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TECHNICAL AND ECONOMIC ASPECTS OF THE IMPLEMENTATION OF WATER REMOVAL TARIFFS ON DRAINED LANDS OF UKRAINE

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Abstract. *The article highlights the main provisions of setting tariffs for water removal services for drainage. The application of tariffs is considered as an economic tool for increasing the efficiency of the use of drained lands when implementing the Strategy of Irrigation and Drainage in Ukraine [1]. An analysis of the provisions of the Law of Ukraine “On the Organization of Water Users and Stimulation of Hydrotechnical Land Reclamation” [2] regarding the provision of water users with water removal services for drainage by water user organizations and the payment of services by water users by the established water removal tariff was carried out. Emphasis is placed on the priority of the efforts in the field of hydraulic reclamation, namely proper operation and restoration of the country's drainage systems. The main point of the study is to realize the role of the status of water users who use water bodies to meet the needs of agriculture. According to the current legislation of Ukraine, the methodology of tariff formation should be based on a single basis – both for water supply and water removal.*

It is necessary to take into account the requirements of EU regulations regarding the consideration of the activities specifics in the field of water policy. Information on the development of water user organizations in Ukraine is provided and the operation costs of reclamation infrastructure facilities on the country's drainage systems are analyzed. The practice of foreign countries regarding the application of tariffs for water removal is given and the factors of the natural environment that were taken into account when selecting the option/options of water management in agriculture on drained lands of the country are outlined. The vision of researchers regarding the method of establishing and applying tariffs is given and a thorough assessment of the reasoning of scientists is provided. The areas for further research in the field of tariff formation for drainage are indicated. The base of tariff formation and methodical approaches to the formation of tariffs for water removal in the drainage area in Ukraine are proposed. The normative legal acts of Ukraine, the UN, EU bodies, the World Bank, data from scientific studies on tariff formation in agriculture on drained lands for 1991–2023, and administrative data were used as the main sources of information for the article.

Key words: *tariffs, water removal, tariff formation, reclamation infrastructure, drainage*

The relevance of the research. The response to the challenges of the times is a sustainable course for the development and increase of the volume of agricultural production in Ukraine by ensuring the necessary water and air regime of the soil. Solving this task will require the application of economic mechanisms to increase the productivity of drained lands, in particular through the introduction of water removal tariffs for drainage, which is provided for in the Strategy of Irrigation and Drainage in Ukraine for the period until 2030 [1]. This economic instrument is considered as an important component of

increasing the efficiency of drainage systems functioning in the Polissya area, along with their reconstruction and modernization into the combined irrigation systems and increasing the efficiency of drainage reclamation measures, growing new crops on the drained lands, which was previously impossible due to unfavorable natural conditions. Until now, tariffs for water removal in agriculture have not been applied in Ukraine.

The purpose of the study is to substantiate the main provisions of tariff formation for drainage by a unified approach to the formation of tariffs

in Ukraine, based on the analysis of normative legal acts of Ukraine and a critical study of best practices in the application of tariffs for drainage needs.

Analysis of the latest research and publications. In literary sources, the issue of tariffs in irrigation is most often considered along with drainage. Tariffs for water removal when draining land were not considered separately. The regulatory acts indicate the cost of services for irrigation of drained agricultural land, which is determined by water management organizations depending on the distance from a water distribution point [3]. The list of paid services includes: recommendations for improving the condition of water bodies and drained lands; services on water supply from reclamation systems and water sources for irrigation of drained lands and water regime regulation on combined irrigation systems [4]. The indicator “Area of drained land” provided by the recommendations on water resources statistics [5] is also used in Ukraine. In Ukraine, there are no publications regarding proposals for the introduction of water removal tariffs when draining.

Research methodology. Analysis of regulatory acts, learning the experience in providing paid services for the maintenance of reclamation systems of the drainage zone of Ukraine, critical study of best international practices in tariff formation for water removal services, logical and abstract methods (implementation of positive experience of using tariffs in drainage practice in Ukraine, attracting data from literary sources); analytical and synthetic methods (system analysis, generalization and synthesis of research results). The publication data were used to justify the mechanism of tariff formation for water removal services in Ukraine.

