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UNIVERSITY OF WARMIA AND MAZURY IN OLSZTYN (Poland)
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The journal includes original articles on land administration, land management, real property cadastre, land use, rural development, geodesy and cartography, remote sensing, geoinformatics, other related fields, as well as education in land management and geodesy throughout the Baltic countries, Western and Eastern Europe and elsewhere. The journal is the first one in the Baltic countries dealing with the mentioned issues. Journal disseminates the latest scientific findings, theoretical and experimental research and is extremely useful for young scientists.

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CONTENT

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IMMOVABLE PROPERTY TAXATION POLICY IN LATVIA

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Abstract
After the restoration of independence, Latvia took a path towards a market economy and private land ownership and which mentioned wide land privatization process and building an immovable property cadastre to collect information on immovable properties. Transition to private land ownership meant that immovable property taxation will start to tax privately owned assets not assets rented from the state, a model similar to other market economies. Initially, there were two laws on the taxation of the property – The law on land tax and the Law on Property Taxation to tax commercial assets and unfinished construction objects which were adopted in December of 1990 even before the starting of land reform and privatization. In 1997 new Law on immovable property tax was approved by the Latvian Parliament and it is still in force with numerous amendments which due to the rapid development of the immovable property sector have been approved until today. Before the global economic-financial crisis in 2008 prices of immovable property were increasing rapidly followed by contraction during the global economic crisis. Immovable property tax is often considered as taxing accumulated wealth however it may have distortions and disproportionate impact on those owners who did not contribute to immovable property value growth. Therefore, the aim of this research is to evaluate the development of the immovable property taxation system development in Latvia and to compare it with the systems of neighbouring countries. Therefore, to achieve this aim following objectives were set: to analyse legislative acts regulating immovable property taxation in Latvia, and practices of other countries and to draw research conclusions.
Key words: tax, immovable property, property, land.

Introduction

During the existence of the Soviet Union, all land in the territory of Latvia belonged to the state and there were no other landowners. In December of 1990, two legislative acts on taxation of the property were adopted – one law on land taxation and another law on taxation of commercial assets and unfinished construction objects. It means that the immovable property taxation system was created even before the full restoration of independence and it was intended to collect taxes from land users and owners of commercial assets. During the last few years many discussions on immovable property taxation were conducted both on a political and expert level, however, there is no agreement so far on what changes could be made to immovable property taxation.

After the restoration of independence in 1991 Latvia started to transform into a market economy just like in other democratic countries where it is based on private ownership of assets. This radical change required to implementation of land reform and privatization process as well as the developing immovable property cadastre to collect information on immovable property properties. Several legislative acts, such as law "On land reform in cities of the Latvia Republic", law "On land reform in rural areas of the Latvia Republic" and law "On land privatization in rural areas of the Latvia Republic" were developed and adopted by the Latvian Parliament to ensure privatization of land and other assets, including residential and commercial buildings. Transition to private land ownership meant that immovable property taxation will have private land and assets as a subject for taxation purposes making Latvian taxation policy similar to other market economies meanwhile providing necessary financial means for municipalities and national government to finance their functions. In 1997 new Law on immovable property tax was approved by the Latvian Parliament to regulate taxation both of land and other immovable property assets. In scientific literature, most attention regarding immovable property-related taxation is given to so-called betterment tax, broad base or special area tax, and tax on immovable property transactions or transfer tax. In this article, authors will concentrate mostly on broad base immovable property tax while highlighting some aspects of so-called value capture aspects. Immovable property tax traditionally is considered a local level tax that is to be paid into the local municipality budget. There are the following main criteria that are attributed to taxation instruments as a part of the system of public finances: efficient, equitable, administratively practical, and cost-effective (Abelson, 2018). The principle of equitable tax means that payment should be based on the ability of a household to pay and benefits should go to those in greatest need. The principle of efficient tax means that it is levied on benefits that can be earned from land use irrespective of whether they were or were not earned to ensure that land is used efficiently for economic gains and development. It is also supported by other authors who state that experience highly developed states demonstrate that immovable

property tax serves as an objection to inefficient use of land and inappropriate allocation of capital in geographical terms (Hozer, Kokot,2005). Another important aspect is that the base for land tax should be calculated accurately as this substantial issue in case of land value uplift. Therefore, it is important to have a quickly reacting cadastral valuation system that can catch sometimes very rapid changes in the immovable property market, in particular, if there are rapid booms and busts. At the same time, the immovable property taxation system should be flexible enough to take into account the needs and ability to pay of specific target groups.

Methodology of research and materials

This research aims to evaluate the development of the immovable property taxation system development in Latvia. Therefore, to achieve this aim following objectives were set: to analyse legislative acts regulating immovable property taxation in Latvia, and practices of other countries and to draw research conclusions. Immovable property taxation system development in Latvia was chosen as a subject for this research, as well as immovable property taxation system of Latvia was compared with those of Lithuania and Estonia. Relevant legislative acts on immovable property taxation in Latvia, as well as in Estonia and Lithuania were chosen for analysis. Monographic descriptive method, analysis, and synthesis methods were used for the research of immovable property taxation system development, theoretical aspects, and problem identification. Logical construction and interpretation methods were used to conclude the research.

Discussions and results

Immovable property taxation in Latvia, as mentioned earlier, has been started in December 1990 when the Parliament approved two very important legislative acts on taxation. One of them was Law on land tax but another one was Law on Property Tax. It is important to stress that at that particular moment, the independence of Latvia was not yet restored "de facto" and land reform and land privatization were not yet implemented therefore taxation, in principle, was oriented toward land users but not land-owners. It should be mentioned that in 1997 new Law on immovable property tax was approved by the Latvian Parliament and the since that numerous changes have been made to the regulation of immovable property taxation and therefore authors consider it necessary to highlight the most important aspects in the initial legislative acts and currently enforced law "On Immovable Property Tax". These aspects are described and compared further in the text and tables below.

Table 1

Comparison of some aspects of the immovable property tax laws adopted in Latvia since 1990

Aspects	**Law on Land Tax, 1990 – 1997 (not valid anymore)**	**Immovable property tax law introduced in 1997 (currently in force)**
Aim of the Law	To encourage land users and local municipalities in better management of land as well as to get rent payment from land users.	Not stated
Land tax rate	Average amount per hectare of agricultural land in each municipality the Double the average amount per hectare of non-agricultural land Specific amount per square metre cities	To be set by the local municipality in a range from 0.2 % up to 3% of immovable property cadastral value. If not decided by municipality: 1) 1.5% of land cadastral value; The tax rate for unfinished buildings
Land tax rebates	100% rebate for farmers but not longer than 5 years Rebates are available for retired people, disabled people, families with at least three children, poor families, young families, and charity and religious organizations (upon request and subject to the decision of the municipality)	Rebate up to 90% for poor persons and householdsThe rebate, 50% for families with three and more children for politically repressed persons A municipality may decide on rebates for other categories of immovable property owners and rebate size can be 90% or 70% or 50% or 25%.
Increased tax rate	Not set, subject to the decision of the municipality	Tax rate to be increased by 1.5% for unused agricultural land

It is worth mentioning that the Immovable property tax law does not state the ultimate purpose of the immovable property tax. It is possible to refer to Law on taxes and fees which defines tax as a statutory and

mandatory periodic or one-off payment for ensuring revenues of the State budget or local government budgets (basic budget or special budget) and funding the functions of the State and local governments (Law on taxes and fees). However, this definition does not provide a specific rationale for immovable property tax and this could be considered a substantial deficiency of the legislative process.

The law on Land tax stated that this law aims to encourage land users and local municipalities to better management of land as well as to get rent payments from land users. Land that by decision of the state institution was allocated to or owned by the natural or legal person was subject to taxation. It is important to mention here that already then there were several exceptions on what kind of land should not be taxed, among them was land that is used for private residential buildings as well as the land where by law or decision of the state institution economic activity is prohibited. There were different tax rates set in the law for each of rural area and these were set as the absolute amount of money as cadastral values did not exist at that time. For a purpose of setting these tax rates quality of agricultural land was used as a reference point.

It can be seen from the comparison that at the beginning of the nineties, the strong role of the state and very centralized regulation at the level of the central government was prevailing in taxation policy as Law set tax rates for each small municipality as well as differentiated tax amounts and rebates were set for various land use categories. This probably could be explained not only by the highly centralized governance approach but also by the fact that there was no mass cadastral valuation done at this moment. After developing an immovable property cadastre and introducing immovable property mass cadastral valuation more decentralized approach for immovable property taxation became possible and was as a consequence implemented as it is possible to see from comparison with current regulation. It is interesting to mention here that Land tax law stated a differentiated approach towards tax for agricultural land, forestry land, and land in cities somewhat similar to the model of Poland which was more in detail described in an article by Maria Heldak and Vivita Baumane which was devoted to a comparison of tax systems in Poland and Latvia (Heldak, Baumane, 2014).

Currently, each municipality is free to choose what tax rate it is willing to set depending on local circumstances and what rebates in addition to those set by the law could be determined by the municipality. Current regulation may be considered rather flexible because it allows municipalities both to set immovable property tax rates and set numerous rebates for various categories of immovable property owners according to the principles set in the Immovable property tax law. The main principles for the decision-making on tax rates and rebates which should be abided by the local municipality are as follows: 1) objective grouping or categorization of immovable properties or immovable property owners; 2) efficiency principle to ensure that income from tax covers administration costs; 3) principle of responsible budget planning; 4) principle of stability which requires to set tax rates for two year period if tax base did not change more than by 20%. In addition to that municipality is allowed to apply two more principles:1) the principle of entrepreneurship support; 2) the principle of territorial development and rehabilitation. These principles are very much in line with those mentioned above and once again underline how much power regarding immovable property taxation is delegated to the local municipalities.

The law on Property Tax was abolished in the year 2000 and regulation of property taxation was partially transferred to the Immovable property tax law. Before that this law stipulated that only commercial assets and unfinished buildings are subject to taxation. Under the Immovable property Tax law thereby was no anymore separate tax on land and separate tax for property and there was, in general, only immovable property ownership as a subject for taxation. Another substantial difference is that it is not anymore clearly stated that only those buildings that are used for commercial activity are subject to tax. Still, in the year 2000 when the Immovable property law was enforced, it set the single tax rate for immovable property in the whole of the country, initially, it was set at 1.5% and for the period from the end of the year 2002, it was set at 1%.

There were more exemptions on tax in the Immovable Property Tax law when it was adopted in comparison to both of the previous laws. It should be noted that residential buildings and flats in multi-apartment houses since 1998 were exempt from tax unless these are used for commercial activity, however, it was stated in the law that this exemption will be in force until 31 December 2003. Since the beginning of the year 2003 also those buildings used for agricultural production were subject to exemption until 31 December 2003. After the end of 2003, both exemptions were kept without a specific winding-up deadline until the beginning of the year 2010 when a new amendment to the law Immovable property Law was enforced which excluded previously existing exemptions for residential buildings and flats in multi-apartment houses. Since then differentiated tax rates for residential buildings were introduced and there were differing

tax rates for land and residential buildings. Currently enforced regulation on the tax rate is described in table 2 below.

Table 2

Comparison of some aspects of the immovable property tax laws adopted in Latvia since 1990

Legislative aspects	**Law on Property Tax, 1990-1999 (not valid anymore)**	**Immovable property tax law, introduced in 1997 (currently in force)**
Aim of the Law	To tax fixed assets, commercial assets, and unfinished buildings.	Not stated
Property Tax rate	Specific fixed amount and additional percentage depending on the value of the property. As larger the value of the property as the larger the tax rate is.	To be set by the local municipality in a range from 0.2 % up to 3% of immovable property cadastral value. If not decided by municipality: 1) 0.2 % of residential building cadastral value if it is less than 56915 Euros; 2) 0.4 % for the share of residential building cadastral value which is in range of 56915 - 106715 Euros; 3) 0.6 % for the share of residential building cadastral value which is above 106715 Euros. The tax rate is 3% for unfinished buildings. The tax rate is 3% for buildings that degrade the local environment, are collapsed, or dangerous
Property tax rebates	Municipalities may approve 90%, 50%, and 25% rebates Specific differentiated rebates up to 50% if serving state procurement	Rebate up to 90% for poor persons and households Rebate 50% for families with three and more children Rebate 50% for politically repressed persons A municipality may decide on rebates for other categories of immovable property owners and rebate size can be 90% or 70% or 50% or 25%.
Increased tax rate	Not set	Tax rate to be increased by 1.5% for degraded buildings and building dangerous for the environment

Residential buildings became subject to tax because of the very poor budget situation both at the national and municipal levels during the global economic crisis that started in 2008. There is no clear reasoning mentioned in an annotation to amendments of the Immovable property tax law which introduced taxation of residential buildings however authors consider that budget needs could be the main reason. It should be noted that initially, tax rates for residential buildings were 0.1%, 0.2%, and 0.3% depending on their cadastral value but these rates were doubled later in 2012. It meant an additional tax burden on residents and allowed the central government to compensate local governments for a decrease of their income from personal income tax which is a main source of municipal budgets. It should be mentioned that there are differing tax rates for land and for residential buildings which creates some confusion in public even though tax for immovable property is to be calculated considering both cadastral values of the land and residential building. The reason for such confusion is sometimes made by the comparison by immovable property owners when the market price of a private residential building or apartment in a multi-apartment house with included land value is compared with a similar building or apartment without land value included.

In Estonia rate of land, tax shall be 0.1-2.5% of the taxable value of land annually. It is to be paid by the land-owner to the respective municipality (Land tax law, Estonia). In Estonia, residential buildings and apartments are not subject to tax but only land under them. Land tax will not be imposed if the calculated tax payment is less than 5 Euros. In comparison, in Lithuania, immovable property tax is to be paid by the Lithuanian and foreign natural and legal persons and tax is to be paid into a municipality budget. In Lithuania, immovable property tax is set to be in a range from 0.3% up to 3% but usually, municipalities set it at a 1% rate. Immovable property tax is to be to paid only for the value of property exceeding 150 000 Euros (so-called taxable value) but for families with three or more children or with children in need of permanent care this threshold is 200 000 Euros. Immovable property tax in Lithuania has progressive tax rates – 0.5% for part of the value of immovable property in a range from 150 000 Euros up to 300 000 Euros, 1.0% for part of the value of immovable property in a range from 300 000 Euros up to 500 000 Euros, 2.0% for part of the value of the immovable property which is over 500 000 Euros. Land tax in

Lithuania includes payment only for land and the tax rate can be set from 0.01% up to 4.0% of the land value. (Immovable property tax, Lithuania).

Table3

Comparison of tax exemptions in the immovable property tax laws adopted in Latvia since 1990

Legislative aspects	Law on Land Tax (1990-1997) and Law on Property Tax (1990-1999)	Immovable property tax law, - 1997 (currently in force)
Main exemptions to Land tax	The land where economic activity is prohibited Land under roads, communication lines Land under residential buildings Land under municipal buildings Land under objects of culture, communal services, education, healthcare, and sports facilities	Land under roads, communication lines Land in nature protection areas where economic activity is prohibited Land under reforestation Land under cemeteries and related buildings
Main exemptions to Property tax	Property of natural persons if not used for commercial activity Property used for agricultural production Monuments of culture Communal services and municipal buildings Residential buildings Property of NGO's and religious organizations (subject to the decision of the Government) Public roads and communications Property used for nature protection and fire security	Roads, communication lines, streets, public water areas Immovable property owned by the municipality and foreign countries (for diplomatic relation purposes) Immovable property owned by religious organizations Monuments of culture, except if used for residence or economic activity Buildings and engineering infrastructure used solely for agriculture Buildings owned by the state or used by state institutions Buildings used by museums, libraries, National Opera, state theatres, and concert organizations

There are numerous exemptions from the tax in Latvia and it should be mentioned that other Baltic states follow rather a similar approach as can be seen from their respective legislation. It is worth mentioning that Latvia has set a more flexible approach towards the possibility to grant tax rebates for various categories of immovable property owners while Estonia allows municipalities to decide on rebates for retired people, people partially or fully without the ability to work and politically repressed persons while Lithuania only uses a differentiated threshold of taxable value for families with three or more children. It should be mentioned that in Estonia only land is subject to tax while in Latvia and Lithuania value of both land and buildings are subject to immovable property tax. It should be mentioned that the Estonian taxation system is considered one of the most liberal and simplest systems in the world and Estonia is mentioned as a European pioneer in introducing flat tax rates (Mazure, Viksne, 2014). Local level budgets constitute rather a small share of the national GDP in Baltic states and property taxes which are single own-resource income is about 10% of the total municipal budget (Bernardi, Chandler, Gandullia, 2017).

