air, soil and water, etc.;

- pay special attention to waste processing, as this process is the foundation of the circular economy concept;

- attraction of international financial assistance for the implementation of modern scientific and technical developments in production, which is especially important for Ukraine.

At the national level, environmental policy cannot be formed in isolation from other issues of the state, it is a component of the internal and external policy of the state, which is based on state regulation regarding the stability of the environmental sphere. At the same time, various types of public policies can contribute to the improvement of the environment, even if this is not their main goal.It is worth noting that in order for the implementation of the environmental policy of Ukraine to be effective, it is necessary to introduce innovative state and non-state regulation, which will be focused on production processes, waste management and on the orientation of the value of products, materials and resources, etc.

At the legislative level, it is also stated that the state environmental policy is a component of the state policy, which is aimed at solving urgent environmental problems through the joint work of communities, government and industry. In addition, the activities of state bodies are focused on ensuring the integration of environmental policy into other sectors and other areas of policy. In addition, it has a defined purpose, goals and objectives, principles and tools for its implementation, etc. For example, the purpose of the state's environmental policy is disclosed in the Law of Ukraine "On the Basic Principles (Strategies) of the State Environmental Policy of Ukraine for the Period Until 2030", this document states that through the implementation of the ecosystem approach in all directions of the socio-economic development of Ukraine, it will be possible to ensure a satisfactory state of the environment of Ukraine [2]. This Law also defines the basic principles, tools and stages of implementation of state policy.

Thus, in order for Ukraine to achieve the Sustainable Development Goals, tasks from twelve goals were included in the basic principles of Ukraine's environmental policy. It is also worth noting that the Ukrainian legislation on the implementation of environmental policy is based on a number of political, legal, economic and other specific measures for the management and protection of the natural environment, the preservation of biodiversity and the introduction of an ecological lifestyle.

In the process of researching the scientific literature, it was established that the joint activity of authorities and society is considered under environmental policy, which consists in: ensuring the protection of the natural environment; formation and development of environmental awareness among the population; guaranteeing the environmental safety of citizens; introduction of ecological innovations related to production and consumption, etc. The activity of state authorities consists in regulating the activities of individuals, enterprises and state institutions that can affect the "quality" of the environment.

In this process, the state plays a key role in ensuring the constitutional right of every member of society to live in an ecologically clean environment. The main goal of the state is that all branches of government worked as a coordinated mechanism in the implementation of environmental policy.

Environmental policy in the context of the circular economy should focus on at least four components, namely [27]:

1) international global ecopolitics, which provides for a system of international environmental governance and various diplomatic initiatives for environmental protection (for example, the functioning of economic zones in the World Ocean, the establishment of quotas for the extraction of natural resources, the activities of international environmental organizations);

2) regional ecopolitics, which is based on taking into account the environmental interests of groups of countries united by a common natural and geographical environment, or integration groups that have a common environmental policy (for example, the Environmental Policy of the EU, or the creation of protected areas by neighboring countries, or joint activities partner countries regarding control of biosphere pollution and solving common environmental problems);

3) national (state) eco-policy, which should provide for measures and means for the introduction of circular economy at all levels of management (for example, development, adoption and implementation of the environmental legal framework, signing of international treaties and membership in international environmental organizations);

4) local ecopolitics (for example, district, city or community policy). The main subjects of ecopolicy implementation at this level include: state authorities, entrepreneurs and citizens. The main forms of implementation of environmental policy at the local level are the introduction of strategic environmental policy planning tools by local authorities taking into account the specifics of the territory, the creation and development of environmental public organizations and cooperation with higher educational institutions in the environmental field [27].

Therefore, it can be concluded that the implementation of environmental policy in the context of

the implementation of the circular economy, taking into account the specified components, should be carried out at the international, state, regional and local levels. That is, starting from the environmental policy of the enterprise, and ending with the implementation of developed state programs regarding the country's transition from a linear economy to a circular (closed) economy model.

The instruments for the implementation of the environmental policy of the state are:

- integrated permit – comprehensive pollution prevention and control;
- legal regulation – up-to-date, adapted to European legislation, which creates appropriate conditions for the functioning of the sphere;
- state regulation of the use of natural resources - ensuring balanced and sustainable development, establishing justified and accessible limits;
- environmental communications – education, raising the level of environmental awareness, strengthening the role of the environmental component in intersectoral partnership;
- environmental impact monitoring and strategic environmental assessment – reducing the risks of planned activities and preventing negative impact on the environment;
- environmental certification and labeling, environmental management, environmental audit - greening of consumption and production;
- environmental accounting and electronic environmental governance – collection, analysis, use and distribution of data on the state of the environment;
- financial and economic instruments (fiscal, stimulating) – development of a "green", resource-efficient and low-carbon economy, modernization of production;
- monitoring and environmental protection control – prevention, termination of offenses and monitoring of the state of the environment [7].