Research results and their discussion. By the statistical data as of January 1, 2021, that is, before the full-scale aggression of the Russian Federation, 5.48 million hectares of reclaimed land were accounted for in Ukraine, including 2.17 million hectares of irrigated and 3.3 million hectares of drained land with the appropriate reclamation infrastructure.

At the same time, the engineering infrastructure of the existing irrigation and drainage systems is out-of-date, practically physically worn out (more than 85%) and needs reconstruction and modernization. The pumping and power equipment of reclamation systems is out-of-date and energy-consuming, its condition poses threats to ensuring water supply and removal during the irrigation season [6]. Given that a significant part of the infrastructure, especially the irrigation

one, has been decommissioned due to damage, destruction or deprivation of water sources caused by the military actions of the Russian Federation, the need in necessary reconstruction measures in the post-war period is growing significantly. The progressive lack of natural water supply in the territory of Ukraine due to climate change even worsens the situation.

Therefore, in our opinion, a significant part of the drainage systems in the Polissia zone, which were less affected than the irrigation systems due to the Russian aggression, has to be reconstructed [1, 7, 22], without waiting for the end of the war.

In 2021, in Ukraine, bilateral water regulation was performed in the area of more than 300,000 hectares, which is less than 10% of the available drainage areas. In addition, despite the important document adopted by the Cabinet of Ministers of Ukraine [1], the primary task of which is to restore drainage systems in the drainage area through their reconstruction and modernization and the Action Plan for its implementation [7], which defines the formation of a tariff system for drainage services, the process of increasing the areas of water regulation and introducing a tariff system for drainage has not started yet. The adoption in 2022 of the Law of Ukraine “On Water Users Associations and Stimulation of Hydrotechnical Reclamation” [2] did not activate this process, but its provisions enable to accelerate the development of the methodology for setting tariffs for water removal by drainage systems.

It is worth considering the status of the water user in water removal processes. According to the law, a water user is a private or legal person who uses water (water bodies) to meet the needs of the population, industry, agriculture, transport and other sectors of the economy, including the right to water withdrawal, discharge wastewater and other types of water use [8]. Water resources are qualified as partially non-renewable resources, i.e., they are those elements of the enterprise’s property, the rate of recovery of which is lower than the level of economic consumption, therefore, at the enterprises effective measures should be taken to restore water resources, prevent or reduce water pollution, introduce the integrated water use, etc.

The above definition of water user by the legislation of Ukraine is closely related to the importance of water use [9], as a type of water services (any activity that has a significant impact on the status of water), namely the collection, accumulation, storage, treatment and distribution of surface or underground water; collection and treatment of wastewater, which

is discharged then into surface water. All these are the functions of a water user. Despite the fact that water removal/drainage of agricultural land differs significantly in terms of work technique from such a “canonical” and “stereotypical” land irrigation, is valued as an effective, necessary, technically justified type of water use, to which the principle provisions of irrigation tariffs can be applied to implement the water-regulating functions of drainage systems.

When applying economic levers (tools, water prices, tariffs, levies, taxes, subsidies, evaluation, financing and investment of some measures, etc.), the requirements of EU legal acts should be followed to take into account the specifics of activities in the field of water policy: implementation of the general program of measures for the effective use of water resources; following the rule of water supply costs reimbursement, when the “polluter pays”; conducting an economic analysis of water supply services; collecting information and preparing relevant reports, etc. The member states of the European Union can thus take into account the social, environmental, and economic consequences of costs reimbursement, as well as the geographical and climatic conditions of the water supply of the regions. When implementing a sustainable water policy, the available scientific and technical data are taken into account, the potential benefit and cost of the measures or loss from not implementing water removal measures are estimated [10]. It is appropriate to note that the regulatory documents of Ukraine take into account the key requirement of the Directive – inter-basin and/or intra-basin redistribution of water resources [2].

The already mentioned Law [2] defines the legal status of water user associations (WUAs), the procedure for their establishing, operation and termination, etc. The law also regulates appropriate services for water users and the procedure of payment for them using the established water removal tariff. WUAs services include water removal from drained lands. WUAs serve the land plots of water users, from where water is removed for hydrotechnical amelioration needs. The water users’ needs in engineering infrastructure of amelioration networks for water removal are determined. The regulations for water removal services provide for the existence of rules for the provision of water supply and removal services by the associations to water users and proposals from the water users regarding water removal, conclusion of a contract for services, and provide for payment by the water users for the services based on the water removal tariff.