Immovable property taxation has become one of the important political discussion subjects after Latvia joined the EU in 2004 and the Latvian economy overheated before the global economic-financial crisis of 2008-2009, thanks to the inflow of EU funding, a substantial increase in remuneration of public sector and rather relaxed credit policies of the commercial banks. Much of the financing made available by commercial banks were directed to the immovable property sector and many new residential area projects were built-up. This massive flow of investment into the immovable property as a consequence was increasing immovable property prices, creating an immovable property bubble that went bust when the global economic-financial crisis arrived. It created large disparities between immovable property prices and immovable property cadastral values which meant that due to inappropriately low levels of cadastral values set immovable property tax payments were lower than they actually could be according to the current market situation. Considering that new developments mostly took place around and in Riga and other largest cities it needs to be mentioned that the largest disparities between cadastral value and market price were also there.

Another important immovable property segment that experienced substantial changes was the agricultural land market. When Latvia joined the EU in 2004, there was an exemption set in national legislation that provided that citizens of other EU states will not have a right to buy agricultural land until 2011. This restriction period was prolonged by the Parliament to make it effective until 2014 arguing that there is sufficient evidence that after the end of the transitional period (seven years after accession to the European Union), there will be serious disturbances or the possibility of such disturbances in the Latvian agricultural land market. However, after this additional restriction period, agricultural land prices have grown substantially year-by-year as competition to buy agricultural land in Latvia was increasing. As the growth of agricultural land prices was so rapid it was logical that cadastral values should also be adjusted. It would have a further consequence for immovable property tax on agricultural land which would grow likely similar to the market price growth and would raise for farmers. That is why Parliament decided to limit the growth of immovable property tax for agricultural land in order to allow it to grow not more than 10% year by year.

There have been discussions in the political environment on reshuffling the immovable property tax system however this discussion stopped for a while because of disagreements over the cadastral value base which is a basis for further discussion on immovable property tax developments. It should be also mentioned that discussion on overall taxation policy would be needed but considering Parliamentary elections in October 2022 they may probably start in the year following the election year.

Conclusions and proposals

1) Immovable property taxation in Latvia has had many developments since 1990 and the most important ones are the decentralization of immovable property taxation decisions from central regulation of tax rates, the introduction of taxation of residential buildings, growth of the number of exemptions from the tax, and increase in the number of tax rebates;
2) Latvia's immovable property taxation system is most flexible as it allows large room for municipal decisions on the tax rate and tax rebates for various categories of immovable property owners;
3) Latvia has the highest immovable property tax burden among the three Baltic states which can be seen as a consequence of the fact that the global economic crisis hit Latvia more than its neighbours;
4) It is possible to conclude that Latvia and Lithuania have similar immovable property taxation approaches as both land and buildings are subject to taxation while Estonia's approach is to tax only land;
5) It would be necessary to consider an opportunity to legislate a single tax rate for land and residential buildings in Latvia as well as to minimize the use of tax rebates and introduce minimum immovable property value which is not subject to tax.

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ANTHROPOGENIC IMPACT ON AGRICULTURAL LAND IN THE REPUBLIC OF KAZAKHSTAN

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Abstract
The purpose of the article is to consider the features of the anthropogenic impact on agricultural land in the Republic of Kazakhstan (RK).
The article deals with the current problem of agricultural land degradation, and desertification in Kazakhstan, where one of the causes is the anthropogenic activities of the population and the aridity of the country's climate.
Most of the territory of Kazakhstan is located in conditions highly vulnerable to anthropogenic desertification when in combination with natural factors of desertification the ecological situation is sharply deteriorating. Another cause of land degradation is urbanization and intensive degradation of desert habitats - unsystematic road network, regulation of river flows, illegal cutting of saxaul for firewood for sale. As a result of urbanization and intensive agricultural development of the foothill strip in the south and east of the country, the natural vegetation cover is highly disturbed. Roads, pipelines, and power lines, which are being laid at an increasing rate, have a great impact on the fauna. The area of land occupied by mining enterprises is steadily growing. In the last 10 years, the areas of oil and gas extraction, development of uranium ores, etc. in Western Kazakhstan, the Eastern Caspian Sea region, the Betpakdala desert, etc. have been sharply increasing.
As a result of insufficiently thought-out land management from water erosion 5.6 million hectares of arable land was affected and grain yield was reduced by 20-30%. Degradation of agricultural lands, including pastures, is 30-50% and higher %. in 9 of 14 regions of Kazakhstan.
The use of the existing model of agricultural development of raw materials leads to inefficient economic development and constantly increasing pressure on ecosystems.
The soil in Kazakhstan is very vulnerable, as it is comprehensively affected by various anthropogenic factors that lead to the constant deterioration of its quality. Soils near the Aral Sea and the Caspian Sea are subjected to the most intensive degradation, as wind erosion is widespread there.
Key words: agricultural land, degradation, anthropogenic impact, urbanization, soil erosion.

Introduction

Soils play an important role in ecosystem functioning. They provide provisioning ecosystem services such as water retention, regulating services such as carbon sequestration, and provisioning services such as nutrient cycling or habitat provision (Adhikari & Hartemink, 2016). Soils serve as archives of the customs and activities of humans over history and thus also provide cultural services (Yaalon & Arnold, 2000).
Soils have been widely transformed and degraded by human activities. The area occupied by soils that remain unmodified is decreasing, while recent rural outmigration and land abandonment provide new opportunities for soil restauration across a larger area. (Novák et.al, 2020)
The problem of land degradation or desertification is one of the most pressing problems of our time.
It is well known that irrational land use has led to a decrease in productive land, a decrease in its fertility, and a deterioration of the ecological situation, which affect the reduction of agricultural production. According to research by Russian scientists: Bogolyubov, Kutliyarov and Kazakh scientists Kerimova, Tireuov, Pentaev, the land is stably continuing to go out of balance of economic turnover, soil fertility level falls, it is not a deterrent for production anymore (Боголюбов, 2016).
Agriculture has an enormous impact on the ecological balance of much of the earth's surface. The limited natural land-resource potential for production purposes in agriculture causes the need to expand and develop the steppe and forest areas, which disturbs the natural balance, intensifies degradation processes, and reduces soil fertility. The desire to improve the agro-ecological condition of lands is based on the use of technogenic technologies leading to the destruction of land resources, and pollution of the atmosphere, water sources, and forest areas. Water erosion and deflation of soils develop, desertification of lands increases, production decreases, and its quality decreases. The current rate of erosion on agricultural land

is an order of magnitude higher than the rate of natural erosion or soil formation processes (Wall et.al, 2012) This requires a new approach to the technology of production of agricultural products and raw materials for industry, improving the environmental quality of food.
The Republic of Kazakhstan is the ninth largest country in the world in terms of land area. Its territory is characterized by deserts, semi-deserts, and steppes, which in combination with arid and continental climate determines the vulnerability of ecosystems to desertification/land degradation processes. Another factor influencing the aggravation of the problem is anthropogenic activities. (Yaalon, 2000)
The country's territory is more than 90 percent plain, with high mountains in the south-eastern and eastern parts of the country. A large part of the country is covered by arid natural zones (deserts, semi-deserts, dry steppes), while wet steppes and forest-steppes are found only in the northern region. (Материалы Республиканской научно- теоретической …, 2013)

Research methods and materials

There were used different methods to write the article. The economic-statistical method was used to analyze and assess the current state of agricultural land in RK. There was a summary and grouping of materials from various reports from 2019 to 2021 related to land management in Kazakhstan. Also, the abstract – logical method was used to identify sectoral and regional features.
Scientific conclusions and positions of foreign scientists of directions on the formation of land use based on the regulation of land relations were important methodological part of the research. The research is based on principles of the system approach and the techno-economic analysis of the results of research of experts in the field of land use in foreign countries.

Discussion and results

Soil salinization, water and wind erosion, reduction of humus, and secondary salinization at water discharge after irrigation are observed on more than 90% of the arable soils of the republic. The problems of irrational use of land in livestock and pasture management are currently aggravated by the large number of small agro-industrial and livestock formations, which do not have sufficient resources to fully manage the territories. (Kazakhstan Environmental Performance…, 2019)
The main areas of agricultural land subject to wind erosion are in the Almaty region (about 5 million ha), Atyrau and South Kazakhstan oblasts (3.1 million ha), Kyzylorda oblast (2.8 million ha) and Aktobe and Zhambyl oblasts (over 2 million ha). The largest share of eroded agricultural lands (over 30 percent of their total area) covers Almaty, Atyrau, and South Kazakhstan oblasts (Figure 1). (Пятый национальный доклад…, 2018)

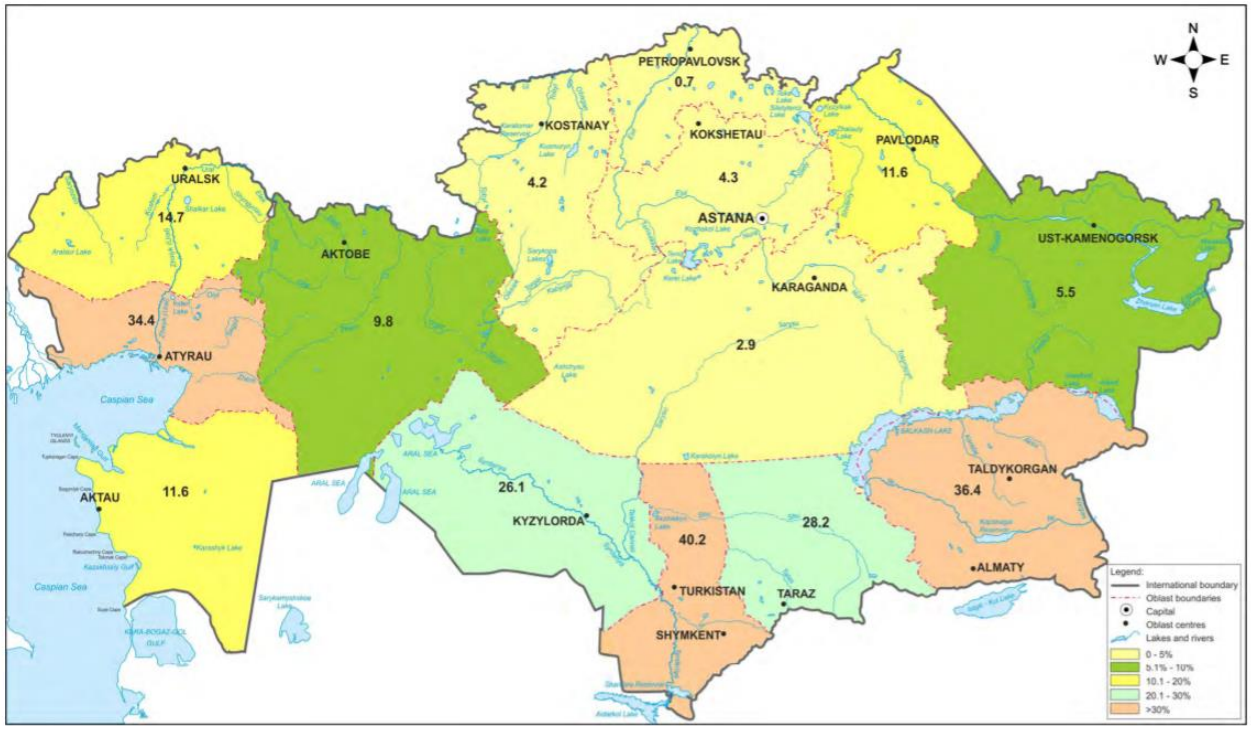

Fig. 1 - Eroded Soil of the Republic of Kazakhstan (2019)

Other causes of degradation of desert habitats are haphazard road networks, regulation of river flows, and illegal cutting of saxaul for firewood for sale. As a result of urbanization and intensive agricultural development of the foothill strip in the south and east of the country, the natural vegetation cover is highly disturbed. In the valleys of desert zone rivers - Ili, Syrdarya, Shu, Talas - due to the limitation of river flow highly productive floodplain communities are almost completely degraded; floodplain forests of the west of the country, riparian forests of the south and south-east, forests of steppe and forest-steppe zones of the north are under strong pressure. Due to the threat of an increase of water intake from the Ili river in its upper reaches in China for irrigation, there is a danger of a sharp drop in water level and degradation of ecosystems of Balkhash lake and Ili river valley; the same problem exists for transboundary rivers Irtysh and Syr Darya with the steady decrease of annual inflow by 2-3%. Roads, pipelines, and power lines, which are being constructed at an increasing rate, have a great impact on fauna. The area of land occupied by mining enterprises is steadily increasing. In recent years, the areas of oil and gas extraction, and development of uranium ores, etc. in Western Kazakhstan, the Eastern Caspian Sea region, the Betpakdala desert, etc., have been sharply increasing. Soils have been extensively transformed and degraded as a result of human activity.

Notable pollution of atmospheric air and soil occurs due to transport. Most heavy metals contained in dust and gas emissions from industrial plants are, as a rule, more soluble than natural compounds (Бутовский, 2005).

Unfavorable environmental properties of the soils of Kazakhstan are frequent exposure to erosion processes, salinity, and low natural fertility. The reason for this is both natural factors (natural desertification processes), the predominant sandy loamy texture of soils, and irrational economic activities. Such farming is manifested in non-compliance with agrotechnical rules of soil cultivation, which led to the active manifestation of water and wind erosion, soil depletion, loss of fertility, and, as a consequence, to dehumidification of arable soils. Wind erosion of soils (deflation) is developed on anarea of 45 million hectares, it has affected 18 million hectares of agricultural lands, and 18,9 million hectares are exposed to water erosion. Loss of soil fertility as a result of dehumidification and deflation is observed on the area of 11.2 million ha of non-irrigated lands and 0.7 million ha of irrigated arable land. (Сапаров, 2016)

A large part of the country is occupied by arid or semi-arid ecosystems that are subject to or have already suffered from land degradation. In particular, this applies to irrigated and rainfed cropland affected by salinization, soil erosion, or loss of humus, as well as rangelands, which have been severely deteriorated by concentrated grazing on relatively small areas in the last decade, and forested areas degraded by illegal forest harvesting and fires. In Kazakhstan, about 14% of all pastures have reached an extreme degree of degradation. Most of these processes are observed in the areas of the Aral and Caspian seas and around lake Balkhash. The Northern Caspian Sea, the area of the Aral Sea, the delta of the Syrdarya river (Kyzylkum), and the southern Balkhash deserts refer to a significant and high degree of land degradation under the influence of cattle grazing. Degradation of pastures occurs mainly in desert and semi-desert landscapes of Kazakhstan.

Land disturbance and degradation occur as a result of industrial activities. Degradation of pastures and arable lands is one of the priority national environmental problems. The extensive development of agricultural production in Kazakhstan has left a mark in the form of land degradation and impoverishment of landscapes. A significant part of the country's territory is subject to desertification, which leads to a reduction in livestock and crop productivity. Over 40 years of exploitation of plowed virgin and fallow lands as a result of wind and water erosion lost up to 1.2 billion tons of humus (Figure 2).

The trend of land contamination continues to increase. Yield reductions of 10-20% and plant depression are observed in the areas of most agricultural land suitable for agricultural production according to ecological parameters.

Positive impacts and reductions in degradation rates (not including the natural regeneration of abandoned croplands and the creation of protected areas) have been achieved in some places locally by dispersing livestock from settlements, and in two other areas - the restoration of the Aral Sea and the increase in forest cover. The Kokaral dam built in 2005, which separated the Small Aral from the main water area, stabilized and raised the level of this now separate body of water and reduced its salinity. As a result, fish have reappeared in the Small Aral (in addition to the introduced flounder) and fisheries have revived. The area "Small Aral Sea and delta lakes of the Syr Darya" was included in the list of Ramsar sites in 2012. (Пятый национальный доклад…, 2018)

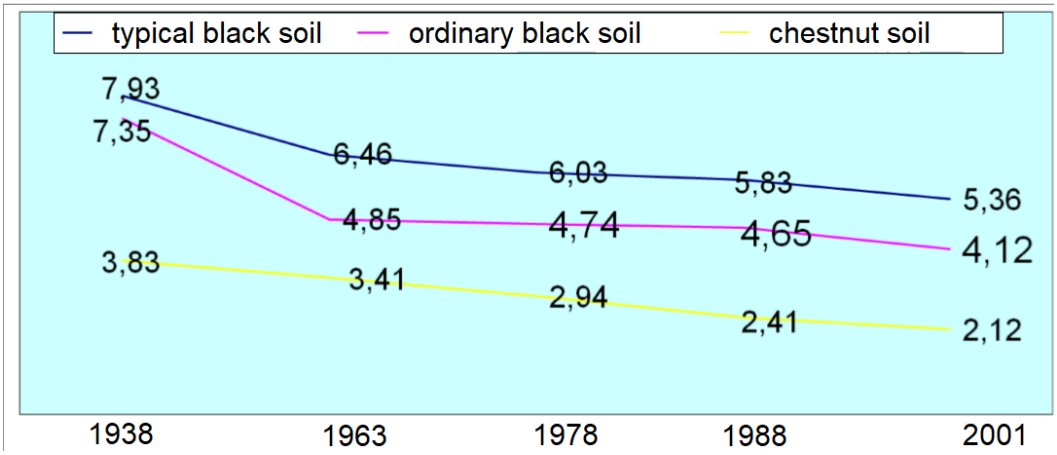

Fig. 2 - Change of humus content in the main types of soils of Kazakhstan.
Source: Национальный план действий …, 2020.

