

Determining and determinable factors influencing the size of zone of land-use restriction

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Abstract

Purpose. Identification and systematization of determining and determinable factors that affect the size of land use restriction zones to ensure both the legal component of land rights and the well-being of society as a whole.

Methods. The method of system analysis established the structural relationships between the determining and determinable factors related to forming zones of restrictions on land use and determining their optimal size. Establishing causation between the relevant factors and determination of their impact during the formation of restrictions' boundaries.

Findings. The current state legal acts of Ukraine are analyzed, specifying the size of zones associated with different types of land use restrictions. Five groups of factors are identified that affect the spatial characteristics of the restriction zones and are crucial for setting the size of the restriction zone. The division into groups of factors allows a better approach to the further process of determining their impact and provides the basis for appropriate specialists for a comprehensive approach in determining the spatial characteristics of land-use restricted zones. It is determined that taking into account the justified impact of each factor on the overall situation, it is advisable to consider in detail and rank the level of influence within each classification group.

Originality. For the first time, factors that influence the formation of boundaries of constraints by such classification as determinable and determining factors have been grouped. An appropriate approach was tested for sanitary protection zones.

Practical implications. Systematized determining and determinable factors can be used to justify the sizes of all types of restrictions, which will further allow the professionals of adjacent branches to carry out easier work on the establishment of boundaries on the terrain of the respective zones and provide their legalization.

Keywords: land administration, buffer zone, factor, zone of land use restriction, spatial characteristics of the restriction zone

1. Introduction

Since the post-war years in Ukraine, the number and capacity of industrial enterprises of all types of industry have steadily increased. It is important that the development of industry was in parallel with the development of rural households and other sectors of the economy, which together led to a steady growth of Gross Domestic Product (GDP) and general welfare of the population. Negative component of rapid development was the sporadic development of territories, where, over time, the growth of settlements was limited to the existing industrial enterprises. This period influenced virtually all the major cities of the state, and as a result, industrial enterprises that were formerly on the periphery have now developed into cities' centers. The corresponding situation leads to deterioration of the environmental component and lowers the quality of life of the inhabitants.

In addition to the above, we should also consider the fact that no adequate attention and importance had been given to establishing zones in land use restriction around industrial facilities.

At the end of the 20th century, the economy of urban space in Europe was restructured. Today, in terms of greening, lack of natural resources and increased attention to public health issues, establishment of restriction zones or reduction of the existing zones is becoming more and more relevant.

While establishing the restricted zones, attention should be paid to two aspects: first, restrictions in land use causing restriction of rights of owners (users) of land where the area of restrictions exists; and secondly, the market value of the land may considerably decrease due to the establishment of restrictions there.

Land parcels within settlements usually have high investment attractiveness, so their value plays a key role in urban investment. Recently, in Europe, the renovation of the affected areas of industrial enterprises has become so popular that European experts consider it to be the key to achieving sustainable land use. The most successful results were analyzed in detail [1] on the example of objects in London (UK), Bucharest (Romania) and Ingolstadt (Germany). For cities with sig-

nificant industrial potential, in which for the most part there were no zones of restrictions, the renovation of territories with further establishment of restricted zones is a key solution.

Land is one of the most important natural resources. At the same time, it is limited like any other resource. Positive further implementation of land reform gradually raises the requirements to land use. Establishing restrictions on land use is one of the components that should be subject to state supervision in terms of compliance with land legislation.

Planning and defining of land use restrictions is carried out by city planning and territorial planning authorities on general and detailed plans of settlements. Environmentalists carry out the relevant calculations and environmental reports, surveying engineers establish and organize restrictions around sensitive facility and fix them in the legal field under specific land management projects.

The task of determining the boundaries of land use restrictions is interdisciplinary. The basis of its correct solution is to determine the factors that affect the size of the restriction. Thus, the purpose of this study is to systematize the determining factors that influence the formation of restrictions and factors that outline the characteristics of their influence for further consideration in practice.

According to [2], there are the following types of land use restrictions:

- protection zone (buffer zone);
- zone of sanitary protection;
- sanitary protection zone;
- water protection restriction;
- other restrictions.