The second chapter of the Strategy [2] provides a system of interrelated tools that ensure the implementation of Ukraine's environmental policy. Since Ukraine intends to become a member of the EU, these are primarily instruments, the basis of which is ensuring the compliance of Ukrainian environmental legislation with EU legislation and European environmental standards, etc. The following tools will contribute to faster greening of production: environmental certification and labeling of products, introduction of environmental management and audit. In addition, the Strategy for implementation and development defines the use of financial and economic mechanisms.

As the authors of the article noted, in 2017, a national system of Central and Eastern Europe was developed, which was presented in the National Report "Goals of Sustainable Development: Ukraine" and which consists of 17 goals and 86 national tasks, which were reflected in 145 normative and legal acts of the Government. which provide a solid basis for the implementation of environmental policy in the context of the circular economy. It was in the National Report that the task of introducing the principles of the circular economy was first set.

At the same time, the approved "State Environmental Policy Strategy for the period until 2030" [2] sets four national goals, the implementation of which will consistently introduce the concept of circular economy in Ukraine, since they are aimed at reducing the level of resource intensity of the economy, introducing waste-free production/consumption and activating innovative – environmental activities. The expected result of the implementation of the Strategy in 2030 should be Ukraine's achievement of such a level of circularity, during which there will be a constant improvement of ecological efficiency to ecologically acceptable levels [2; 28].

International practice has shown that an important place in the implementation of environmental policy in the context of the circular economy is occupied by the public movement, which turns environmental policy into an object of state and public management [30; 33]. Under the influence of the social movement, the ecological consciousness of the society is formed. It is he who draws society's attention to environmental problems in a certain area and in the world as a whole, defends the rights of citizens to live in an ecologically safe environment. More than five hundred public environmental organizations operate in Ukraine, among which the most influential are: National Ecological Center, All-Ukrainian Environmental League, "Green Wave" Environmental Club, "Ecology – Pravo-Lyudyna" BF, "Ekodiya" Center for Environmental Initiatives, Save Dnipro etc. [28]. Most of them have an extensive system of their representative offices in regions, cities, communities.

One of the conditions for the effective implementation of environmental policy in the context of the circular economy is the optimal combination of various management methods aimed at ensuring partnership relations between environmental policy developers, implementers, environmental policy analysts and stakeholders, the purpose of which is to review and discuss information, problems, analysis and options, related to each stage of implementation of the state environmental policy. The establishment of such partnerships should occur throughout each stage of environmental policy implementation, helping decision-makers concerned to move from one stage to the next.

Studies of international organizations, such as the Organization for Economic Cooperation and Development [25; 35] testify that states can perform one of the following roles in the implementation of environmental policy in the context of the circular economy:

1. Promoters (Netherlands, Japan). States develop development strategies, adopt framework documents, conduct information policy among stakeholders.

2. Facilitators (USA). States are already playing a more active role, involving stakeholders in the development of circular economy development projects, implementing a multi-level system of circular economy regulation.

3. Catalysts (Norway, China). States determine specific mechanisms for the transition to a circular economy, use financial and economic methods to support business and innovation, develop tools for evaluating the effectiveness of the implementation of the circular economy model.

Awareness of the depth and spread of environmental problems that exist in Ukraine today is increasingly pushing the country to introduce the principles of a circular economy. For the implementation of environmental policy in the context of circular economy, environmental protection bodies function in the organizational structure of the state administration, and the corresponding regulatory and legal framework has been created, taking into account the principles of the EU environmental policy [29]. Note that on the basis of the adopted Strategy, such strategic documents are being developed as: the National Program for the Development of the Mineral and Raw Material Base for the Period Until 2030, the National Waste Management Plan, draft laws "On Waste", "On Waste Electrical and Electronic Equipment", "On Batteries", batteries and accumulators", "On packaging and packaging waste", Decree of the President of Ukraine No. 722/2019 "On the Sustainable Development Goals of Ukraine for the period until 2030", etc. In addition, it is worth remembering that the development of new regulatory and legal documents should be carried out including taking into account the main principles of the circular economy, because when the economy becomes closed, then people will become wealthy, and the environment will be clean.

More than 30 years have passed since the first mention of the circular economy [14], however, only after its official introduction in the EU [25] did its popularity grow rapidly, and countries gradually began to realize its priority for achieving sustainable own development, where the value of products, materials and resources [33] is kept in the economy as long as possible [22].