Conclusions and proposals

Kazakhstan is characterized by an arid climate, aridity, uneven distribution of water resources, low forest cover, and the dominance of steppe, semi-desert and desert landscapes, which leads to the low resistance of the natural environment to anthropogenic impacts, so the desertification problem for Kazakhstan is very urgent.

Most of the territory of Kazakhstan is located in conditions which are very vulnerable to anthropogenic desertification, when in combination with natural factors of desertification the environmental situation sharply deteriorates. The main zones of ecological stress and land degradation in Kazakhstan are the regions of the Aral Sea and the Caspian Sea region, as well as abandoned lands in the northern areas of the country. Wind erosion (deflation) of soils on sandy massifs and zones of spreading of soils of light texture and carbonate soils has the greatest spread in the territory of Kazakhstan (40.4% of agricultural lands). More than 11% of agricultural lands are exposed to water erosion.

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USING ANALYTICAL HIERARCHY PROCESS TO DETERMINE INTRA-FIELD HETEROGENEITY ZONES UPON IMPLEMENTATION OF PRECISION FARMING

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Abstract
The study aimed to develop a methodology for determining zones of intra-field heterogeneity for precision farming. In this study, we took into account the Belarussian national land use system which provides for the absence of private ownership of agricultural land. The spatial distribution of intra-field heterogeneity zones within the land use area of 7549.49 thousand hectares was identified using the analytical hierarchy process (AHP). The algorithm for determining zones of spatial heterogeneity provides for: (1) the selection of indicators and their ranking; (2) developing a pairwise comparison matrix, (3) estimating relative weights and (4) assessing matrix consistency. It is recommended to use data from agrochemical soil studies which are conducted centrally every 4 years for each agricultural enterprise as input parameters. These data include the humus content in the soil, the content of available phosphorus and potassium, soil pH, and the content of B, Cu, Zn, Ca, and Mg. The data should be carefully examined using spatial statistics tools to provide a more accurate delineation of the management-zones boundaries. The developed technique makes it possible to determine fertile and marginal areas within each field and differentiate the use of fertilizers, taking into account the presence of intra-field heterogeneity. This will reduce the total cost of purchasing and applying phosphorus fertilizers by 34 $\$\cdot ha^{-1}$ and potash fertilizers by 9 $\$\cdot ha^{-1}$ due to the redistribution of the fertilizer dose calculated for the planned yield, taking into account the identified site-specific management zones. At the same time, the level of chemical pressure per hectare of arable land will decrease by 6.7% without loss of crops productivity.
Key words: land management, GIS, analysis of hierarchies, precision farming, profitability.

Introduction

Agriculture is the most important area of the world economy, which ensures global food security. The agricultural sector is responsible for the production of sufficient raw materials and food for the ever-increasing population. According to a UN report [World Population Prospects…, 2019], the world population is expected to increase by 2 billion people in the next 30 years, from 7.7 billion today to 9.7 billion in 2050 [Loures et al., 2020]. Simultaneously with population growth, due to increased erosion processes and desertification caused by global warming, there is a widespread reduction in areas suitable for growing crops.

In particular, the reduction in the area of arable land in Europe, according to forecast estimates, will reach 1.12% by 2030 [EU agricultural outlook…, 2018]. If approaches to agricultural production are not revised, the global amount of arable and productive land per person in 2050 will be reduced to 25% of the 1960 level [Arsenault, 2014], and land degradation by 2050 will threaten the existence of about 3.2 billion people [Scholes et al., 2018]. These facts, coupled with the constant rise in the cost of energy resources and raw materials for the production of mineral fertilizers, as well as the shortage of organic fertilizers, necessitate the search for more effective ways to manage profitability and reduce the cost of agricultural products. One of the ways to successfully solve this problem is the introduction of innovative technologies in land use, in particular, precision farming technology [Мыслыва et al., 2021]. The International Society of Precision Agriculture (ISPA) defines precision agriculture as: «management strategy that gathers, processes and analyses temporal, spatial and individual data and combines it with other information to support management decisions according to estimated variability for improved resource use efficiency, productivity, quality, profitability and sustainability of agricultural production» [Precision Ag Definition …, 2019; Myslyva et al., 2021]. An important condition for the effective implementation of precision farming is the identification of zones of intra-field heterogeneity or site-specific management zones, which are taken into account when performing various technological processes in crop production [Méndez-Vázqueza et al., 2019]. At the moment, a unified methodology for identifying management zones has not been developed yet, and researchers offer various approaches to their definitions for precision farming [Shannon et al., 2018; Yuxin et al., 2018; Edge, 2019]. Taking into account the peculiarities of land use and land tenure in Belarus, which are the absence of private ownership of agricultural land and the presence in the country of predominantly large agricultural enterprises with an average area of arable land over 3.5 thousand hectares [Agriculture of the Republic of Belarus…, 2021]. The most optimal methodological approach to identifying intra-field heterogeneity zones is the approach in which the division of the

management zones is carried out with the values of several soil characteristics. As universal initial parameters, it is advisable to use indicators that are mandatory for determination during agrochemical surveys of agricultural land and are used by the agronomic services of agricultural enterprises when calculating the application rates of mineral fertilizers and chemical ameliorants [Myslyva et al., 2021]. These indicators primarily include the content of mobile phosphorus and potassium, the content of humus, and the pH of the soil solution. The list of soil parameters recommended for determining intra-field heterogeneity zones can be expanded, based both on the availability of geospatial data on certain soil properties and on the requirements for determining management zones. In particular, this may include data on the content of trace elements, as well as on the level of soil contamination with residues of pesticides, heavy metals, and radionuclides. However, regardless of the approach and parameters used, a universal tool for identifying intra-field heterogeneity zones is the use of the functionality of geographic information systems (GIS) and mathematical analysis methods, in particular, the Analytic Hierarchy Process (AHP). This method involves considering a problem or phenomenon as a multi-level hierarchical structure that takes into account the relationship between its elements [Yeh et al., 2008; Zghibi et al., 2020]. Each element of the hierarchy can represent various: material and non-material factors; measurable quantitative parameters and qualitative characteristics; objective data and subjective expert assessments [Saaty, 2008]. Based on the foregoing the study aimed to develop a methodology for identifying intra-field heterogeneity zones for precision farming, based on the joint application of geoinformation analysis and AHP. To achieve the goal of the study, the following tasks were solved: 1) processing of initial data on soil parameters and creation of thematic layers with corresponding attributive information; 2) search for plots with different land quality according to a complex of 9 parameters using the AHP; 3) assessment of pairwise comparison matrix consistency by determining the value of the consistency index CI and the consistency ratio CR.; 4) detecting and mapping intra-field spatial heterogeneity zones.

Methodology of research and materials

Study area

The studies were carried out in 2020–2022 in the Orsha district of Vitebsk region (Republic of Belarus) within the land use of RPUE “Ustie” NAS of the Republic of Belarus on an area of 7549.49 thousand hectares of arable land. The locational map of the study area is shown in Fig. 1.

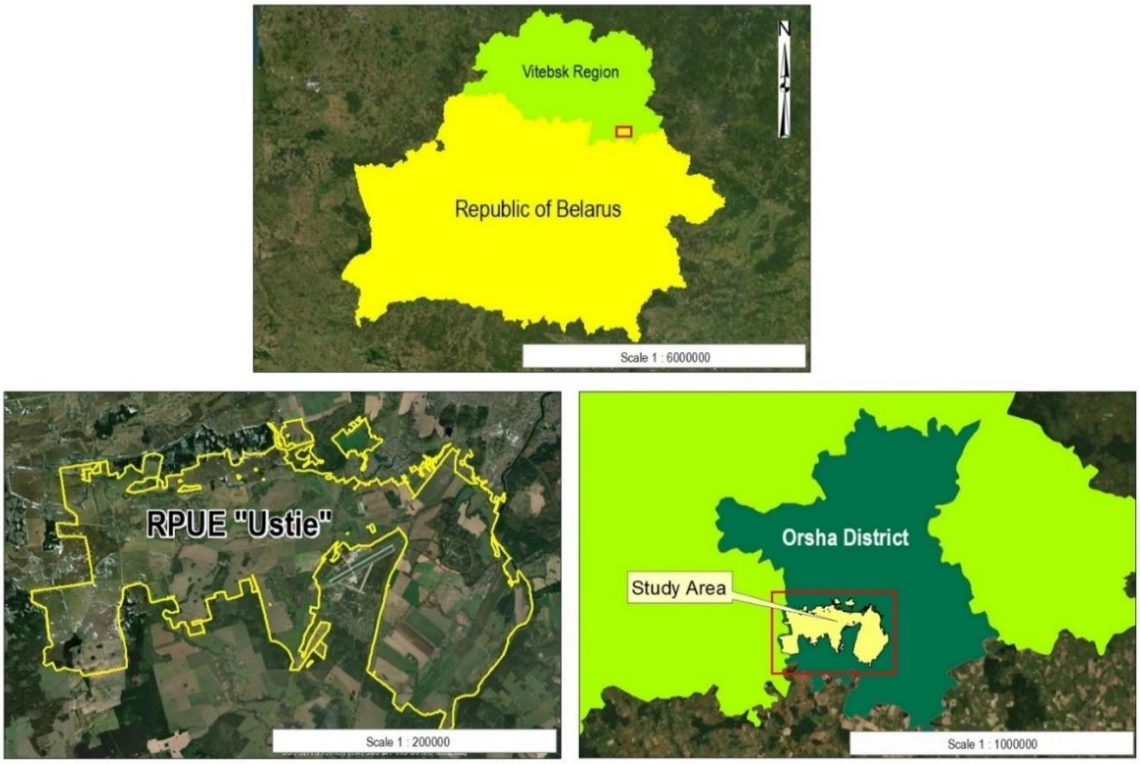

Fig. 1. Locational map of the study area

Data and materials

The shape file with the placement of lands within the study area was created based on the results of the digitization of planning and cartographic materials, which were obtained from the agrochemical survey of the territory of RPUE "Ustie" NAS of the Republic of Belarus, executed in 2019 by the Vitebsk regional design and exploration station of agrochemicalization. The soil cover of the study area is represented mainly by Luvisols and Retisols. To identify the intra-field heterogeneity zones, nine soil parameters were used. These parameters are standard for agrochemical surveys, which are mandatory for each agricultural enterprise and are carried out centrally every four years. The main statistical characteristics of the dataset used in the study are presented in Table 1.

Table 1

Statistical characteristics of soil parameters used to identify intra-field heterogeneity zones, n = 1292

Parameter	Parameter value			Sd	C_v, %	Med	Skewness	Kurtosis
	min	max	mid					
P_2O_5, mg·kg^{-1}	40	450	212	102	48.1	188	0.85	2.98
K_2O, mg·kg^{-1}	42	450	242	99	40.9	244	0.12	2.38
pH_{KCl}	4.53	7.41	6.08	0.48	7.9	6.15	-0.50	3.21
Humus, %	1.17	3.20	2.18	0.57	26.1	2.07	0.48	2.09
Cu, mg·kg^{-1}	0.70	5.10	2.29	0.83	36.2	2.10	1.64	5.75
Zn, mg·kg^{-1}	1.0	10.3	3.02	1.69	56.0	2.50	1.90	7.27
B, mg·kg^{-1}	0.29	1.10	0.77	0.20	26.0	0.75	0.07	1.92
Ca, mg·kg^{-1}	137	2810	1444	270	18.7	1397	0.45	3.83
Mg, mg·kg^{-1}	135	546	384	58.9	15.4	393	-0.68	2.96

Note: Sd is the standard deviation; C_v is the coefficient of variation; Med is the median.

Among these parameters, two indicators had a distribution close to normal (pH_{KC}l and calcium content), two indicators had a leptokurtic distribution (the content of acid-soluble copper and zinc), and the remaining indicators had a platykurtic distribution. The pH_{KCl} of the soil solution and the content of magnesium had a negative asymmetry, and their mean values were less than the median ones. For each of the parameters, a raster image of its spatial distribution within the area of interest was created. Raster images were created by ordinary kriging using ArcGIS 10.5. The presence of the intra-field spatial heterogeneity zones was determined by integrating nine thematic layers and their respective percentages through overlay analysis in the ArcGIS 10.5 environment [Chatterjee et al., 2020].

Analytic Hierarchy Process (AHP)

The spatial distribution of intra-field heterogeneity zones was identified using the analytical hierarchy process (AHP) [Saaty, 1980; Zghibi et al., 2020]. AHP allows to combination and converting geospatial data (input) into the resulting vector layer of zones with different land quality (output), by converting qualitative information from individual thematic layers into quantitative estimates on the Saaty scale [Saaty, 2008]. The method was implemented in four steps: (1) selecting soil parameters and their ranking (2) developing a pairwise comparison matrix, (3) estimating relative weights and (4) assessing matrix consistency. In the first step of the AHP, each soil parameter was given a score between 1 and 9, depending on its significance compared to the other parameters in pairwise comparisons [Zghibi et al., 2020]. For this, a standard Saaty's 1–9 scale was used (Table 2) to describe the relative influence of parameters.

Table 2

Analytic Hierarchy Process (AHP) relative class rate scale according to Saaty [Saaty, 2008]

Importance	Equal		Weak		Moderate		Moderate Plus		Strong		Strong Plus		Very Strong		Very, Very Strong		Extreme
Scale	1		2		3		4		5		6		7		8		9
	1/9	1/8	1/7	1/6	1/5	1/4	1/3	1/2	1	2	3	4	5	6	7	8	9
	Less important								More important								

Then, a pairwise comparison matrix (PCM) [Abrams, 2018; Zghibi et al., 2020; Lentswe, Molwalefhe, 2020] was constructed (Equation (1)) using Saaty's scores obtained in the previous step. In the PCM, the matrix column is constructed based on a descending order of soil parameters. The first element is assigned a score of 1 when compared to itself (Table 3). Other elements of the rows are filled using the actual Saaty's scores when a more influential parameter is compared with a less influential parameter or the reciprocal of Saaty's scores when a less influential parameter is compared to a more influential parameter.

$$A = \begin{bmatrix} X_{11} & X_{12} \dots & X_{1n} \\ X_{21} & X_{22} & X_{2n} \\ \dots & \dots & \dots \\ X_{n1} & X_{n2} & X_{nn} \end{bmatrix} \quad (1),$$

Where A is a pairwise comparison matrix where element X_{nn} denotes the relative significance of one parameter compared to another relative.

Table 3 provides the PCM for the parameters used in this study. The phosphorus content was chosen as the first parameter of the matrix, as it has a greater influence compared to the other factors. Therefore, magnesium content was assigned a value of 9 as the least influential parameter. Potassium content was chosen as the second most important parameter, followed by soil acidity, humus, copper, zinc, boron, and calcium content in descending order. Each parameter in the selected set was assigned a Saaty score depending on its significance for determining zones of infield heterogeneity.

Table 3

Pair-wise comparison matrix of parameters affecting the spatial distribution of intra-field heterogeneity zones

Parameter and its designation	Ph	Po	Sa	Hu	Cu	Zn	B	Ca	Mg
Phosphorus (Ph)	1	2	3	4	5	6	7	8	9
Potassium (Po)	1/2	1	2	3	4	5	6	7	8
Soil acidity (Sa)	1/3	1/2	1	2	3	4	5	6	7
Humus (Hu)	1/4	1/3	1/2	1	2	3	4	5	6
Copper (Cu)	1/5	1/4	1/3	1/2	1	2	3	4	5
Zinc (Zn)	1/6	1/5	1/4	1/3	1/2	1	2	3	4
Boron (B)	1/7	1/6	1/5	1/4	1/3	1/2	1	2	3
Calcium (Ca)	1/8	1/7	1/6	1/5	1/4	1/3	1/2	1	2
Magnesium (Mg)	1/9	1/8	1/7	1/6	1/5	1/4	1/3	1/2	1
Total	2.83	4.72	7.59	11.45	16.28	22.08	28.83	36.50	45.0

Further, the parameters were assigned weights derived by normalizing the pair comparison matrix (NPCM) [Rezaei-Moghaddam, Karami, 2007; Zghibi et al., 2020]. The NPCM elements were computed by dividing thematic element values by their corresponding total column values from the PCM (Table 4).