Rational use of areas where there are restrictions in areas of land use, depends on clear understanding of how well defined the size of restrictions is. Determining the size, in turn, depends on the availability of reliable information on the type of restriction, its specificity, spatial characteristics of the mode-forming object, its established boundaries, etc.

Special industrial mode-forming objects integrate different types of restrictions and could be a good example for the current research. The scientific article [3] is dedicated to the analysis of the mineral fund of Dnipropetrovsk oblast, the concept of anthropogenic mineral fund development as an alternative for the industrial development of Dnipropetrovsk oblast. For the first time, a careful analysis of the storage of technogenic waste from the activities of mining and energy industrial enterprises was conducted in the study. The authors also propose to group man-made waste by origin, density of deposits and content of components. The number of industrial complexes in Ukraine and their areas has been estimated. The analysis revealed that significant volumes of man-made raw materials are present in our country, which is a powerful potential for its economic development. The development of such raw materials, with the involvement of investment and scientists, will allow to compete with the traditional development of mineral deposits. But, in any case, whether it is a traditional development of the field, or the one proposed by scientists in [4], the establishment of sanitary protection zones around such objects is obligatory in terms of ecology, protection of public health, land and town planning legislation. It is also important to fill in the data on the objects of the automated system of state land cadastre indicated in the study, as well as their state registration of sanitary protection zones around them.

In the context of environmental globalization, the health of the population in a powerful industrial region will be threatened with the emergence of such waste deposits.

The authors [4] raise the problem of unsatisfactory condition of the rehabilitating disturbed lands of industrial enterprises after their liquidation. The main reasons for the authors to believe in the deficit fertile soil is breeding and water quota. The legislation of Ukraine regulates the process of liquidating mining enterprises and the rehabilitation of disturbed territories to restore their condition for later use. The main result of the study is a proposed method of mine wastewater treatment. Because, if biota breeds in water, then biodiversity will change in the soil. After proper rehabilitation of the territory, the need for sanitary protection zones around these objects will disappear. Then there is a need to update the data of the state land cadastre.

The study [5] raises questions about the sustainable development of Ukrainian industrial enterprises. Sustainable development is always a very broad concept. The authors have limited themselves to think-tanks that specialize in ferrous metallurgy, namely optimization of efficiency of waste utilization of its production. The method of integrated approach is analyzed and systematized for the Ukrainian and foreign state of accumulation of industrial waste and its processing for other industries. The analysis revealed that the international economy is booming thanks to the rational and efficient processing of waste, in terms of resource conservation and greening of society. The paper identifies the complexity of waste management in Ukraine, formulates policy instruments to create the necessary conditions for the development of competitive conditions for the recovery of ferrous waste in our country and the sustainable development of these industrial enterprises.

The analysis of scientific articles shows that the problem of sustainable land use especially of industrial ones is impossible without the use of complex approach. To solve the task, it is important to classify the restrictions depending on their types and source of harmful influence.

2. Methods

The article aims to show another point of the problem of the rational land use optimization. At the state level, it could be solved using the principles of effective cooperation not only of professionals in geodesy, ecology, environmental protection but also land and urban planning cadastres.

Formulating any restriction of land use by defining its spatial characteristics should be clearly provided by the professionals in urban planning. Their main task is to take into account all state building regulations and sanitary rules during the process associated with the development of urban planning documents of any settlement.

Together with professionals in urban planning, experts in ecology define the influence of mode-forming objects around which the restriction zone is determined.

The precise boundaries of restriction zones are defined by professionals in geodesy. After their measurements and calculations, land management projects are usually developed. All processes are finished after the land parcel is registered in the State Land Cadastre and State Register of Rights.

This research is based on the authors' previous studies and papers aimed to systematize the factors influencing each separate land use restriction [6], [7]. On the basis of the anal-

ysis of scientific publications by domestic and foreign scientists, concerning the factors that influence the formation of the land occupied by settlements and zones of restrictions on the use of lands in particular [8]-[13], the authors came to the conclusion that there are many factors which have to be grouped into the determinant (basic) clusters. Based on systematization and cause-effect relations, all justified factors were grouped according to the type of land use restriction. Such system approach allowed to develop another classification – the enlarged one. For the first time, the factors were aggregated in the following classification: natural, ecological, economical, functional-planning and administrative. For each group, the most important factors were justified.