The tariff includes the cost of services for water transportation and the cost of electricity necessary for water removal, as well as other costs, the size of which depends on the volume of removed water and the cost of maintaining the WUAs. The right of WUAs to stop providing services to the water users for water removal in case of delay in payment for WUAs services is also noted. It should be noted that the fact that the water user has paid for water removal/water regulation services is a requirement for state compensation for his losses.

In addition to the legally regulated works of the WUAs regarding water removal from the lands of water users, the researchers propose a wider range of relations between partners when removing water from drained lands. It is noted that tariffs for water removal should reflect the fact that drainage of one area may benefit not only farmers, but also other landowners elsewhere. Tariffs for drainage must ensure economic efficiency, financial sustainability and fiscal transparency, and also ensure equity, namely when rain on one land plot may cause a need for drainage on another, and consequently that drainage may benefit a third downstream area and such fair interactions usually involves the establishment of a single fee per hectare for the entire drainage area. Agricultural drainage can also help protect houses, roads and other infrastructure against flooding, so the funding system should ensure a fair balance between the various beneficiaries.

One special case is the combined irrigation systems found in the northwestern part of Ukraine, where open canals and closed drainage are used to lower the groundwater level in winter and early spring and to raise it in late spring and summer. Water used for irrigation often comes from an upstream drainage system, rather than from purpose-built irrigation canals, so its volumes cannot be measured. In most such cases, the most appropriate financing mechanism will be a single tariff per unit of both irrigation and drainage area during the year.

Upon acquisition of ownership rights to agricultural land plots, large farms may wish to build and operate their own pressure pumping stations and pipeline networks, so the WUAs should be ready to attract private investment to expand drainage area. At that the tariff system is expected to remain the same as it is for small farms that pump water directly from the canal to the irrigation system. However, the WUAs have to ensure that this approach will not lead to the situation when small landusers will not have an access to irrigation services and that private

pumping stations will comply with the control system of water supply and distribution along the secondary canals.

First stage of the implementation of the Strategy includes: (a) reforming the system of water management and land reclamation by separating the functions between the State Water Agency and the newly formed business entity for managing the engineering infrastructure of irrigation and drainage systems (it has been implemented through the formation of the State Agency for Land Reclamation and Fisheries); (b) modernizing the system of monitoring and management of water resources in the State Water Agency and providing financing for the reconstruction of critical state water infrastructure within the State Fisheries Agency system; (c) developing the Law on the WUAs (the Law was adopted by the Verkhovna Rada of Ukraine in 2022) and starting establishing the WUAs (34 WUAs were established, in particular 4 in the drainage area: “Lesyni Dzherela” WUA on the Tesnivska system and “Tovscha” WUA on the Tnyanska system (Zhytomyr Region); “Sylna Voda” WUA on the Brovarka system (Kyiv Region) and “Subotiv” WUA on the Tyasmynska Drainage System (Cherkasy Region)) [13]; (d) forming financial mechanisms to support the investments of WUAs and farmers (the relevant procedure approved by the CM of Ukraine is applied); (e) establishing a regular structure and procedure for financing tariffs and subsidies [11].

The strategy stipulates finding a balance of the interests of the state, WUAs and water users and establishing the actual state of managing drainage facilities through inventory and timely implementation of measures for its improvement, improvement of operational practices and reasonable and effective spending of limited budgets. In some cases, it will be necessary to include in the tariffs the costs of improving water quality and the ecological condition of drained lands [12]. The application of tariffs for water removal will contribute to the efficient use of water resources and is considered as the provision of water services [9].

The formation of tariffs based on the cost of services for the transportation of water and electricity, necessary for water removal, increases the importance of the analysis of the actual costs of maintaining the infrastructure in the drainage area. It is necessary to compare the for operation costs for reclamation systems in Ukraine by the data of the State Water Agency of Ukraine for 2020. According to the data on the irrigation systems budget expenditures ranged from UAH 2.782/ha for the Black Sea and Lower Danube

Basin Administration of Water Resources (BAWR) to UAH 3.481/ha for the Lower Dnipro BAWR and accounted for from 46 to 260 % of the total costs for their operation. The budget funding for the drainage systems of the Rivne region was much lower compared to the irrigation systems (139 UAH/ha), but its share in the total funding of the operating costs was significantly higher (more than 85 %) compared to irrigation systems.