Table 4

Standardized pairwise comparison matrix and weight factors affecting the spatial distribution of intra-field heterogeneity zones

Parameter and its designation	Ph	Po	Sa	Hu	Cu	Zn	B	Ca	Mg	Weight, W
Phosphorus (Ph)	0.35	0.42	0.40	0.35	0.31	0.27	0.24	0.22	0.20	0.31
Potassium (Po)	0.18	0.21	0.26	0.26	0.25	0.23	0.21	0.19	0.18	0.22
Soil acidity (Sa)	0.12	0.11	0.13	0.17	0.18	0.18	0.17	0.16	0.16	0.15
Humus (Hu)	0.09	0.07	0.07	0.09	0.12	0.14	0.14	0.14	0.13	0.11
Copper (Cu)	0.07	0.05	0.04	0.04	0.06	0.09	0.10	0.11	0.11	0.08
Zinc (Zn)	0.06	0.04	0.03	0.03	0.03	0.05	0.07	0.08	0.09	0.05
Boron (B)	0.05	0.04	0.03	0.02	0.02	0.02	0.03	0.05	0.07	0.04
Calcium (Ca)	0.04	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.03
Magnesium (Mg)	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02
Total	1	1	1	1	1	1	1	1	1	1

A relative weights matrix was built to determine the values of the relative weights of the parameters. (Table 5). To obtain it, the values from each column of the pair-wise comparison matrix were multiplied by the value of the weight of the corresponding parameter W (see Table 3), and the relative weight of each parameter W_i was calculated as the sum of the weights of the factor in each row of the matrix.

Table 5

Relative weights of the parameters affecting the spatial distribution of intra-field heterogeneity zones

Parameter and its designation	Ph	Po	Sa	Hu	Cu	Zn	B	Ca	Mg	Relative weight, W_i
Phosphorus (Ph)	0.31	0.44	0.45	0.44	0.40	0.30	0.28	0.24	0.18	3.04
Potassium (Po)	0.16	0.22	0.30	0.33	0.32	0.25	0.24	0.21	0.16	2.19
Soil acidity (Sa)	0.10	0.11	0.15	0.22	0.24	0.20	0.20	0.18	0.14	1.54
Humus (Hu)	0.08	0.07	0.08	0.11	0.16	0.15	0.16	0.15	0.12	1.08
Copper (Cu)	0.06	0.06	0.05	0.06	0.08	0.10	0.12	0.12	0.10	0.74
Zinc (Zn)	0.05	0.04	0.04	0.04	0.04	0.05	0.08	0.09	0.08	0.51
Boron (B)	0.04	0.04	0.03	0.03	0.03	0.03	0.04	0.06	0.06	0.35
Calcium (Ca)	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.04	0.24
Magnesium (Mg)	0.03	0.03	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.18

To confirm or refute the correctness of judgments about the magnitude of the influence of one or another soil parameter, the consistency of the weight matrix was assessed. At the first stage of the assessment, the eigenvalue of the consistency vector λ_{max} was determined as the quotient of dividing the total relative weight of each parameter W_i by the weight of the corresponding parameter W (Table 6).

Table 6

Calculation of the principal eigenvalue, λ_{max}

Parameter and its designation	Relative weight, W_i	Weight, W	Principal eigenvalue, λ_{max}
Phosphorus (Ph)	3.04	0.31	9.90
Potassium (Po)	2.19	0.22	10.01
Soil acidity (Sa)	1.54	0.15	10.00
Humus (Hu)	1.08	0.11	9.88
Copper (Cu)	0.74	0.08	9.70
Zinc (Zn)	0.51	0.05	9.56
Boron (B)	0.35	0.04	9.46
Calcium (Ca)	0.24	0.03	9.40
Magnesium (Mg)	0.18	0.02	9.44
The average value of the principal eigenvalue, λ_{max}	9.70		

According to Saaty [Saaty, 1980; 2008], for a pairwise comparison matrix to be consistent it must have a principal eigenvalue (λ_{max}) greater than or equal to the number of the parameters considered (n). The principal eigenvalue of 9.70 was obtained for the 9 x 9 matrix, hence the condition $\lambda_{max} \geq n$ is satisfied, and the pairwise comparison matrix is consistent.

To assess the overall inconsistency of the created hierarchical model, which is due to the accumulation of errors associated with the inconsistency of local judgments, the consistency index CI, (Equation (2)) and the consistency coefficient CR, (Equation (3)) were calculated:

$$CI = (\lambda_{max} - n) / (n - 1) \quad (2);$$

$$CR = CI / RI \quad (3),$$

where RI is a Random inconsistency index [Saaty, 1980].

The hierarchy is considered consistent if the value of CR does not exceed the level of 0.1 [Yeh et al., 2008]. In this study, for a matrix of nine variables, RI is 1.49, and the consistency coefficient is CR = 0.0591. This indicates that the weights assigned to the soil parameters are consistent and the hierarchical model is correct and structured in detail.

Discussions and results

As mentioned earlier, nine thematic layers with different soil parameters were used as initial geospatial data, which were obtained through the utilization of GIS (Figure 2).

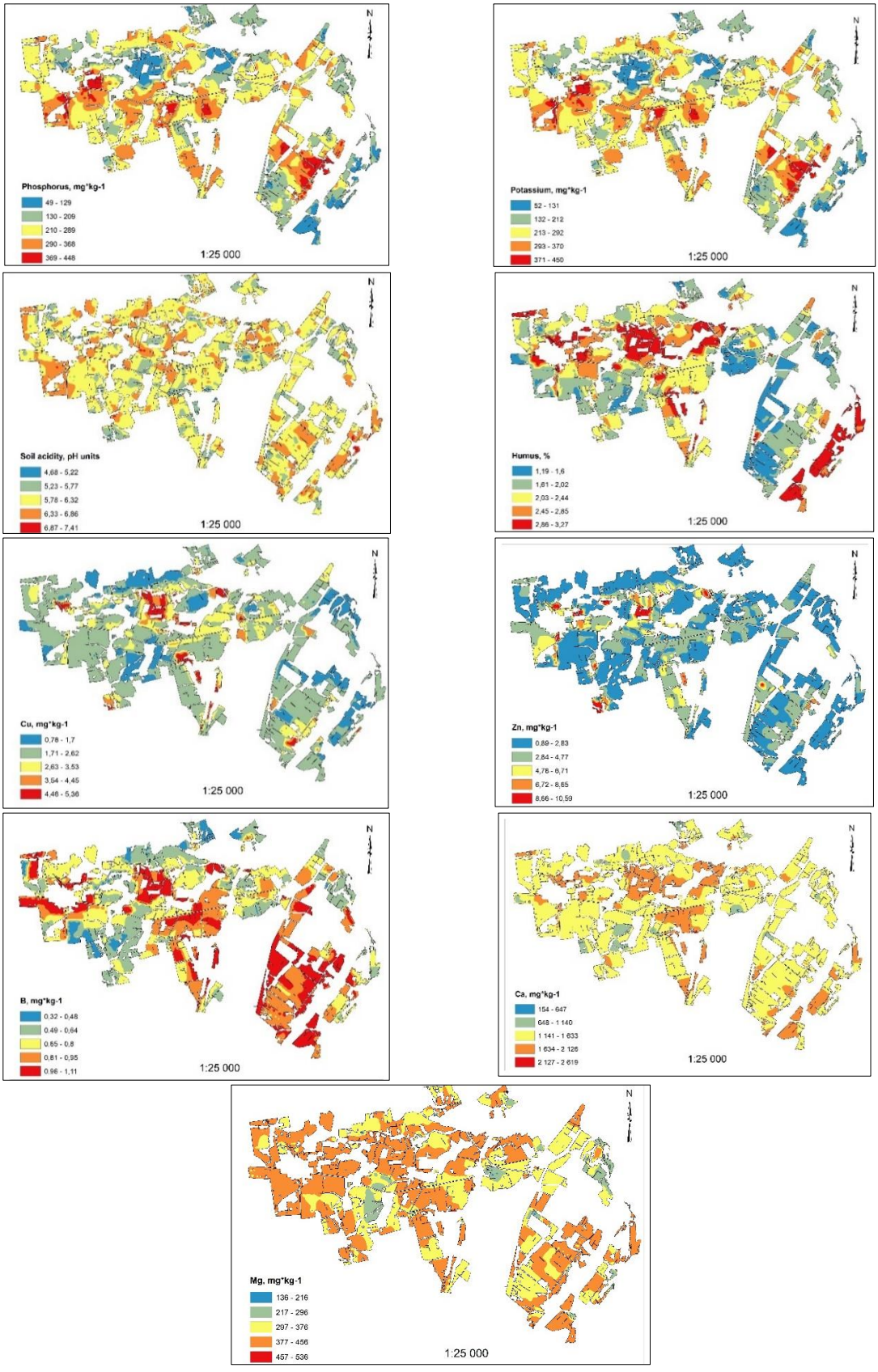

Fig. 2. Thematic layers with different soil parameters which were used to determine intra-field heterogeneity zones

The content of phosphorus and the content of potassium in the soil were determined as parameters with the highest influence weights. This is that because the identification of intra-field heterogeneity zones was carried out primarily to use its results for the off-line differentiated application of mineral fertilizers. In addition, these parameters are directly taken into account when calculating the norms of mineral fertilizers, the methodology for determining which is regulated by industry regulations that are mandatory for all agricultural entities in Belarus [Organizational and technological standards …., 2012a; 2012b]. The third most influential parameter is the acidity of the soil solution since this indicator is one of the most important factors in soil fertility and determines numerous features of the behavior of chemical elements in the soil ecosystem. The fourth most important place is occupied by the content of humus, which is one of the main indicators of soil quality, as well as carbon pools in the terrestrial ecosystem. This factor is considered important in environmental modeling, environmental forecasting, precision farming, and sustainable land use [Myslyva et al., 2017]. Further, in descending order of influence, the content of copper in the soil, the content of zinc, and the content of boron are located. Ranking within this group was carried out with the availability of soils with these elements, as well as the need for them in the main cultivated crops.
Values in the input raster layers were reclassified into a common evaluation scale of 1 (very low), 2 (low), 3 (satisfactory), 4 (good) and 5 (excellent). This was done by multiplying the cell values of each parameter class by the parameter weight and summing the resulting cell values to produce a map of intra-field heterogeneity zones [Senanayake et al., 2016], as summarized in Equation (4):

$$IFHZ = \sum_{i=1}^{n} W_i * R_i = (Ph_rPh_w + Po_rPo_w + Sa_rSa_w + Hu_rHu_w + Cu_rCu_w + Zn_rZn_w + B_rB_w + Ca_rCa_w + Mg_rMg_w) \quad (4),$$

where IFHZ is the localization of the identified intra-field heterogeneity zones; W_i is the weight of each thematic layer, R_i is the rating of each class of each thematic layer; Ph, Po, Sa, Hu, Cu, Zn, B, Ca, Mn are soil parameters; the subscripts r and w refer, respectively, to the factor class of a thematic layer and its percent influence [Mageshkumar et al., 2019].
Figure 1 shows a general flowchart of the process of the identification of intra-field spatial heterogeneity zones, whose delineation is performed through the combined use of AHP and overlay analysis.

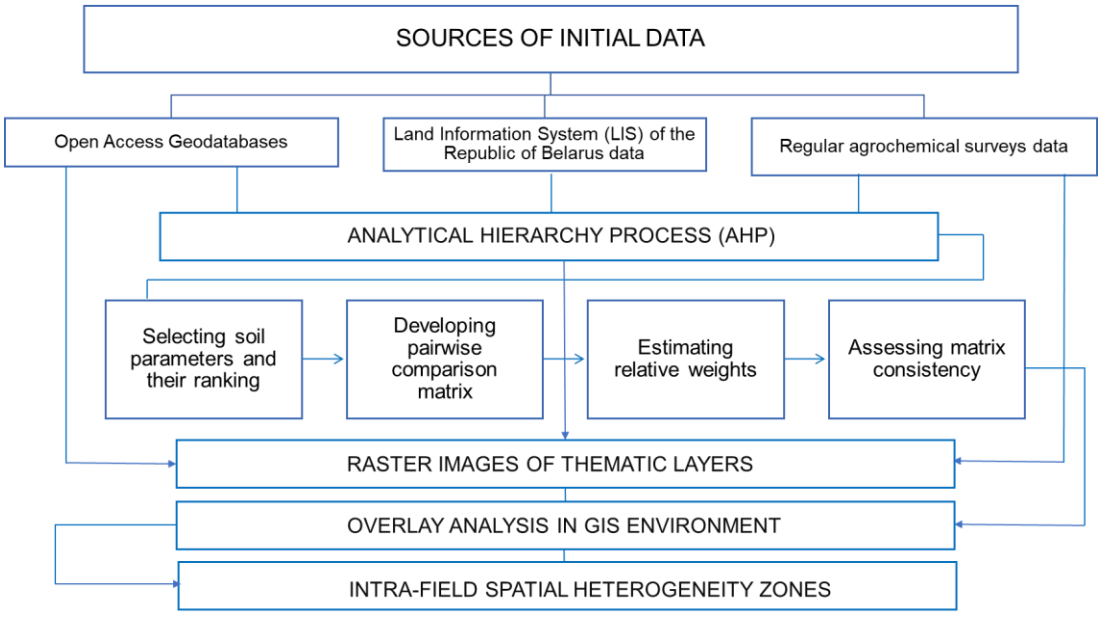

Fig. 3. Flowchart for intra-field spatial heterogeneity zones identifying

As a result of the identification of intra-field spatial heterogeneity zones, performed on the basis of estimates and weights of nine thematic layers with different soil parameters, a geoinformation model has been created (Equation 5).

$$IFHZ = 0.31Ph + 0.22Po + 0.15Sa + 0.11Hu + 0.08Cu + 0.05Zn + 0.04B + 0.03Ca + 0.02Mg \quad (5),$$

Raster images of the results of geoinformation model implementation are shown in Figures 4 and 5.