All the grouped factors define and influence spatial characteristics of land use restrictions. It is important to note, that they do not consider any semantic or attribute characteristics. All factors could be used to justify any possible type of restriction according to State Legal acts of Ukraine.

3. Results and discussion

The size of the areas associated with land use restrictions is affected by many factors that are not yet clearly defined and vary depending on the type of restriction and the sensitive facilities around which it is determined.

The study analyzed the current regulatory acts of Ukraine specifying determination of the size of zones related to different types of land use restrictions. The study confirmed that the problem of substantiation and determination of restrictions zones is interdisciplinary and combines specialists in construction, surveying, land management, environment etc.

The study identified five main determining factors in defining the boundaries of restricted areas. Each determining factor was supported by the factors to be determined, analyzed in detail and emphasized as the most important.

A systematic analysis of both determining and determined factors gives a clear view of the complexity and relevance of the issue of justifying the size and setting boundaries of land use restrictions zones in situ.

The previous research [6] systematized the factors that influence the planning characteristics of different types of land use restrictions zones, depending on the sensitive facility, in accordance with the current normative legal acts of Ukraine.

Based on the results of this study [6], Figure 1 identifies five groups of factors that influence the spatial characteristics of restrictions zones. They are crucial for setting the size of the restriction zone.

According to Figure 1, 5 groups of determining factors were identified:

- natural;
- ecological;
- economic;
- functional-planning;
- administrative.

For each group of determining factors, we systematized the key factors that needed to be determined.

Natural factors include relief, geology and hydrogeology. Particular attention is paid to hydro-geological factors, because in accordance with [14] industrial enterprises, and the zone of restrictions around them respectively, cannot be formed between the water object and the residential territory and, moreover, upstream in relation to recreational or residential zones.

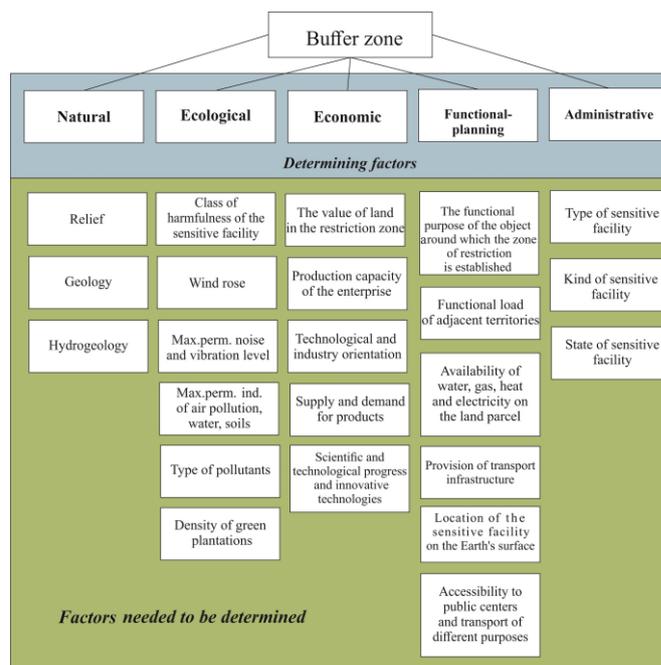


Figure 1. Determining and determinable factors

The presence of a facility that is a source of contamination near an aquatic object violates the sanitary rules of planning and development of settlements [14]. In practice, such cases often occur, therefore, in accordance with the required calculations of the maximum permissible concentrations of harmful substances, a planning decision may be made to increase the zone of restriction. Also, for example, during an underground mining of a deposit, a possible violation of the hydrogeological regime of groundwater may occur, which may lead to such effects as landslides, formation of karsts, etc. In this case, increase in the zone of restriction is obligatory. The most common factor influencing the size of the zones of the land use restrictions was relief. This factor is present in each type and even each kind of restriction. It is well known that relief is a complex of all inequalities on the earth's surface. In this article, we refer to relief as the surface that, in some cases, conditions the existence of restrictions as well as its size and configuration.