This indicates that in the drainage area the state of the existing infrastructure of drainage systems is much worse compared to irrigation infrastructure, because the income from farms for the maintenance of drainage systems does not exceed 10 % of the budget funding. It is expected that introducing two-way regulation of the water regime with the help of more complex drainage and irrigation systems will provide farms with a guaranteed water regime for more efficient crop cultivation and will require greater participation of agricultural producers in financing the implementation of water regulation, which is possible only by increasing the tariffs for these services.

Practices of applying water removal tariffs in foreign countries. It is known from the history of irrigation of agricultural lands [14] that in the practice of draining lands, tariffs for water removal have been used for a long time. The table 1 provides the information about the practice of applying tariffs for water removal when draining land.

Legal relationships on water removal for drainage between free market agents, who benefit from the use of drained land, are formalized by the payment by water users of fixed and variable fees for services, area of drainage, use of water, etc.

The basis for the formation of tariffs in the drainage zone of Ukraine. On the basis of the current legislation of Ukraine, in particular the Law [2], the above analysis of the foreign practice in tariff formation, it is possible to propose the following provisions regarding the establishment of tariffs for water removal in the drainage area of Ukraine (Table 2). They should take into account the benefit as a result of reclamation systems operation, saving and rational use of water by farms, the category of land tenure, the implementation of high-quality climate-optimized water regulation technologies, the consequences of climate change, etc.

Increasing pressure on land and water use requires larger integrated drainage strategies, including the transfer of responsibility, decision-making and funding for irrigation and drainage systems from the public sector to water user associations.

1. Best practices in the application of tariffs for water removal in drainage services

Country, source	The practice of applying tariffs for water removal
The Netherlands [12]	Water boards/water administrations are responsible for land drainage and flood protection. Water board costs including the full cost of drainage are fully covered by water users.
Switzerland, Croatia [15]	It was established a fee for water removal in agriculture
Portugal, France [15]	It was established a fee for land drainage
Italy [15]	Consorzio di Bonifica e Irrigazione Company specialized in drainage and water supply uses 2 payment instruments: (i) tariffs and (ii) the self-service fee (both for abstraction of surface and groundwater). At the same time, the fee for water removal services is calculated in proportion to the benefit received (ranking plan) taking into account the served area. The organization splits the costs between drainage services and the supply of irrigation water to end users.
Serbia [16]	Based on the climatic conditions of the country, water excess causes higher economic costs than its deficit. Operation and maintenance costs have always been much higher for drainage than for irrigation, therefore, funds obtained as water removal fees must be earmarked funds used to maintain and improve the operation of publicly owned water bodies and systems used for drainage purposes.
Great Britain (England and Wales) [17]	It is considered that all land and property within the drainage district benefits from the drainage facilities and therefore the land owners are obliged to pay contributions to the operation and maintenance of the drainage facilities. Water removal and special fees have been established. The drainage fee includes a fee that combines a fixed right-of-delivery fee, based on the recovery of capital costs incurred in case of drainage works, and a variable fee per megaliter of distributed water. Both types of fee may differ depending on the category of land tenure, as it is specified in the List of Fees and Prices.
Australia [18]	Irrigation and drainage areas were transferred from state control to the private sector or under the control of water user cooperatives. There are capital and operating costs. The operation and maintenance costs for evaporation basins are covered by a tariff system based on a service fee, which includes a fee "per hectare" and "per megaliter"* when irrigating land. There is a service fee (annual cost for being connected to the system), an area fee (paid by all landowners in the area regardless of water use) and a water use fee, which is paid based on the total supply of water for irrigation.
*Megalitre ML = 1 000 cubic metres m ³ [5, p. 206]	
Georgia [19]	There are separate tariffs for irrigation and drainage services
India [20]	There is a fee for drainage maintenance. In the state of Tamil Nadu there is a fee for pumping and treatment of drainage water for agricultural needs.
Turkey [21]	Farmers, farmer cooperatives, or appropriate government agencies perform cost-effective cleaning and repair of subsurface drainage systems in case of clogged or visible damage to pipes or old sludge chambers.