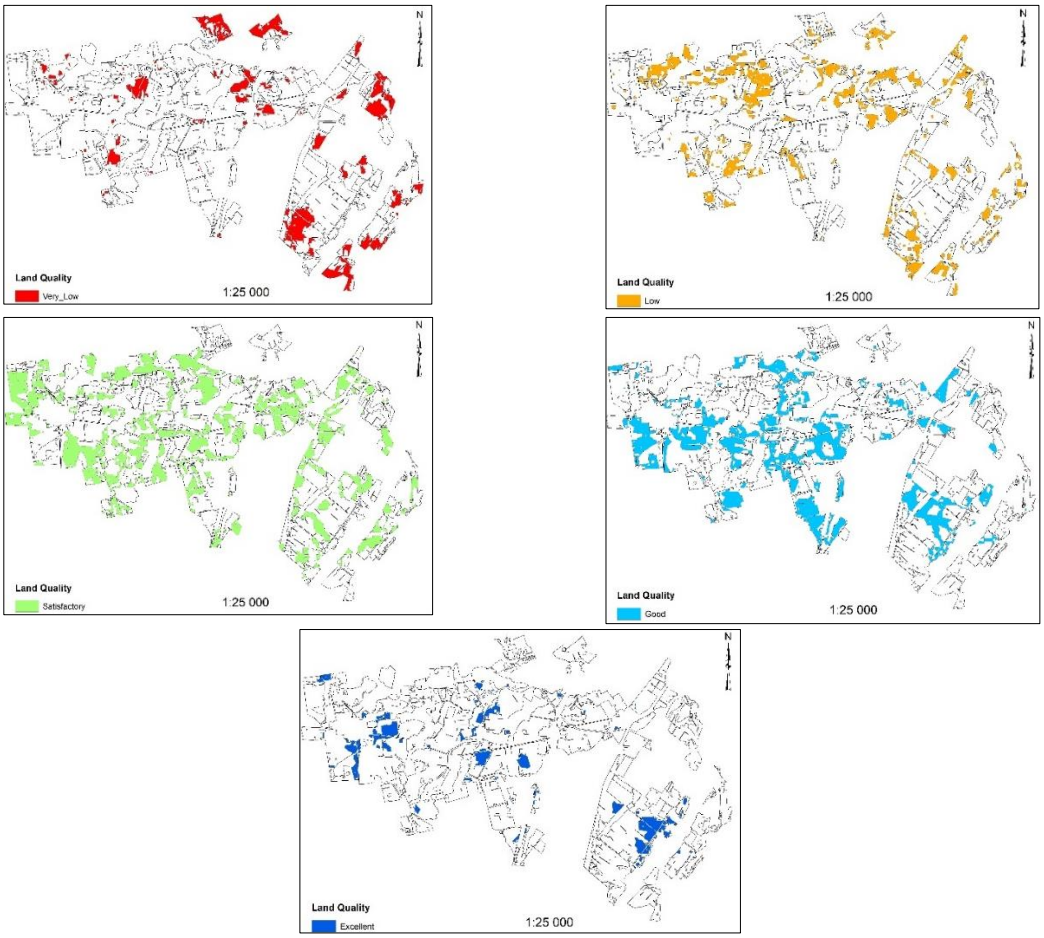

Fig. 4. Spatial localization of individual intra-field heterogeneity zones within the arable land of RPUE "Ustie" NAS of the Republic of Belarus

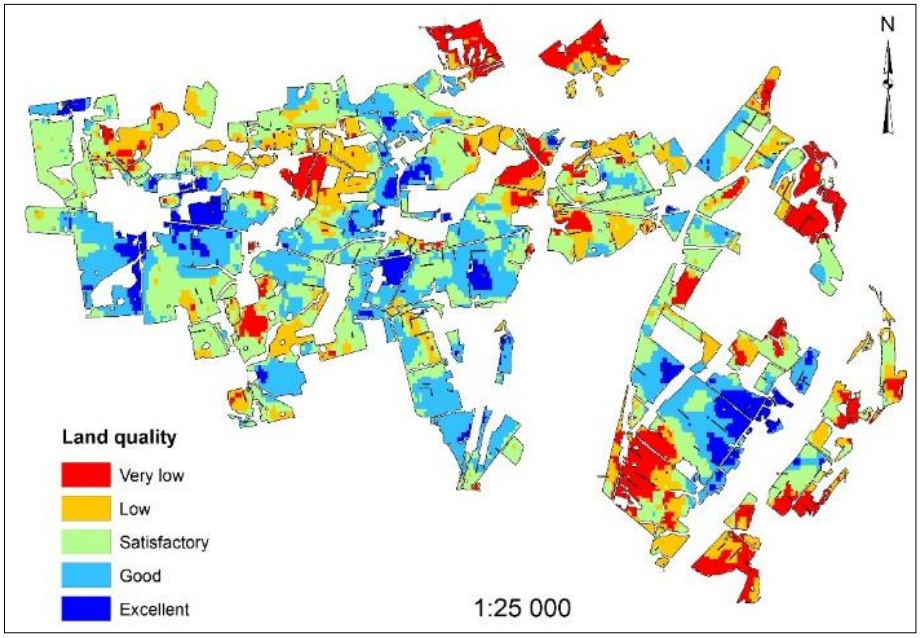

Fig. 5. Resulting raster of spatial distribution of intra-field heterogeneity zones within the arable land of RPUE "Ustie" NAS of the Republic of Belarus

(*Land with very low quality – 988.65 hectares; land with low quality* – 1385.99 hectares; *land with satisfactory quality – 2678.38 hectares; land with good quality – 1993.55 hectares; land with excellent quality – 502.92 hectares)*

Among the five identified zones with different land quality, the maximum share falls on land of satisfactory and good quality – 35.5% and 26.4%, respectively. At the same time, the area of land with very low quality is twice the area of land with excellent quality.

The use of the results obtained makes it possible to identify fertile and infertile areas within each individual field and differentiate the use of fertilizers in accordance with the provision of soil with nutrients, as well as more effectively plan the structure of sown areas. On the example of the RPUE "Ustie" NAS of the Republic of Belarus it was found that the use of dedicated intra-field heterogeneity zones for differentiated application of mineral fertilizers would reduce the total cost of purchasing and applying phosphorus fertilizers by 34 USD·ha^{-1} and potash fertilizers by 9 USD·ha^{-1} due to the redistribution of the fertilizer doses calculated for the planned yield. At the same time, the level of chemical pressure per hectare of arable land will decrease by 6.7% without loss of crops productivity (Table 7).

Table 7

Efficiency of intra-field spatial heterogeneity zones utilization to ensure differentiated application of mineral fertilizers

Characteristics of the created effect	Amount of the created effect		The crop for which the maximum effect is recorded
	%	USD·ha^{-1}	
Optimization of application rates and reduction of costs for the purchase of phosphate mineral fertilizers	12,8	5.3	Winter wheat
Optimization of application rates and reduction of costs for the purchase of potash mineral fertilizers	29,1	0.5	Sugar beet
Reducing the cost of applying phosphate mineral fertilizers	15,3	28.7	Winter wheat
Reducing the cost of applying potash mineral fertilizers	29,8	8.5	Sugar beet
Increasing the profitability of growing crops	1,35	–	Winter wheat
Reducing the level of chemical pressure on the soil	6,7	–	Winter wheat

Conclusions and proposals

The research results show that for the conditions of Belarus it is most expedient to determine ~~of~~ intra-field spatial heterogeneity zones based on data on the chemical properties of soils.

The AHP method, together with overlay analysis, makes it possible with a high probability to identify heterogeneities both within a single field and within the entire land use in several parameters.

The combination of these methods also makes it possible to establish clear boundaries between fertile and marginal lands, which can be used to determine site-specific management zones for precision farming, within which certain land management or agro-reclamation activities are planned.

The results of the study can also be used in other countries with agricultural organizations or farms with the land use area exceeding 500 ha.

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MODELLING RESDENTIAL PROPERTY VALUES IN BIDA USING GEOGRAPHIC INFORMATION SYSTEM

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Abstract
Many studies have unveiled the importance of variation in residential property values overtime, but failed to cover different types of residential property value and location. The aim of this research is therefore to model residential property rental value in Bida from 2015 to 2020 with the aid of Geographic Information System (GIS). The study focused on the rental values of the residential property and rental value variation across space. Data collected for this paper includes residential rental values and geographic coordinates from 196 residential properties in the study area, comprising 101 one-bedroom, 80 two-bedroom and 15 three-bedroom apartments. Inverse Distance Weighted (IDW) interpolation tool of ArcGIS was employed in analyzing the data. It was found out that the core areas of the town commands lower rental values while the southern part of the town commands higher rental values. It was also found out that one bedroom apartment is the most dominant residential rental property followed by the two bedroom apartments and three bedroom apartments respectively. Geospatial database was produced for each model in a bid to ascertain the level of changes with time. The benefits associated with the application of GIS technology were established by this research and recommends its application to other property values modeling.
Key words: residential properties, rental values, modelling, geographic information system, inverse distance weighted.

Introduction

Price variations and the cyclical nature of the housing market are risk factors that might jeopardize the stability of the financial and banking sectors dynamics, as evidenced by recent experience and property value crises in emerging countries (Yuan et al., 2018; Olszewski et al., 2017). Valuation of properties, particularly residential properties, was traditionally done manually or based on a current report and site survey, and was largely documented on paper and hardcopies (Sharafat et al., 2021). The current trend in property revaluation is to create a property valuation model that can estimate residential property values on a wide scale and in a short period of time. Geographic Information System (GIS) are one of the tools used to record all information about the value of properties and spatially represented based on the data collected (Mohammed & Sulyman, 2019; Bohari et al., 2015).

GIS are responsible for establishing spatial links between items that can be identified in respect to the earth (Hu et al., 2018). Cichociski & Dbrowski (2013) describe how these systems may be used to analyze the features and relationships of spatially defined objects. All geographic phenomena vary through time, and comprehending geographic processes and events requires both spatial and temporal qualities. In addition, knowledge derived from spatio-temporal data will aid in the better prediction of spatial processes and events (Li et al., 2020).

The rapid growth of cities has put a strain on land, making it difficult to precisely describe property qualities and value (Biozor & Cielak, 2021). GIS and remote sensing data have been widely employed for property appraisal due to their abundant spatial information and robust image processing capability (Zhang et al., 2014). Although, locational influences on property value are often viewed as the most essential, their inclusion in valuation methodologies is frequently assumed (Li & Luo, 2022). The use of GIS-based value maps to depict fluctuations in value at the individual property level is introduced.

General data such as social, economic, planning, and environmental features, as well as specific data such as local market conditions, transaction details such as location, physical and functional form, and legal characteristics, are used in all valuation approaches (Kemiki, 2012). Market data is generally difficult to obtain due to regulatory limits on the release of property data into the public domain; therefore valuers rely on their own expertise and experience. Despite the lack of access to property data, IT and data analysis techniques are fast evolving. Early IT implementations in the real estate sector were simply computerized duplications of human operations (Yang et al., 2018). Property management software, for example, was built on accounting programs, while valuation software transformed old value processes into spreadsheets (Cellmar, 2011). These programs have been developed and polished to the point where they can now effectively replace manual systems. Complex valuations and sensitivity analysis can be carried out using valuation software to a degree that would be prohibitively time demanding if done manually.

Property valuation estimates are crucial in making strategic real estate investment decisions (Ullah & Sepasgozar, 2020). This is due to the fact that real estate stakeholders (including professionals, corporations, and the government) rely heavily on property valuation estimates provided by valuers (Yalpir, 2014). The inaccuracy of such appraisal forecasts could have a negative impact on real estate stakeholders' investments, which could eventually undermine a country's economy, as the global financial crisis of 2007 demonstrated (Jiang et al., 2013).

Several methodologies have been employed to estimate property values in the real estate research arena, ranging from traditional to advanced valuation techniques (Assimakopoulos et al., 2015). Traditional valuation methods have been proved to be unreliable and erroneous in studies (Zurada et al., 2006). As a result, there has been a shift toward advanced valuation methodologies, which are more accurate and dependable than traditional methods (Abidoye, et al., 2019). Traditionally, property transaction data was only available through a network of professional connections. The contact established by estate surveyor within the property industry and in the area where he or she practices, the 'jungle telegraph' can be effective (Adegoke et al., 2017). However, it can be difficult to obtain the necessary information in many circumstances, particularly when companies are secretive or the market is slow.

In order to examine the drivers of property value, previous research has either disregarded or dealt with location analysis in a very general way (Wyatt, 2013). It's possible that modeling location for the purposes of valuation may be challenging. According to Dabaniyu (2013), valuers infer a great deal about a property from its location, which is based on local experience and knowledge. Acknowledging why a specific location has a particular impact on property value is not the same as attempting to quantify that element (Adetiloye & Eke, 2014). The market value of every asset is the price a potential buyer is willing to pay a willing seller in the presence of all relevant information and acting in their own best interests (Brown & Matysiak, 2017). As a result, the price an occupier is willing to pay determines the value of a property.

It is from the foregoing, that this study attempts to model residential rental properties value with the aid of Inverse Distance Weighting (IDW) interpolation tools of GIS to determine the variation in rental value of residential properties of the study area in 2015 and 2020 respectively.

Methodology of research and materials

The study was conducted in Bida traditional Nupe town in Nigeria. The primary data collected for this study includes the location of residential properties in terms of their coordinates with the use of a Global Positioning System (GPS) receiver to produce a map for residential rental properties as well as rental values for residential property types in the study (see Fig. 1). Questionnaire was administered on occupants of residential properties to ascertain the rental value of varying residential properties for the years 2015 and 2020 to 196 residential properties comprising 101 one-bedroom, 80 two-bedroom, and 15 three-bedroom apartments respectively. Residential rental values collected for each category of properties were used to build the geodatabase in ArcGIS 10.6. The collected information was analyzed using the IDW interpolation technique of GIS using the residential rental values of each category of residential properties (i.e. one-bedroom, two-bedroom, and three-bedroom) as the input field from the attribute table of the geodatabase in the spatial modeling of residential property rental values of the study area.

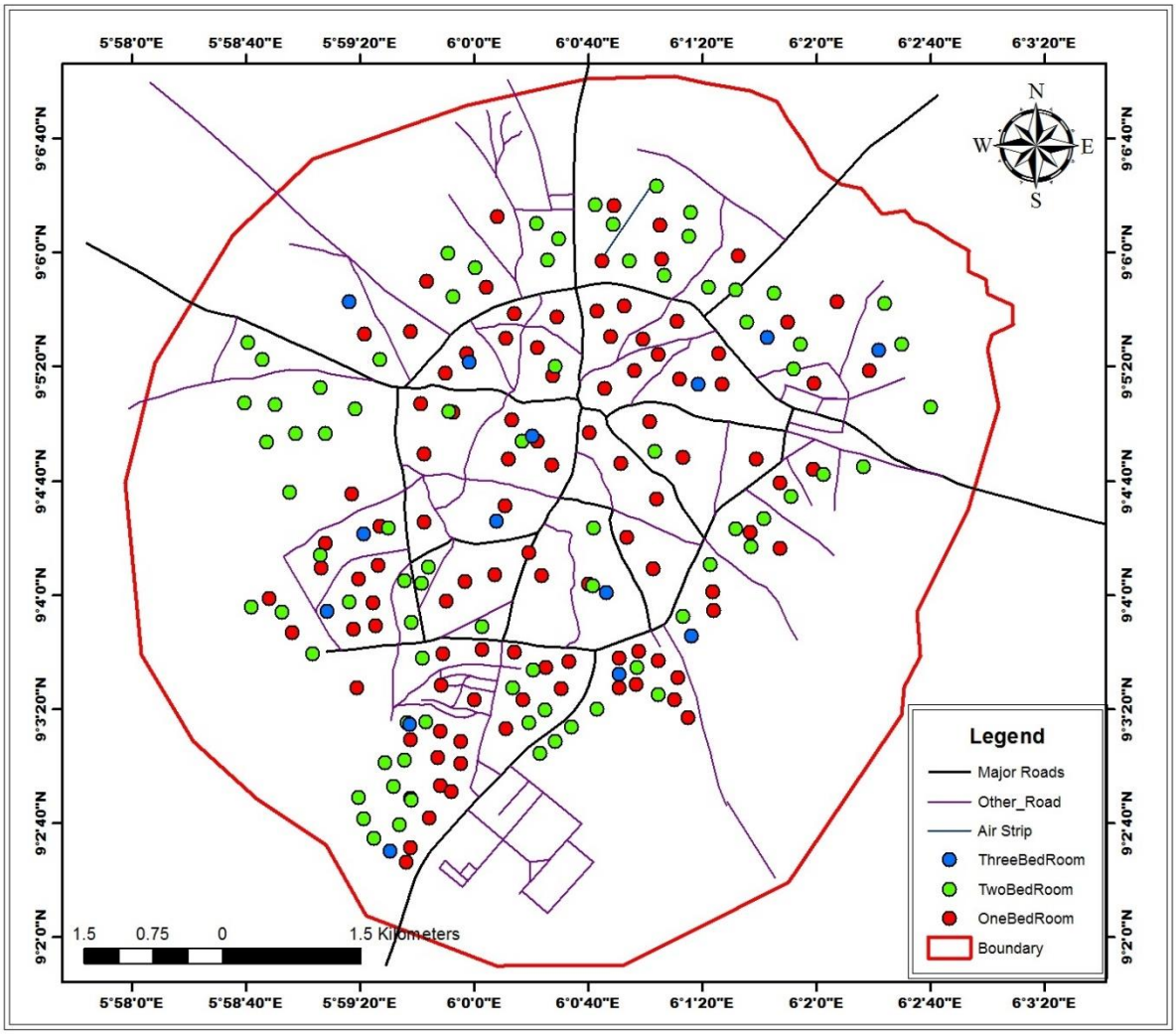

Fig. 1. Location of Sampled Residential Rental Properties in the Study Area

Discussions and results

Model for spatial residential rental value in the year 2015

The rental value of residential properties in the study area as of 2015 is presented in Fig. 2, 3, and 4 respectively. The IDW results show that in 2015 the minimum rental value of a bedroom residential property is thus put within the range of NGN6000 to NGN12000 and NGN61000 to NGN67000 at its peak, while that of two-bedroom residential property was at NGN100000 to NGN107000 and NGN167000 to NGN174000 at the minimum and maximum values respectively. For the three bedrooms' residential property rental values in the study area, the minimum value as of 2015 was between NGN11000 to NGN29000 and the maximum value was around NGN181000 to NGN190000 respectively. The spatial model shows a lower rental value in the central area for one-bedroom residential properties and higher rental values along the southern parts of the region (see Fig. 2). The model indicates decreasing residential rental value with the decreasing distance away from the city center. For two-bedroom rental values, the model shows that the highest rental value is found in southwestern and northwestern areas of the study area, while the city center has a lower rental value for two-bedroom apartments (see Fig. 3). The two-bedroom residential rental property model also indicates the increasing rental value with increasing distance away from the city center. The model for three-bedroom apartments shows a contrasting spatial pattern, although, the city center also records lower residential rental values (see Fig. 4).