Environmental factors are very important for determining the size of sanitary protection zones, as the impact of industrial enterprises on the natural environment, which, unfortunately, does not decrease despite the development of science and technology. The class of enterprise harmfulness concerns only sanitary-protective zones among other ecological factors. Often, owners of enterprises inflicting a negative impact on the environment decide it to be more economically viable to pay a fine to the local budget for environmental pollution than to install the latest waste treatment systems, which is very disappointing. The maximum permissible concentrations of harmful substances and the type of pollutants are the main environmental factors. Environmental experts carry out the necessary data sampling, certain calculations and provide a technical report, as a result of which the restriction zone can be justified by specialists in urban planning and spatial planning, these zones are then mapped in the general and detailed plan of the settlement. That is, the regulatory size of the established restriction zone [14], there is a need to check the calculations in accordance with the requirements [14], taking into

account the actual state of contamination and the growth prospects of the sensitive facility. Calculations of the concentration of harmful substances in the lower atmosphere, determination of the distance from the source of pollution, determination of wind speed are corrected separately depending on the wind rose of the area in which the sensitive facility is located.

Today, one of the points of the last European Union Directive SEVESO III [15] and its important concept is land use planning. This Directive is the EU law aimed at improving the safety of cities and, in particular, of people under high concentrations of harmful substances. This Directive defines the obligations of the industrial business owner, and establishes requirements for land use planning, as well as a system of inspections and safety management. Within the framework of SEVESO III, a seminar was held in Ukraine, where all points of the Directive were discussed and clarified.

Taking into account the capacity of the industrial enterprise and the demand for the products it produces as economic factors, the size of the restriction zone may be increased, because the emissions of harmful substances and the production wastes may have significantly higher values than the limit. However, the current capabilities of industrial emissions treatment must be taken into account. If the defined components are used, the size of the restricted zones may be significantly reduced. Modern developed enterprises today have the opportunity to install treatment systems, filter elements to reduce the emission of harmful substances, all types of transport are equipped with systems of filtration of emissions resultant from their operation – the basis for the use of this factor is sufficient financial support.

The most important *economic factor*, in our opinion, is the value of land that falls into the restricted zone. This factor influences not only the size of the restriction zone, but also the establishment of this area on the ground in general, however there is no mechanism of compensation for establishing a land use restriction on land to the landowner or land user.

The *functional and planning group of factors* contains the largest number of different factors that regulate the provision of land with engineering communications. Functional planning factors are determined by the existing project and planning documentation within a specific locality. The main factor for this group highlighted by the authors is the functionality of the facility around which the zone of restriction was established. Functionality of the facility reflects its use in the implementation of certain business activities. It is the functional purpose that determines the level of harmfulness of the facility, and therefore all the indicators calculated to justify the size of the restriction zones.

The above functional and planning factors are significant. The profitability of land use in the restriction zone also depends directly on its functional purpose.

Among the classified factors, certain factors influence the establishment of a restriction zone of only one type of restriction, not all the existing ones. Alternatively, all factors equally influence the establishment of the restriction zone. Therefore, it is impossible to say that the performed analysis is final, or the identified factors can be unified and applied to establishment of the size of all existing types of land use restrictions.

The set of structured factors identified in the study will give specialists a comprehensive understanding of how to correctly and accurately determine the spatial characteristics of the restricted area, taking into account all the features and

limitations, the sensitive facility around which it is established, and the functional load of adjacent territories.

All factors that determine the spatial characteristics of the restrictions are characterized by belonging to five groups: natural, environmental, economic, functional-planning, and administrative. Among them, natural ones in most cases characterize adjacent territories, rather than the land-use restriction zone itself. For further deeper study, each factor should be ranked by its importance and the combined effect of the decision about setting the boundaries of the restrictions zones.

4. Conclusions

An important basis for the creation of an effective system of city functioning and improvement of the system of settlements territories planning is the establishment of restrictions zones on land use in situ, input of information into the automated system of the state land cadastre, and the input of up-to-date information to the Public cadastral map.