Methodical approaches to the formation of water removal tariffs in the drainage area in Ukraine. The main goal of introducing tariffs on drainage systems of Ukraine should be reimbursement of costs, and the main measure of tariffs in drainage should be the fixed cost of services per hectare of area and the cost of removed water (in the areas where measuring devices are installed). On drainage systems, the basis of tariffs will be a fixed cost of services per hectare of drained land area, while on combined two-way drainage systems it is reasonable to apply a two-rate tariff, which includes a fixed

rate per a unit of drainage area and a variable rate per a unit volume of water supplied to the plot or removed from the plot. In some cases, it may vary depending on crop type, and the more moisture-loving crop, the higher is the water fee. It is necessary to adapt the legislation in terms of introducing water removal and supply tariffs in accordance with the established rules, to enlarge public participation in water management, participation of water users in the development of the tariff system for water removal, as well as of the adaptation systems to climatic conditions. State support for maintenance, reconstruction

2. The general technical and economic basis for setting tariffs for water removal on reclamation systems in Ukraine

Elements of the tariff formation mechanism	On drainage systems	On combined two-way drainage systems
Land plots of the water users that require water removal (bilateral regulation), total area	area of the system, type of drainage	area of the system, type of drainage, availability of two-way water regulation
Reclamation facilities (reservoirs, canals, drains, pumping stations, roads, protective dams, observation network and other hydrotechnical structures and objects)	reclamation facilities provide water removal	reclamation facilities provide two-way water regulation
Rules for the provision of water supply and water removal services, developed by the WUAs, conditions of service provision, water user applications for the provision of water removal/water regulation services, contracts with the WUAs for water removal/water regulation services, compliance with the rules for the provision of the WUAs services to the water users, timely payment for services	existence of rules, contracts for water removal	existence of rules, contracts for water removal/water regulation
Schemes of engineering infrastructure facilities of reclamation networks, which ensure water delivery and removal for the needs of water users.	existence of schemes	existence of schemes
Developed tariffs for water removal /water regulation services; established fee for the WUAs services for water removal/water regulation; formation of the Budget Plan for maintenance of the systems, payment for electricity/fuel for the operation of pumping stations; income and expenses; schedule of services payment by water users by the tariffs	the cost of water and electricity transportation services necessary for water removal, as well as other costs, the amount of which depends on the volume of removed water, the costs for operation of the WUAs	the cost of water and electricity transportation services necessary for water removal, as well as other costs, the amount of which depends on the volume of removed water, the costs for operation of the WUAs
taking into account the changes in natural and climatic conditions, actual capability of water-regulating function of reclamation systems	water removal from the area	water removal and water supply to the area
*the possibility of introducing differentiated tariffs for services on drainage systems with pottery/plastic drainage and under different crops		
protection of the objects of state and communal property against flooding, damage, etc.	protection of the objects on the system	protection of the objects on the system
establishing the mechanisms to support the investments of the WUAs and farmers in improving the reclamation infrastructure	applying on the system	applying on the system
capability of transferring removed or supplied water from one area to another one	water removal from the area	water removal from the area and water supply to the area

and modernization of reclamation infrastructure should be maintained. The introduction of tariffs will require a higher level of qualification of workers in the field of drainage and agricultural use of reclaimed land, and personnel of the reclamation infrastructure management services. The level of self-organization of water users will be important.

Tariff formation should display the reclamation infrastructure management schemes, local and regional water removal/supply characteristics, water availability, structure and number of cultivated crops, use of alternative water-saving technologies, drainage/irrigation methods, and existing subsidy systems. Different regions and drainage facilities in Ukraine require

different approaches to setting tariffs. The cost of services paid by water users will depend on the water intake facilities and the state water removal systems. A detailed economic analysis with different pricing scenarios for both drainage and irrigation tariffs will help to choose more efficient alternatives to the tariff system. At that, it is also necessary to take into account the need to develop effective mechanisms for controlling and accounting for the use of water resources, as well as the mechanisms of preventing the cases of unauthorized water withdrawal from natural water bodies.