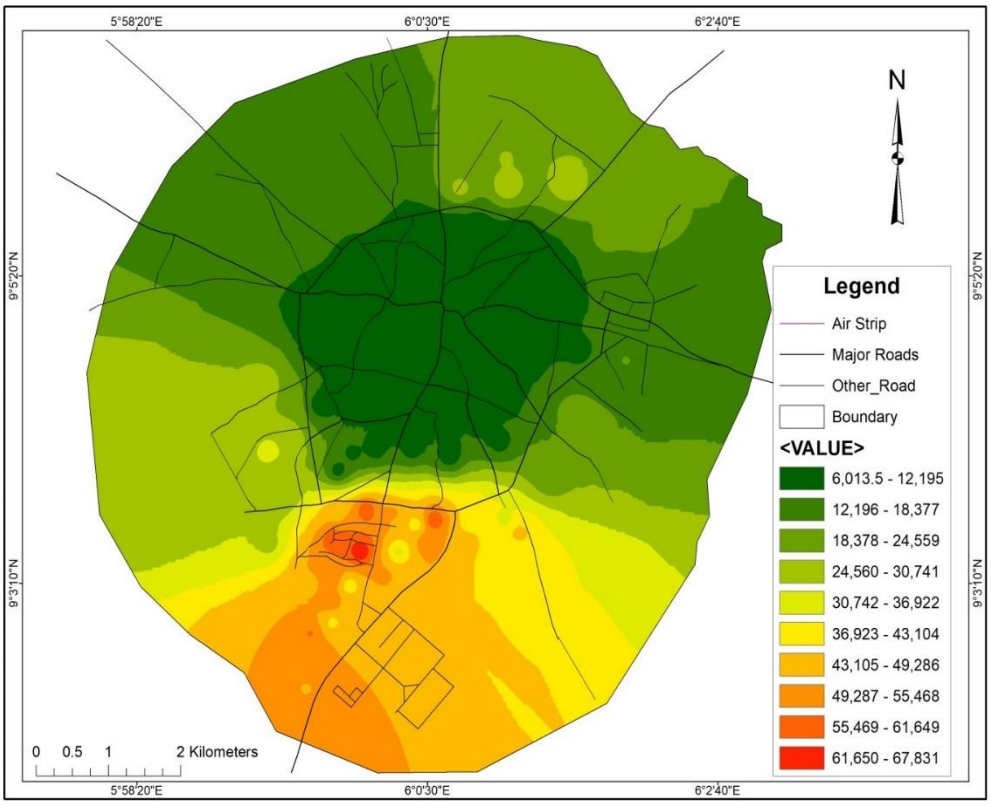

Fig. 2. One-bedroom spatial residential rental value for 2015

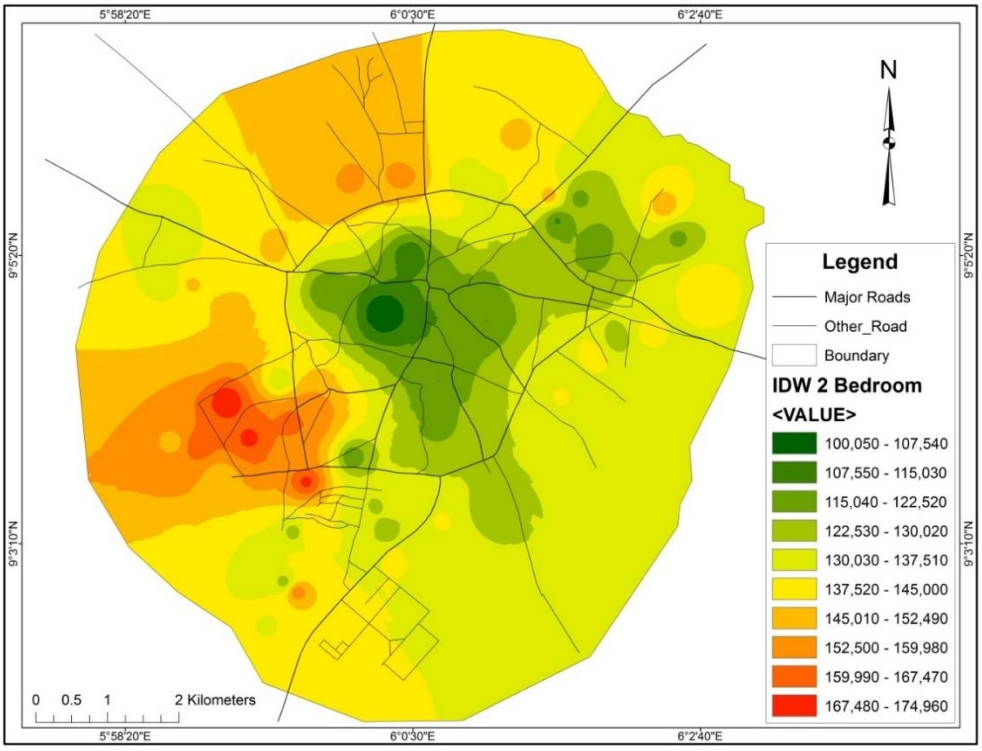

Fig. 3. Two bedrooms spatial residential rental value for 2015

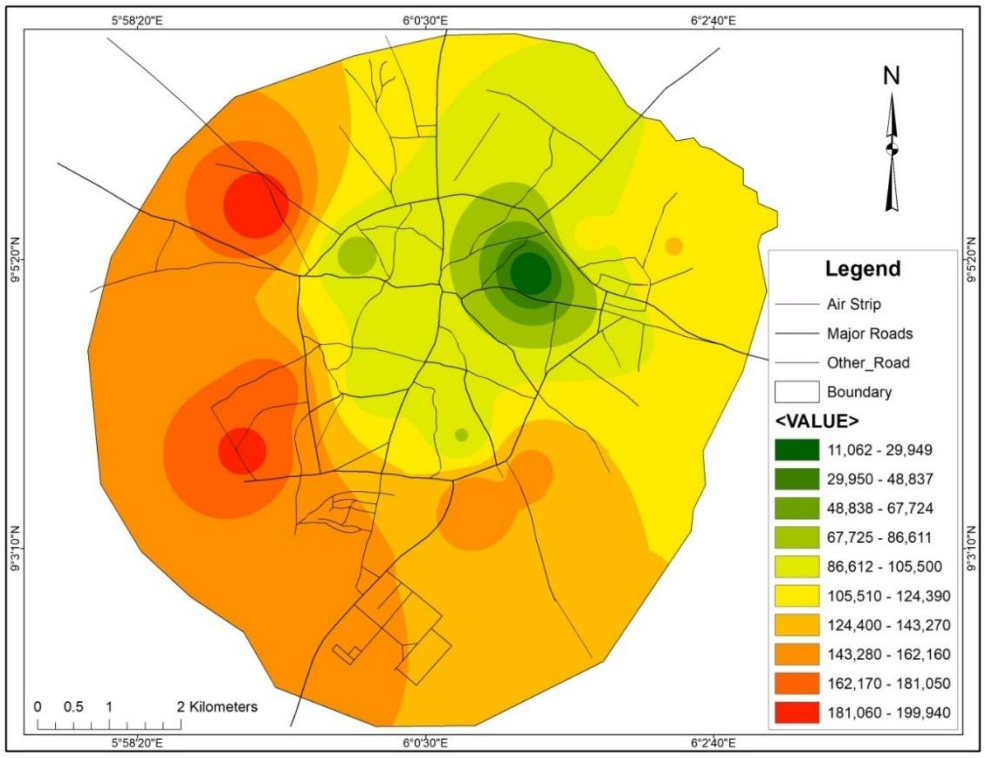

Fig. 4. Three bedrooms spatial residential rental value for 2015

Model for spatial residential rental value in the year 2020

The The IDW analysis presented in Fig. 5, 6 and 7 respectively represents the residential properties rental values for the year 2020 where it was revealed that the rental values for one bedroom residential property was lower in the core areas of the town from NGN14000 to NGN30000 and a bit higher towards the northern part within the range of NGN30000 to NGN50000 while the rental values for a bedroom residential property is considerably high in the south and estimated around NGN60000 to NGN80000 as shown in Fig. 5. Similarly, rental values for two-bedroom apartments were lower at the core of the town estimated around NGN20000 to NGN80000, while other parts of the town commands high values with areas the western axis having the highest values for two-bedroom residential properties estimated around NGN100000 to NGN140000 as presented in Fig. 6. Three-bedroom residential properties command the highest price in the southwestern part of the town with the price ranging from NGN180000 to NGN200000 while the northern part of the study area has a considerably lower rental value of NGN11000 to NGN30000 as shown in Fig. 7. This implies that residential property values in the southern part of the town irrespective of the number of room commands higher value than the core areas and northern part of the town across the time space analysed.

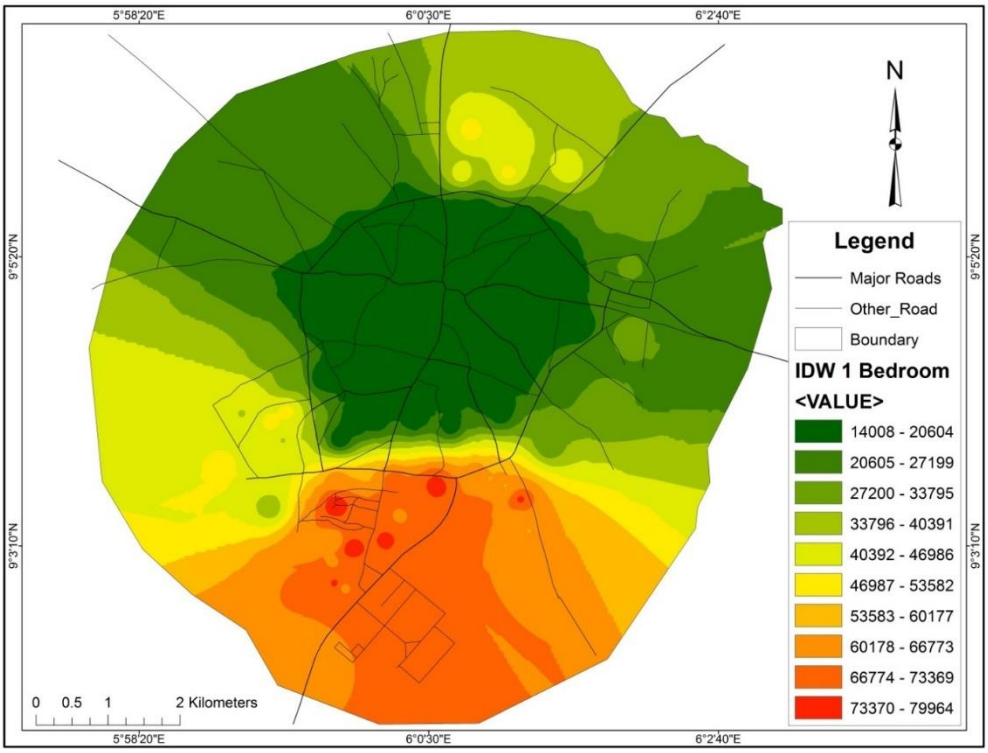

Fig. 5. One-bedroom spatial residential rental value for 2020

Similarly, rental values for two-bedroom apartments were lower at the core of the town estimated around NGN20000 to NGN80000, while other parts of the town commands high values with areas the western axis having the highest values for two-bedroom residential properties estimated around NGN100000 to NGN140000 as presented in Fig. 6. Three-bedroom residential properties command the highest price in the southwestern part of the town with the price ranging from NGN180000 to NGN200000 while the northern part of the study area has a considerably lower rental value of NGN11000 to NGN30000 as shown in Fig. 7. This implies that residential property values in the southern part of the town irrespective of the number of room commands higher value than the core areas and northern part of the town across the time space analysed.

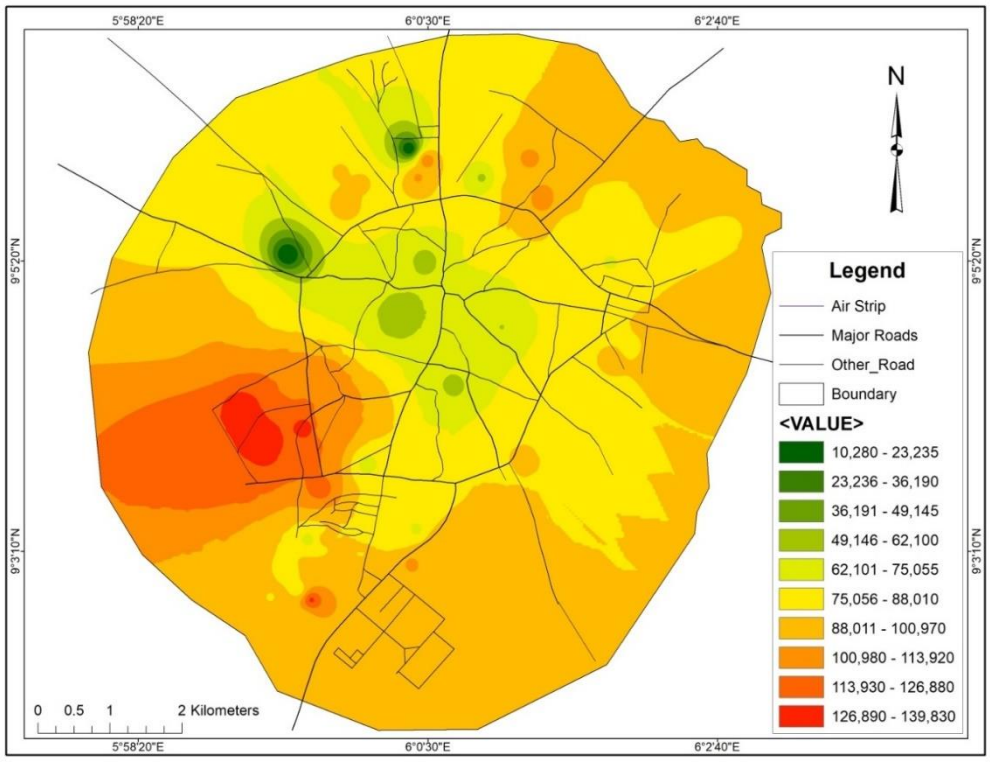

Fig. 6. Two bedrooms spatial residential rental value for 2020

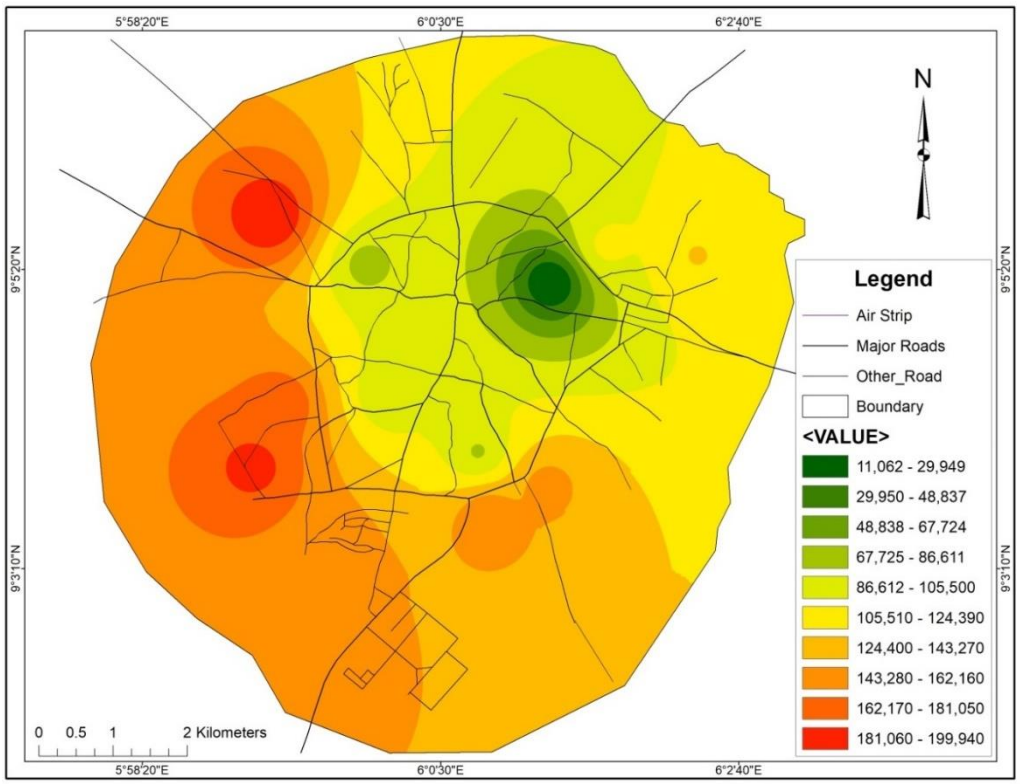

Fig. 7. Three bedrooms spatial residential rental value for 2020

The various analytical tools of GIS present an easier medium of processing, manipulating, understanding, and presenting environmental, social, and economic-related data (Mohammed et al., 2021; Kuller et al., 2019; Grekousis, 2020). As revealed by the findings of this study in 2015, three-bedroom residential rental properties commanded the highest rental value which agrees with the finding of Ciu et al. (2018) in a study conducted in Beijing, China, that residential properties with a higher number of rooms

has more economic return than the lower ones. Similarly, it was observed that residential properties closer to the central business district (CBD) had relatively lower rental values compared to other farther locations from the city center which conforms with the findings of Hussain et al. (2019) in a study conducted in Islamabad region of Pakistan and Nepal et al. (2020) in a study conducted in Nepal. This is due to the organic nature of the city (Mohammed et al., 2021). The model revealed a pattern that shows that all residential rental properties command lower value with proximity to the city center and higher rental value towards the suburb. This is in line with a study conducted by Delventhal et al. (2022), Miessner (2021), and Olowu et al. (2019) indicating that the closer a property is to the city center, the higher the rental value of the such property.