It is important to consider the degree of the analyzed factors influence on determining the size of the restriction zones. In this way, it will be possible to plan the territory of settlements more rationally and to use it more effectively. The analysis of the set of different factors made it possible to identify the main ones for specific types of restrictions.

These types of restricted zones, such as sanitary protection zones, are necessary for public safety and public health. That is, all professionals who make projects and set sanitary protection zones in cooperation with the authorities must meet legal requirements to environmental quality and at the same time preserve the development of industry.

The analysis shows that the size of the restriction zones is set in three ways:

- according to clear regulations of state legal acts;
- during development of different types of documents: planning, land use or other projects;
- based on specific calculations.

Taking into account the factors systematized in the article, careful consideration should be given to the planning and determination of the future location of a sensitive facility. In the case of existing development, systematic approach to determining such factors will allow careful planning of the placement of other facilities that will be in close proximity to the sensitive facilities.

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References

- [1] Ponomariova, A. (2011). Urban renovation of brownfields in Europe. *Modern Problems of Architecture and Urban Planning*, (26), 155-161.
- [2] *The procedure of maintenance of the State land cadastre* (2012). Approved by the Resolution of the Cabinet of Ministers of Ukraine. Retrieved from <https://zakon.rada.gov.ua/laws/show/1051-2012-%D0%BF>
- [3] Petlovanyi, M., Kuzmenko, O., Lozynskyi, V., Popovych, V., & Sai, K. (2019). Review of man-made mineral formations accumulation and prospects of their developing in mining industrial regions in Ukraine. *Mining of Mineral Deposits*, 13(1), 24-38. <https://doi.org/10.33271/mining13.01.024>

- [4] Kostenko, V., Zavialova, O., Chepak, O., & Pokalyuk, V. (2018). Mitigating the adverse environmental impact resulting from closing down of mining enterprises. *Mining of Mineral Deposits*, 12(3), 105-112. <https://doi.org/10.15407/mining12.03.105>
- [5] Filonenko, O. (2018). Sustainable development of Ukrainian iron and steel industry enterprises in regards to the bulk manufacturing waste recycling efficiency improvement. *Mining of Mineral Deposits*, 12(1), 115-122. <https://doi.org/10.15407/mining12.01.115>
- [6] Petrakovska, O., & Trehub, Yu. (2018) Systematization of factors affecting definition of buffer zones. *Scientific and Technical Collection Engineering Geodesy*, (65), 92-103.
- [7] Ryabchii, V.A., Ryabchii, V.V., Trehub, M.V., & Trehub, Yu.Ye. (2017). Substantiation of land parcel configuration in buffer zone. *Scientific Bulletin of National Mining University*, (4), 80-85.
- [8] Gorova, A., Pavlychenko, A., Kulyna, S., & Shkremetko, O. (2012). Ecological problems of post-industrial mining areas. *Geomechanical Processes During Underground Mining – Proceedings of the School of Underground Mining*, 35-40. <https://doi.org/10.1201/b13157-7>
- [9] Biriuk, S.P. (2013). Urban planning factors and criteria for choosing directions for the reconstruction of industrial areas. *Modern Problems of Architecture and Urban Planning*, (32), 263-270.
- [10] Jalal, A., & Fikri, M. (2008). *Awareness of noise hazard from construction site*. Master's thesis. Skudai, Malaysia: Universiti Teknologi Malaysia, Faculty of Civil Engineering.
- [11] Torr, P. (2000). *Guidelines for separation distances*. Washington, United State: Environment Protection Agency.
- [12] Druzhinin, M.A., & Pleshkanovska, A.M. (2015). Methods of optimization of the territory of sanitary protection zones on the example of the city of Vinnitsa. *Modern Problems of Architecture and Urban Planning*, (39), 201-205.
- [13] Mamonov, K.A., & Shternodk, E.S. (2017). Classification of spatial factors that affect the value of land in a metropolis. *Utilities of Cities. Series: Technical Sciences and Architecture*, (134), 138-142.
- [14] *State sanitary rules for planning and housing of settlements approved by the order of Ministry of Health of Ukraine as of 19.06.1996 No. 173*. (1996). Kyiv, Ukraine: Ministry of Health of Ukraine.
- [15] *Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC*. (2012). Brussels, Belgium: European Union.