At the same time, the adoption of the Sustainable Development Goals (SDGs) became the UN's plan for a more sustainable future for all, which forced the organization's members to take a different look at the problems of the environment, climate change and water security. Attention is directly focused on the joint efforts of all subjects of nature management in overcoming environmental challenges, along with this, the main role still belongs to the state. At the same time, the environmental policy of the state was considered as a coordinating priority, which forms and sets in motion the resources of the enterprise (organization), in order to achieve goals in the field of rational nature management, environmental protection and ensuring environmental safety with the help of political, economic, legal, educational and other measures [10]. In the opinion of the authors, it is important to focus on the territorial approach when implementing environmental policy, which will allow to more fully take into account the peculiarities of each region when implementing the circular economy at all levels.

The effectiveness of the mechanisms for implementing Ukraine's environmental policy in the context of the circular economy can be improved by providing for their adaptation to EU legislation [7] and the experience of EU member states taking into account the peculiarities of Ukraine's natural resource potential. Moreover, taking into account international practice, the implementation of the country's environmental policy [8] was considered as a set of means and measures directed by society and the state to the protection and improvement of the environment, an effective combination of nature use and nature protection and ensuring the normal life of citizens, which has two dimensions, in particular, normative and regulatory

The analysis of the theoretical foundations of the implementation of environmental policy in the context of the circular economy gave us the opportunity to note that the best way to solve environmental problems is to reduce waste. And as we know, the circular model of the value added chain is based on a similar concept. Therefore, the introduction of the concept of extended responsibility [12] will ensure the fulfillment of the national goals approved in the "State Environmental Policy Strategy for the period until 2030" and the achievement of the 12th goal "Responsible production and consumption" [1], which clarify the main tasks of the circular economy

Based on research [13], it is also important to gain public support and change established consumer behavior, which will ensure the implementation of Ukraine's environmental policy in the context of the circular economy. Scientific research is designed to activate the social movement, which is aimed at changing the role of the consumer (quite often disposable) to the role of the user (for the long term). As part of ties with non-governmental organizations that systematically draw the attention of a wide audience to environmental issues, the principles of the circular economy are promoted in the process of implementing the country's environmental policy and the idea that the main task of the circular economy is the intention to act in the interests of the public the public. Their main tool is a call to the public for the rational use of natural resources, informing society about the benefits of a circular economy and the possibility of ensuring economic growth and increasing well-being without excessive consumption of natural resources.

Particular attention is focused on the tools [21] of environmental policy implementation, which are

constantly changing [25] and spreading. We believe that each country uses an individual approach to regulating the circular economy, has specific organizational and economic tools, all of which emphasize the importance, perspective and effectiveness of this concept.

What is common in the studies [25] is that states in the implementation of environmental policy in the context of the circular economy can perform one of the defined roles and determine specific methods of implementing environmental policy, develop tools for implementing the circular economy model. Having chosen a clear role (whether promoter, or facilitator, or catalyst) in the implementation of environmental policy in the context of the circular economy, the country will achieve its goals in the field of environment and climate in a cost-effective way, while ensuring this process with adequate funding.

Unlike Ukraine, where the circular economy is not declared a priority area of economic growth at the legislative level, in most developed countries there is a clear awareness of environmental disasters in the future and they take an active part in implementing the principles of the circular economy in the process of implementing the state environmental policy. At the moment, Ukraine still remains on the sidelines of the circular economy implementation process, which necessitates the development of a system of regulatory and legal acts and measures to stimulate the circular economy at the state level.

As a result, the introduction of the circular economy in the world has become a rapidly developing topic as an opportunity to combine environmental protection and economic growth. These statements indicate to us the need for further development of the study of the implementation of the environmental policy of Ukraine in the context of the circular economy in terms of taking into account the components of the environmental policy, aspects of the circular economy and the comprehensive implementation of the environmental policy at the international, state, regional and local levels.

Therefore, the importance of the implementation of the circular economy for the world is that it will be recyclable, which will help to save and produce a large amount of energy. The study of the Law of Ukraine "On the basic principles (strategies) of the state environmental policy of Ukraine for the period until 2030" showed that it introduced environmental norms and standards in the state administration, and also provided for a number of measures to reduce atmospheric air and water pollution. In the process of implementing the environmental policy of the state, specific directions of action are first determined, and then, on their basis, environmental policy tools are developed and applied.

CONCLUSIONS

The implementation of environmental policy in the context of the circular economy should become one of the main strategic tasks in Ukraine for the next 30 years. During the research, it was established that the process of implementing environmental policy in the context of the circular economy takes place with the determination of policy levels and the relationships between them. It has been proven that ensuring the implementation of environmental policy in the context of the circular economy is a step-by-step process that is based on both legislative and non-legislative measures to eliminate the root causes of environmental problems and is aimed at improving the quality of the environment, and therefore improving the quality of life of every Ukrainian. As a result, it has been established that the transition to a circular economy is a valuable factor in the fight against environmental challenges, such as overexploitation of natural resources, inadequate air quality, and climate change.