Conclusions and proposals

The spatial models of the residential rental value of the study area show a variation in the spatial structure of the city. However, the uniqueness of the model is that all the residential rental property values depict lower rental values in the central area of the study area. In conclusion, the study revealed a spatial pattern that is contrary to the monocentric city models. The study revealed a spatial pattern that depicts a decreasing rental value with decreasing distance from the city center. However, there is a slight variation in the spatial pattern of two-bedroom rental values for the years 2015 and 2020, yet, the city center commands lower rental values. It was therefore concluded by the study that the IDW interpolation tool of GIS is a unique tool to predict and model property value. The adoption and application of this tool are therefore recommended to estate valuers and managers as an important valuation tool that will aid the processing, analysis, and presentation of valuation-related data efficiently than the traditional approach.

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AGRIBUSINESS DEVELOPMENT AND INSURANCE AS A FACTOR OF GEORGIA'S ECONOMIC GROWTH

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Abstract
Georgia is a small state, stretched between two seas, which has always aroused constant interest in the world due to its geopolitical position. Many called it Iberia or Iveria, and often called Gurjistan. At the crossroads of Europe and Asia, this small oasis attracted many conquerors not only because of its importance, but also because of its culture, historical buildings and fruitful lands. Georgia is a sunny and fertile country, where everything blooms and pleases. Our ancestors from ancient times engaged in agriculture, cattle breeding and had an active connection with the land. According to historical sources, Georgia is more than four thousand years old, and the Georgian alphabet and writing are unique to the whole world. Since the fourth century, Christianity has been our state religion, but the country unites representatives of many cultural ethnic groups and religious beliefs. A completely different historical page began after the collapse of the Soviet Union, when Georgia found itself alone in the face of new challenges and realities. Although we do not have oil and gas ores, which allows the state to develop rapidly, in other areas we may well take a leading position. For example, it is possible to develop the tourism sector at a high level, since the country is distinguished by its historical monuments, some of which are included in the UNESCO World Heritage List. However, a small state like Georgia can focus on agriculture and succeed. For rural welfare, there is the Rural Development Agency, which coordinates projects with the Ministry of Environment and Agriculture of Georgia and assists enterprises interested in this area. Since 2014, the Agricultural Insurance scheme has been operating, the purpose of which is to promote the development of the insurance market in the agricultural sector, promote agricultural activities, save income and reduce risks for those involved in this activity. Our topic is about the development of agribusiness and insurance, which is one of the key factors in Georgia's economic growth.
Keywords: Agribusiness, Agriculture, Insurance, Economics.

Introduction

First of all, it is necessary to say what is a village? A village is a locality whose population is mainly engaged in agriculture, which combines various fields such as animal husbandry, horticulture and forestry. Thus, the modern world of agriculture is divided into two types: Agrarian sector of developed and developing countries. This area employs 40-50% of the total population of the earth, in developed countries the figure does not exceed 5-6%. (Georgia Agriculture and Rural Development Strategy 2021-2027, December 2019) For developed countries, the agro-sector is at a higher level, because everything is automated there and modern methods are used, which makes it possible to achieve a high level of labor productivity. That is, here a smaller number of farmers and the rural population helps the country achieve its goals, because the functions of farmers are equal to the functioning of firms that have high-quality infrastructure, which contributes to the disappearance of borders between cities and villages. And developing countries are the opposite, there are many problems and unresolved cases.

Agriculture and food production is very important for the whole world, because more than 850 million people are starving in many countries and in all corners of the earth, but mainly African states. (www.actionagainsthunger.org) Due to the negligent attitude towards the village, the level of agriculture may further decrease and this will lead to a crisis in the production area and there will be a shortage of products in the markets. We live in the era of globalization and this process affects all spheres of development of the national economy and other sectors, of course, at the level of gross domestic product. Georgia is a developing country, which for many years was part of the Soviet Union and the base of subtropical production, such as tea, citrus fruits, as well as viticulture and grain crops. But in the 90s, the level of agriculture and the role of the village decreased, so if in 1998 the share in the Georgian economy was 28%, in 2008 - 9.4%, and in 2018 - 8%. What was the reason for such a big drop in level? First of all, the strongest problem is the lack of specialists in the agricultural sector, that is, those people who have knowledge and interest in this area. The situation was challenged by the breakup of the Soviet Union and the transition to the individual needs of the states, therefore, in some countries, for some reason, agriculture was not prioritized, but other areas, which gave us the given statistics, although the fact that the governing bodies of the country have been actively involved in agricultural aid programs since 2012 and to date More and more people are interested in having their own farms, so the share of agriculture in the gross domestic

product is 7% in 2021, this relatively small figure is due to the impact of the pandemic and other factors, although further growth is predicted.[1] According to preliminary estimates, in January 2022, compared to the corresponding period of the previous year, Real gross domestic product (GDP) growth was 18.0 percent.[2]

Georgia is a fabulous and magical country that has experienced a lot during its existence, but still remains sunny and hospitable. Our symbol is "Mother Kartli" and she personifies hospitality and respect for our culture, meets enemies with a sword, and friends with a cup full of wine, so we can say that winemaking has been familiar to our state since ancient times. Our country has a total area of 69,700 km2, of which agricultural land totals 43.3%, and forest areas about 43.2%. In Georgia, at the moment there are about 3,729,600 people, but only 41.7% of them live in villages, i.e. 1,554,800 people, and the rest in cities, but according to United Nations calculations, urbanization is increasing and in 2050 the population of the village in our country will be 27%, so way it will affect the development of agriculture, so you need to think about the future of the state. thanks to the correct policy of the Georgian government since 2014, very important and strong steps have been taken to develop and stimulate agribusiness, we have strategic documents and long-term plans that will help our country to interest not only business entities, but also residents of the country in the field of agriculture, so that it becomes it is easy for them to settle in the countryside.

Currently, Georgia is actively exporting the following goods:

- Wine, soft drinks and alcoholic drinks from countries such as the Netherlands, France, Poland, Latvia, Lithuania, Russia, Ukraine, Armenia and Kazakhstan;
- Nuts and walnuts: Italy, Germany, Spain, Czech Republic, Russia and Ukraine;
- Canned fruits and vegetables: Germany, Austria and Slovakia;
- Fruit and vegetable juices: Germany and Greece;
- Hazelnut flour: Germany and France;
- Citrus fruits: Russia, Ukraine and Azerbaijan;
- Livestock and small ruminants: Azerbaijan, Lebanon and Saudi Arabia.

The article discusses the main issue of the importance of agricultural development for the economy of Georgia and how the state helps in insurance and financing issues. References New and interesting sources, which include the strategy of agriculture and rural development of Georgia in 2021-2027, where general information is given, who we are, what we want and what we will achieve. The country's strategy, vision, goals and objectives for the given sector are outlined. At the same time, the expected results of what the government expects from the planned projects. I also think it is necessary to know by what means the mentioned plans will be implemented. I found the manual on beekeeping interesting (Beekeeping, textbook UNDP Georgia 2017), which is a kind of guide for people interested in these issues. It is worth noting that there is a whole series of similar manuals on different fields of agriculture, such as: horticulture, viticulture, etc., which is an extraordinary way, especially for beginners, to find and understand the necessary information, to create an idea about the agriculture.

Research methodology and materials

While working on the topic, we reviewed many documents, including the "strategy for the development of agriculture and rural areas of Georgia", which is designed for 2021-2027, as well as statistical analyzes of what and how to achieve in this area. As for programs, there are a lot of them in our country, not only state ones, but also international ones, and there are also ideas in the process. The Ministry of Environmental Protection and Agriculture of Georgia brings together various agencies that work in concert with each other, so this is a step forward, thanks to which agribusiness is being promoted. The departments of the ministry include wine, forestry, environmental protection and similar structural units, the main task of which is to promote the development of agricultural activities. Let us consider among them the projects of the greatest importance, which are carried out by the Ministry of Environmental Protection and Agriculture of Georgia and the Rural Development Agency. the implementation and availability of which contribute to the development of agriculture.

[1] The statistical information given in the article is taken from *www.geostat.ge*

[2] Preliminary Estimate of Economic Growth, National Statistics Service of Georgia, January 2022.

Discussion and results

While working on the article, I got acquainted with a lot of statistical information, which is available to any interested person on the websites of the National Statistics Service of Georgia and the Ministry of Agriculture. Research has shown that more and more people are interested in agriculture and insurance issues related to it, the number of people interested in and willing to work in rural areas has increased, despite the fact that the number of people living in the city is increasing, the population tries to use the lands of the regions to grow products that they use for personal needs or for sale in the market. Therefore, it is probable and hopefully this trend will increase even more, which the state supports through various grant projects, in which foreign partner organizations also help. Agriculture and its insurance issues are one of the most important issues for any country, the correct management of which affects the welfare of the state and citizens, because if agriculture ensures the production of the required amount of products, it will no longer be necessary to import from foreign countries, and we can even think about exporting in some matters, such as wine and other It happens in the case of products. These issues are important for the greater growth and development of the Georgian economy, because countries that have proper agriculture are much stronger.

Agriculture is an interesting and inexhaustible field, I think it should be one of the priority fields for Georgia at all times, because the current environment and climatic conditions allow us to focus on the diversity of flora and fauna, which ultimately has a positive impact on the country's economic situation. The state promotes interest in the given field, therefore there are many funding and research promotion programs that allow farmers, agriculture and people interested in the agro sector to take their place in the given field. It should be noted that while working on the topic, I researched a number of interesting information and statistical materials, which are given in the attached literature and allow us to make a presentation on the important steps that the state takes in terms of assistance. We can highlight:

- **Preferential agricultural loan**

The project was initiated by the Ministry of Environmental Protection and Agriculture of Georgia, which has been implemented by the Rural Development Agency since March 27, 2013. The aim of the project is to support the production processes of agricultural raw materials, processing and storage by providing cheap and affordable funds to individuals and legal entities, so enterprises will receive preferential agro loans / agro leasing from financial institutions. . Under the project, credit will only be given to those who meet the conditions set by the project.

Within the framework of the “Preferential Agro Lending Project”, agro loans are issued by commercial banks and financial institutions participating in the project, in accordance with the conditions established by the Rural Development Agency. An individual entrepreneur or a legal entity can participate in the project.

The project "Preferential agrocredit" includes the following components:

1. Preferential agricultural loan for working capital;
2. Preferential agricultural loan for fixed assets;
3. Preferential agroleasing.

The amount of the project and the share of funding from the agency are determined by the type of agro loan and the sector financed. The interest rate of the Agrocredit can be a maximum of 21%, the total amount of the loan is 15,000,000 lari, depending on the direction of financing.

- **Agricultural insurance**

Agricultural activity is an area of high risk. What is the risk? This is the uncertainty of the results obtained in the presence of the probability of a positive or negative fact. To avoid such facts, there is the concept of insurance, which is a means of managing risks and avoiding financial losses. Consequently, such risks have always existed and exist in the agricultural sector, because even getting a good harvest by caring for a garden is impossible, nature should also provide assistance. This is what led to the introduction of a new type of insurance, which we call agricultural insurance. Recently, issues of agricultural insurance have become active in Georgia and this area continues to develop steadily. The agricultural insurance program was launched on September 1, 2014 and is aimed at developing the insurance market in the agricultural sector, supporting agricultural activities, maintaining incomes for those involved in this activity and reducing risks.

The program is implemented by the Rural Development Agency, which enters into contracts with insurance companies licensed under the laws of Georgia, subsidizes insurance premiums and controls them based on

these contracts. The implementation of this project is facilitated by 8 insurance companies operating in Georgia, where interested beneficiaries can purchase an insurance policy. As part of the agricultural insurance program, the insurance policy covers the following insurance risks: hail, floods, storms, autumn frosts (only for citrus crops) - from September 1 to November 30.
Agricultural insurance can be used by a natural or legal person who uses or actually owns a land plot and can insure up to 5 hectares of land, and in the case of cereals - 30 hectares (this restriction does not apply to agricultural cooperatives). Each insurer will receive 70% co-financing for all crops covered by the program and 50% for grapes. It should also be noted that the insurer can simultaneously insure both grain and other crops. The fixed insurance rate will be determined according to the program. Only registered plots are accepted for insurance. Agricultural insurance is actively used in viticulture, because wine is part of Georgian culture and needs special care and protection.

- **Tea Plantation Restoration Program**

The history of tea dates back to 1848, when the first factories appeared on the territory of Georgia, and the first success was achieved in 1900, when Georgian tea received an award for the best quality at the Paris exhibition. For a long time, the tea industry was the main branch of the agricultural sector and produced 100-120 thousand tons of products, most of which were exported for sale. Currently, tea plantations are up to 19 thousand hectares, although only 2.4 thousand hectares are used, the rest are literally cut down and covered with eelgrass, and up to 7.5 thousand hectares are subject to rehabilitation. The tea season lasts 6 months, taking into account the soil and climatic conditions of Georgia. To revive this activity, a tea plantation restoration program has been in place since January 18, 2016, which has been extended from February 8, 2021. Program goal:
1. Efficient use of the potential of tea plantations in Georgia, contributing to the growth of local production of tea (including biotea), as a result of which we will increase the export potential;
2. Restoration of private and public tea plantations, which are currently abandoned;
3. Creation of new jobs and improvement of the socio-economic situation of the population.

- **Program for the integrated development of pilot regions**

The program is currently under implementation and applications will be accepted from February 1, 2022. This is a pilot version in four regions: Imereti, Kakheti, Guria, Racha-Lechkhumi and Kvemo Svaneti. The Rural Development Agency funds the creation of new businesses and the expansion or promotion of existing ones. The goal of the program is to increase the competitiveness of the country and its regions, as well as to stimulate interest in the countryside, which allows maintaining a balance between the urban and rural population. The goal is a balanced socio-economic development and improvement of the living conditions of the population living in the region, reduction of regional inequalities in Georgia and development of the entire territory.
It is noteworthy that the state has increased support for farmers and those involved in agriculture, which is reflected in various assistance programs, infrastructure, fuel distribution, fertilizer vouchers, etc. In the results of the research, we can highlight the main problems in the agro-insurance sector:
1. Small coverage of farmers and areas with the first program of agro insurance (respectively 8 % and 5% (as of 2020))
2. Limited range of insurance risks covered by the first agricultural insurance program
3. The first agricultural insurance program with an alternative price and implementation mechanism Absence of insurance package.
All persons participating in agro insurance have their own interests. For example:
- farmers need a guarantee of compensation for losses, business continuity and finances Availability.
- Insurance companies need a financially sustainable and developing market, more beneficiaries and Financial profit obtained by accurate calculation of premiums.
- The state needs a strong farmer base, sustainability and continuity of production, food High level of security, social protection of citizens and necessary for agro-risk management Highly effective, optimal and targeted spending of funds.