The law [2] establishes the principles of tariff formation for water removal and the tariff components, specifies the activity of the WUAs on water removal and its cost, as well as the rules of providing services. The conditions for the performance of contracts for the provision of services are recognized as relevant for the parties. Based on the existing tariff formation mechanism, investments will be attracted in the modernization and restoration of the network of drainage systems, pumping stations, reduction of energy consumption and non-productive water losses.

The water-user as a business entity and a beneficiary, receives economic benefits from maintenance of optimal water and air regimes, which are formed as a result of proper functioning of drainage systems and water removal from them. Tariffs for water removal services for drainage, paid by the water user, connect the interests of the beneficiary, water removal service, territorial communities, the state, regional and national economy.

Conclusions. Applying tariffs in water removal is considered as an innovative area in

the relations of water users and the state through the interaction of the WUAs. They must take into account the availability of engineering infrastructure facilities of reclamation networks, features and specifics of the reclamation complex, control the compliance with the requirements for ensuring hydraulic connectivity and technological integrity of reclamation systems. When transferring from the payment procedure for water removal services to the introduction of tariffs, it is advisable to use the successful experience of developed countries in terms of agriculture. The imperative of the state's interests under market conditions in developing drainage in the agricultural sector is manifested in the monitoring of the proper use of reclaimed land and control of the responsibility of landowners and the WUAs through services payment by tariffs. The aim of introducing paid water use based on drainage tariffs in Ukraine is a cost reimbursement. The fixed service cost per hectare of reclaimed land should be a main measure of tariffs in drainage.

The areas of further research should be the following: development of legislation in the area of introducing water removal tariffs, learning the current state of reforms in the introduction of tariffs, generalization of the best practices of managing reclamation infrastructure based on tariff application both in Ukraine and in the world, development of the method of applying tariffs for drainage systems, conducting a survey/study of the practices of tariff formation, development of adequate water drainage infrastructure management schemes and providing water services taking into account ecological and economic justifications.

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ТЕХНІКО-ЕКОНОМІЧНІ АСПЕКТИ ЗАПРОВАДЖЕННЯ ТАРИФІВ ІЗ ВОДОВІДВЕДЕННЯ НА ОСУШУВАНИХ ЗЕМЛЯХ УКРАЇНИ

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Анотація. У статті висвітлено основні положення встановлення тарифів на послуги з водовідведення для дренажу. Застосування тарифів розглядається як економічний інструмент підвищення ефективності використання осушуваних земель при реалізації Стратегії зрошення та дренажу в Україні [1]. Був проведений аналіз положень Закону України «Про організацію водокористувачів та стимулювання гідротехнічної меліорації земель» [2] щодо надання організаціями водокористувачів послуг із водовідведення для дренажу користувачам та сплаті водокористувачем послуг за встановленим тарифом на водовідведення. Наголошено на пріоритеті зусиль у сфері гідротехнічних меліорацій на експлуатації та відновленні осушувальних систем країни. Вихідним моментом дослідження є розуміння ролі статусу водокористувача, який використовує водні об'єкти для задоволення потреб сільського господарства. За чинним законодавством України, методологія тарифоутворення повинна ґрунтуватися на єдиній основі – як при подачі води, так й і її відведенні. Слід брати до уваги вимоги нормативних актів ЄС щодо врахування специфіки діяльності у галузі водної політики. Надано інформацію щодо розвитку організацій водокористувачів в Україні та проаналізовано витрати на експлуатацію об'єктів меліоративної інфраструктури на осушувальних системах країни. Викладено практику зарубіжних країн щодо застосування тарифів при відведенні води та зазначено чинники природного середовища, які враховувалися при відборі варіанту/варіантів управління гідросферою у землеробстві на осушених землях країни. Наведено бачення дослідників щодо методики встановлення та застосування тарифів та надана ґрунтова оцінка міркуванням науковців; зазначено напрями подальших досліджень у сфері тарифоутворення для дренажу. Запропоновано базу формування тарифів та методичні підходи до формування тарифів на водовідведення у зоні осушення в Україні. Головними джерелами інформації статті стали нормативно-правові акти України, ООН, органів ЄС та World Bank, дані наукових досліджень із тарифоутворення у землеробстві на осушуваних землях за 1991–2023 рр., адміністративні дані.

Ключові слова: тарифи, водовідведення, тарифоутворення, меліоративна інфраструктура, дренаж