The considered aspects of the implementation of the circular economy at the regional level stated that it is a step-by-step process that involves the implementation of the principles of circularity at all levels of management, which is based on an informational and educational component and which has negative consequences for resource-extracting countries. The level system of environmental policy implementation in the context of the circular economy clearly outlines to us that the main role in the implementation of environmental policy belongs to the state, which, along with this, is not the only subject of environmental policy.

The study of international practice proved that developed countries strongly support the circular economy model within the framework of their own economic development. The implementation of the circular economy takes place with the direct participation of the state through means of promotion and support tools. Thus, at present, most countries have an investment policy that provides financial support for circular innovations and that is focused on the issues of preserving the natural environment and on effective waste management. Along with this, the analysis of international practice demonstrated that, given the variety of organizational and economic tools in countries, each of them applies an individual approach to the implementation of the circular economy, which is based on the perspective and importance of this concept.

The above makes it necessary to further search for effective tools for the implementation of Ukraine's environmental policy in the context of the circular economy, taking into account international legislation in the field of environmental protection.

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Реалізація екологічної політики України в контексті циркулярної економіки

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Анотація. Європейська практика засвідчила, що всі країни члени ЄС є відповідальними за реалізацію прийнятих європейських природоохоронних угод. Починаючи з 1992 року, країни Європейського Союзу визначили в пріоритеті власного розвитку захист навколишнього середовища. Дослідження процесу реалізації екологічної політики України в контексті циркулярної економіки набуває актуальності. Метою статті є дослідження процесів реалізації екологічної політики України в контексті циркулярної економіки. В процесі написання наукової статті були використанні загальнонаукові методи дослідження: метод теоретичного узагальнення; категоріальний аналіз; метод порівняння; метод абстрагування; метод групування; метод прогнозування. В процесі дослідження наведено ключові напрями реалізації екологічної політики на державному рівні. Встановлено основні аспекти впровадження циркулярної економіки на регіональному рівні. Визначено три рівні формування та реалізації екологічної політики в Україні. Представлено різноманітні інструменти впровадження екологічної політики в контексті циркулярної економіки. Встановлено, що в Україні на сьогодні практично не здійснюється розробка та впровадження дієвих механізмів реалізації державної екологічної політики, відсутні інструменти усунення причин виникнення екологічних проблем та зниження негативного впливу на екологічну сферу при здійсненні господарської діяльності. Встановлено, що в процесі реалізації екологічної політики державі може належати відповідна роль, чи промоутера, чи фасилітатора, чи каталізатора. Зроблено висновки, щодо важливості впровадження циркулярної економіки. Подальшого розвитку набуло дослідження реалізації екологічної політики України в контексті циркулярної економіки в частині урахування складових екологічної політики, аспектів циркулярної економіки та комплексної реалізації екологічної політики на міжнародному, державному, регіональному та місцевому рівнях. Практична цінність наукового дослідження полягає в теоретичному обґрунтуванні процесу реалізації екологічної політики в контексті циркулярної економіки з урахуванням міжнародного досвіду та інструментів реалізації екологічної політики на всіх рівнях

Ключові слова: стратегія, завдання, економічні умови, інструменти реалізації, міжнародна практика

ВІСНИК АГРАРНОЇ НАУКИ ПРИЧОРНОМОР'Я

Науковий журнал

Том 26, № 3. 2022

Заснований у 1997 р.
Виходить чотири рази на рік

Оригінал-макет видання виготовлено у видавничому відділі
Миколаївського національного аграрного університету

Редагування англомовних текстів:
С. Воровський, К. Касьянов

Комп'ютерна верстка:
М. Кришталь

Підписано до друку 30 серпня 2022 р.
Формат 60*84/8
Умов. друк. арк. 11,4
Наклад 300 прим.

Адреса видавництва:
Миколаївський національний аграрний університет
вул. Георгія Ґонґадзе, 9, м. Миколаїв, Україна, 54008
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www: https://bsagriculture.com.ua/uk

UKRAINIAN BLACK SEA REGION AGRARIAN SCIENCE

Scientific Journal

Volume 26, No. 3. 2022

Year of establishment: 1997
Publication frequency: Four times a year

The original layout of the publication was made in the Publishing Department
of Mykolaiv National Agrarian University

Editing English-language texts:
S. Vorovsky, K. Kasianov

Desktop publishing:
M. Kryshtal

Signed for print of August 30, 2022
Format 60*84/8
Conventional printed pages 11.4
Circulation 300 copies

Publishing Address:
Mykolaiv National Agrarian University
54008, 9 Georgiy Gongadze Str., Mykolaiv, Ukraine
tel.: +38(0512) 70-93-54
E-mail: info@bsagriculture.com.ua
www: https://bsagriculture.com.ua/en