Визначальні фактори та фактори, що визначаються, при формуванні розміру зони обмеження використання земельної ділянки

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Мета. Виявлення та систематизація визначальних факторів та факторів, які визначаються, що впливають на розмір зон обмежень у використанні земель для забезпечення як юридичної складової прав на земельні ділянки, так і добробуту суспільства в цілому.

Методика. Методом системного аналізу було встановлено структурні зв'язки визначальних факторів та факторів, які визначаються, при формуванні зон обмежень у використанні земель та визначенні їх оптимального розміру. Встановлені причинно-наслідкові зв'язки між відповідними факторами та визначений їх вплив під час формування меж зон дії обмежень.

Результати. Проаналізовано чинні нормативно-правові акти України, уточнюючі визначення розмірів зон різних видів обмежень землекористування. Визначено п'ять груп чинників, які впливають на просторові характеристики зон обмежень і мають вирішальне значення для встановлення розміру зони обмеження. Розподіл на групи факторів дозволяє більш якісно підійти до подальшого процесу визначення їх впливу та дає підґрунтя відповідним фахівцям для комплексного підходу при визначенні просторових характеристик зон обмежень у використанні земель. Визначено, що для урахування обґрунтованого впливу кожного фактору на загальну ситуацію, доцільним є детальний розгляд і ранжування рівня впливу всередині кожної класифікаційної групи.

Наукова новизна. Вперше були згруповані фактори, які впливають на формування меж зон дії обмежень за такими класифікаційними ознаками як визначальні фактори і фактори, що визначаються. Відповідний підхід було апробовано для санітарно-захисних зон.

Практична значимість. Систематизовані визначальні фактори та фактори, що визначаються, можна використовувати під час визначення розмірів усіх видів обмежень на етапі їх обґрунтування, що в подальшому дозволить фахівцям суміжних галузей простіше проводити дії щодо встановлення меж на місцевості відповідних зон та їх юридичної легалізації.

Ключові слова: управління земельними ресурсами, охоронна зона, зона дії обмеження, просторові характеристики зон дії обмежень

Определяющие и определяемые факторы при формировании размера зоны ограничения использования земельного участка

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Цель. Выявление и систематизация определяющих факторов и факторов, которые определяются, влияющих на размер зон ограниченный для обеспечения как юридической составляющей прав на земельные участки, так и благосостояние общества в целом.

Методика. Методом системного анализа были установлены структурные связи определяющих факторов и факторов, которые определяются, при формировании зон ограниченный в использовании земель и определении их оптимального размера. Установлены причинно-следственные связи между соответствующими факторами и определено их влияние при формировании границ зон действия ограничений.

Результаты. Проанализированы действующие нормативно-правовые акты Украины, уточняющие определение размеров зон разных видов ограниченный землепользования. Определены пять групп факторов, которые влияют на пространственные характеристики зон ограниченный и имеют решающее значение для установления размера зоны ограничения. Деление на группы факторов позволяет более качественно подойти к дальнейшему процессу определения их влияния и дает основание соответствующим специалистам для комплексного подхода при определении пространственных характеристик зон ограниченный в использовании земель. Определено, что для учета обоснованного влияния каждого фактора на общую ситуацию, целесообразным является подробное рассмотрение и ранжирование уровня влияния внутри каждой классификационной группы.

Научная новизна. Впервые были сгруппированы факторы, влияющие на формирование границ зон действия ограничений по таким классификационным признакам как определяющие факторы и факторы, которые определяются.

Практическая значимость. Систематизированные определяющие и определяемые факторы можно использовать при определении размеров всех видов ограничений на этапе их обоснования, что в дальнейшем позволит специалистам смежных отраслей проще проводить работы по установлению границ на местности соответствующих зон и их юридической легализации.

Ключевые слова: управление земельными ресурсами, охранный зона, ограничение в использовании земель, пространственные характеристики зоны ограничения

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