We can easily describe the current situation in the agro sector based on SWOT analysis. Which will give us an answer to the question of what factors are the work on in the near future?[3]

S - Strength	W - Weakness
• the will of the state • Complexity and competence of the Ministry and its agencies • 7 years of experience • Statistical and financial data • Constructive cooperation with insurance companies • Constructive cooperation with the Association of Insurance Companies • Frequent and direct relations with farmers • Network of extension centers • State programs • Access to an external resource	• Existing program frameworks (4 risks, crop insurance) • Lack of low-cost agricultural insurance package • Loss assessors are employees of insurance companies • High cost of assessing damages individually • Lack of technical means needed for damage assessment • Limited budget • Lack of human resources
O - Opportunities	**T - Threats**
• The process of forming a layer of agro-entrepreneurs • Part of the farmers are active in buying insurance • Motivating part of the farmers in acquiring knowledge • Positive impact of information on payment of compensation to farmers • Dependence of insurance sales on price • State assistance in land registration • Growing exports • Strengthening the value chain • Use of new (GPS, drone, satellite etc) technologies • Donor support	• Despite the small size of the agro-insurance market • Climate change and frequent natural events • small earthiness • The cost of agricultural insurance • Low level of risk management culture of the majority of farmers • Skepticism on the part of farmers • Little awareness among farmers • Failure to receive funding • Inexperience of insurance companies newly included in the program • The unpredictability of the Covid-19 pandemic

I think in order to reduce or eliminate the existing weaknesses and threats, it is necessary to strengthen the information campaign and offer a cheap package based on the farm maintenance costs, so that in the future more people will know about the existing programs and opportunities. However, I think that Georgia, as a developing country, is advancing more and more and has withstood many challenges. Therefore, I think the forecast for the future is positive.

Conclusions and proposals

Agriculture is an interesting and diverse industry in which individuals and legal entities working in this field face many challenges on a daily basis. However, thanks to a reasonable policy of the state, these problems can be overcome, and existing projects make it possible to realize this in full. Georgia has the potential to become a leading country in agriculture, which requires the wise use of available land resources and the choice of activities that will be the key to success. What, in our opinion, recommendations can we give for the development of agriculture? We consider it possible to develop beekeeping and floriculture in Georgia.

[3] The SWOT analysis was developed according to the 2021-2024 development strategy of the Ministry of Environment and Agriculture of Georgia.

Beekeeping requires a good education in this subject, because working with bees is not easy. However, it is possible to develop a number of products in this area, such as: honey, honeycomb, beeswax, propolis, bee milk and bee pollen. Accordingly, this gives us the opportunity to develop the farm in different directions, because these products are actively used in any field, be it the food industry, the beauty industry, medicine or other areas. The nature of Georgia allows honey to be varied in taste, and bees are easy to care for and store, seasonally from May to August is the most fertile time for beekeeping, and with a large number of bees, production will be quite productive. Beekeeping involves knowing the nature of bees, caring for them is not difficult, the main correct and consistent approach is not to destroy them, but to promote their reproduction.

The soil and climatic conditions of Georgia allow growing a flower garden both in open space and in greenhouse conditions. All kinds of flowers bloom on our land, be it roses and their varieties, as well as daisies, daffodils, carnations, lilacs, tulips, orchids, violets, etc. This will allow us to grow plants on our own land, which we will use both domestically and and export abroad. Consequently, the state will no longer need to import flowers from abroad so massively, because the fertile land will allow growing any kind of plants and creating new varieties that will develop the work of breeders throughout the country.

In conclusion, together with the recommendations, it can be noted that people involved in agriculture express satisfaction with the steps taken by the state towards the development of this industry. According to recent studies, up to 80% are familiar with existing projects, some of them also use the insurance program, and we hope that the trend of agricultural development will continue. Georgia still has a long and interesting way to go, as well as the discovery and development of various directions.

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RATIONAL USE OF AGRICULTURAL LAND IN KAZAKHSTAN

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Abstract
The purpose of the article is to consider the institutional foundations of the rational use of agricultural land in a multicultural economy. The formation of land use is faced with the acute problem of organizing a sustainable competitive land use, ensuring a high level of marketability of production and a sufficient level of profitability in conditions of the developing land market. This article discusses the rational use of agricultural land in a multicultural economy, taking into account structural and resource indicators. The efficiency of land use in farms with different land ownership depends on increasing labor productivity, strengthening the economic regime, increasing the intensification of production, using internal reserves and agricultural production opportunities, and, especially, rational use of land. The greatest efficiency of production and use of land has been achieved in large agricultural formations, where high-performance equipment is used, crop rotations are observed, and there is greater availability of credit resources, subsidies, and leasing. The monitoring data of the Committee of the Republic of Kazakhstan on Statistics for 1.01.2020 indicate that 93.7% of peasant and farm farms have a land area of up to 500 hectares. To the greatest extent, small-earth peasant farms have become widespread in the southern region, where the share in the total number of up to 50 hectares is 90.1%, while in the northern region only 8.1%, central - 3.9%, and western - 11.3%. In this regard, the tasks of preserving productive agricultural lands, and optimizing arable land and acreage in terms of quantitative and qualitative characteristics of land become a priority. The solution to these tasks is connected with the improvement of technologies for maintaining and increasing the bio-productivity of agricultural lands, the development of technologies for rational land management, land use, and land protection, the creation of effective organizational and legal mechanisms for managing agricultural lands, as well as the development of state monitoring of agricultural lands. Optimization of land use in farms and agricultural enterprises of based on the proposed methodology, taking into account state support measures, will create a basis for a new stage in the development of land reform and will create incentives for the effective use of agricultural land.
Key words: efficiency, agro-formations, land protection, rationality, soil fertility.

Introduction.

The land is the basis of human existence, determining its important role in the process of the socio-economic development of society. As the basis of the ecosystem, an instrument of labor and an object of production and property rights, it is the basis of sustainable development, a condition for social progress and human well-being. The introduction of balanced land use is an extremely necessary problem (Anufriev, Lebedeva, 2017). In the current context, outdated concepts of land organization and management, which are not oriented toward sustainable land use, continue to operate. In this connection, the strategy of extensive land use (unreasonable fragmentation of land masses, reduction of valuable agricultural land and livestock, increase in the area of arable land, pastures, predominance of monoculture, sharp reduction in the application of organic fertilizers) in some regions remains a priority (Polikova 2012). Practically in all natural zones and regions of Kazakhstan, there is a tense ecological situation, therefore the problem of rational use of soil resources, reproduction of fertility, and their preservation from desertification should become an integral part of the national policy, the basis of sustainable economic development of the country (Zhildikbaeva, 2018). The current situation in the protection and use of land resources requires radical changes in land use. To ensure sustainable development of agriculture it is necessary to form such land use, which determines a rational ratio of leading industries, clear specialization by natural conditions, and the structure of agricultural land, which allows establishing of their optimal parameters (Tkacheva, Meshchaninova, 2011). Agrarian transformations in Kazakhstan associated with the privatization of state property have led to certain changes in the legal and organizational structure of farms, land redistribution, fragmentation of large enterprises, and the expansion of small-scale commodity production. In developing countries, land use is mainly determined by food needs as well as land suitability (Zhang, 2012). The land use pattern does not provide enough land for a certain type of agriculture (Burian, 2015; Bizikin, 2015). The experience of most countries demonstrates the practice of limiting the maximum allowable size of agricultural land plots Stepen, 2015). ,The formation of sustainable land use is associated with the need to take into account the basic laws and principles governing the social, economic, and environmental aspects of their functioning. Agricultural land use of any organizational and legal form is an object of management and nature management, and from these positions, it performs the function of rational distribution and

effective use of land as an integral part of the agro-ecological system.
The purpose of this work is to justify the directions and mechanisms to improve the efficiency of the rational use of agricultural land in the development of the private property.
By the goal the following tasks were set:

- to investigate the theoretical and methodological bases of efficiency of land resources use and development of land relations in agricultural production;
- to reveal the basic factors and system of the indicators characterizing effective use of the ground;
- to analyze land use by regions, management forms, and forms of ownership;
- to develop proposals for regulating land relations and increasing use land use and use efficiency in agriculture.

Research methods and materials

An important methodological part of the study is in the scientific conclusions and provisions of economic scientists and directions on the problems of sustainable agricultural land use. Sustainable agricultural land use implies such land use, which preserves the area of agricultural land, does not allow a decrease in its fertility, and complies with legal requirements for the intended use of land that meets the natural, climatic, geographic, and environmental properties of specific land plots, and simultaneously achieves maximum economic benefit per unit area. The data of the State Land Cadastre for 2020, data, and statistical materials of the Committee on Land Resources Management of the Republic of Kazakhstan for 2021 were used in the study. The following research methods were used in the work: monographic (concerning land use in private and leased land use); comparative-economic analysis of land use intensity assessment; expert (about the influence of factors on effective land use); grouping method (according to land use size); calculation and constructive (in determining the effect of applying new science-based technologies and in determining the costs per 1 ha of land). The needs of land market participants for better payment mechanisms for land were studied by the survey method.

Discussion and results

Agricultural land use is a land mass with certain spatial characteristics: boundaries, configuration, area, and location, as well as natural conditions, quality characteristics, legal regime, and peculiarities of economic activity. Land use expresses not only the economic, natural, ecological, technical, social, and legal essence but also the nature of land use and protection. The ecological-economic estimation of the territory of land use allows a reasonable estimate of its initial condition and economic efficiency of development prospects (Alakoz, 2015; Dyusenbekov, 2004).
The natural resource potential of land use influences its market specialization and place in the territorial division of labour, therefore the location and character of the use of land resources of agricultural land use influence regional development as a whole.
Let us consider the territory of Almaty oblast, which by the composition of agricultural lands and land categories reflects the degree of their use in economic activity. Of the seven land categories, the most important is the category of agricultural land, which occupies 37.1% of the territory of the oblast. 18.1% are forest lands, 0.9% - are water, 33.8% - are reserve lands, and 1.01% - are recreational.
There have been formed 59120 peasant and private farms, 140 production cooperatives, 1124 LLP and JSC, 80 state enterprises, and 78 other companies. In the course of agrarian reforms, the average size of farms has constantly changed in the direction of reducing their area and led to the presence of very small peasant farms with the size of land used up to 10 ha, which formed in the use of land - small land use, which hinders the effective use of land and requires the optimization of their size, taking into account the influence of various factors.
Arable lands occupy 986.3 thousand ha (11.9%) in the structure of agricultural lands, of which 474.5 thousand ha (83%) is irrigated. The share of perennial plantations (fruit and berries) is 15,8 thousand hectares (0,19%). Hayfields occupy 230,500 ha (2,8%), pastures 6,110,500 ha (73,8%) (Summary Analytical Report, 2021).
The volume of gross output of agriculture in 2018 according to the Agency of the Republic of Kazakhstan on Statistics was 734.0 billion tenges, including livestock products - 357.2 billion tenges (48.7%), crop production - 374.4 billion tenges (50.01%). Structure of gross output of agriculture by categories of farms: household farms - 47,1 % (346,0 billion tenges), peasant (farm) farms - 38,2 % (280,1 billion tenges), agricultural enterprises - 14,7 % (107,8 billion tenges) (Agriculture, forestry, and fisheries in Kazakhstan, 2020). The distribution of lands for agricultural purposes by forms of farming as of November 1, 2020, in Almaty oblast is shown in tables 1 and 2.

Table 1

Distribution of agricultural land by the form of management as of 1 November 2020.

Agricultural land	Number	Total arable land, thousand ha	including:					
			arable land	perennial plantations	depo-sits	hay-fields	pastures	vegetable gardens
Total	60542	8280,9	986,3	15,8	83,3	230,5	6110,5	0,3
Peasant farms and private farms	59120	5593,7	656,3	9,7	42,4	162,9	3722,8	0,1
Non-state agricultural legal persons:	1342	2670,5	309,8	5	40,3	64,7	2286,2	0,2
economic partnerships and joint stock companies	1124	2241,7	224,4	3,9	35	29,4	1606,5	0,1
agricultural cooperatives	140	407,7	67	0,6	2,8	33,5	468	0,1
Other enterprises	78	21,1	18,4	0,5	2,5	1,8	211,7	
State agricultural legal persons	80	16,7	20,2	1,1	0,6	2,9	101,5	
Note - Data from the consolidated analytical report "On the condition and use of lands of the Republic of Kazakhstan for 2021. Land Resources Management Committee								

In the structure of agricultural land use the share of peasant farms accounts for 66.5% of arable land, 61.4% of mulberry plantations, 50.9% of fallow land, 70.7% of hayfields, and 55.2% of pastures.

To develop the best option for evaluating land use it is necessary to analyze the factors contributing to profitability and efficiency (optimal production structure, land availability, rational combination of branches, zonal specialization, high marketability, etc.), which influence the sustainability of land use (Table 2).

Table 2

Land Availability and Land Use Efficiency in Almaty Oblast for 2020

Region, district	Agricultural land, thousand ha	of which arable land, thousand ha	Gross output of agriculture in all categories, million tenge	Rural population, people	Employed in agriculture, people	Gross output, thousand tenge		Land availability of agricultural land, ha	
						per 100 hectares of agricultural land	per 100 hectares of arable land	per inhabitant	per 1 person employed in agriculture
Almaty region	8292,9	1012,4	733974,3	789178	750242	8,8	72,5	10,5	11,1
Enbekshikazakh district	407	85,7	108205,7	142645	136080	26,6	12,6	2,9	3,0
Talgar district	195	31,1	50816,5	76098	72667	26,1	16,3	2,6	2,7
Zhambyl district	1385,6	120,6	49831,1	82567	78443	3,6	41,3	1,7	17,7

The highest level of land availability is in Zhambyl district, less in Talgar and Enbekshikazakh districts, where the main areas of irrigated lands are located and where there is a high concentration of employed rural population as compared to Zhambyl district.

The purpose of efficiency assessment in the system of land use in the regions of the republic is to characterize the structure of land resources for making managerial decisions aimed at ensuring rational and efficient land use. At the republican level, the potential of agricultural lands reflects their ability to provide food security for the country. On this basis, from the standpoint of economic assessment, it is advisable to distinguish two levels of determining the potential of agricultural land resources: the level of territories and the level of economic entities (Espolov, Seifullin, 2004).

Economic assessment of the potential of land resources at the first level is expressed in the value of gross crop production that can be obtained from a land mass limited in the territory (on the scale of the region, rural areas) if all productive lands within it are involved in economic turnover, the principles of their rational use are observed, and the level of really possible crop yields being achieved of based on modern agricultural technologies. Since a significant share of crop production is used as fodder, an additional assessment of the potential of some agricultural lands allocated for the formation of a fodder base is possible, expressed through the cost estimate of the gross output of livestock production. The size of agricultural land for the potential assessment should be determined taking into account its intended use. For arable land, the optimal cropping pattern is determined; for hayfields, the allocation of improved hayfields is legitimate; and for pastures, the creation of artificial grasslands. For land under perennial plantations, the structure of fruit and berry plantations is calculated (Ivanov, 2008).

The post-privatization period in the Republic of Kazakhstan has left a certain imprint on the formation of land use, where, on the one hand, the old system in the organization and management of land resources has been preserved, resulting in the development of large-scale land use with extensive farming (mainly in the desert and semi-desert natural-agricultural zones), and on the other - multi-location, interspread and long-distance land use (in the foothill-steppe, dry-steppe, and irrigated agriculture zone). If in the first case, it is connected with a shortage or total absence of arable massifs and predominance of pastures, in the other - a large number of land lots, assigned to one owner or land user is connected with imperfect management of rural territories (Staroverov, 2008).

Today in Kazakhstan, the rational use of land resources and the reproduction of the productive potential of agricultural land are not properly ensured. Since the processes of land reform are slow, the land issue has become highly politicized, and the transfer of land to efficient owners has become practically blocked. In this connection, the questions of preservation, rational use, and expanded reproduction of land resources as a basis of the sustainable development of Kazakhstan became aggravated. The urgent problem of today is the solution to these issues.

In the production sphere of land use, especially in agriculture, economic efficiency is the main objective, and social and ecological efficiency have not been taken into account until recently. Nowadays they are conditions of limitation of realization of the main purpose of land use in the production sphere and directly influence the process of expanded reproduction of land. Special attention should be focused on the realization of sustainable development of land use of through a complex solution of problems of provision of rational land use. One of the important components of their solution is the optimization of land use.

Rational use of land is accompanied by several objectives, one of which is the main and plays a dominant role, the need to implement the others limits the achievement of the maximum value of the main objective, therefore, obtaining the maximum of its effectiveness (Varlamov, 2011).

When considering the system of indicators for assessing the efficiency of land use, three groups of indicators can be distinguished:

1. Quantitative and qualitative assessment of the productive potential (capacity) of land: availability and composition of agricultural land; distribution of land by land users and landowners; the landscape of the area; soil fertility; soil erosion indicators; water, thermal, light, air regime of soils.
2. Intensity of land use: labor supply (land supply); land endowment; energy supply; fertilizers; unit weight of intensive crops; capital investments; unit weight of irrigated and drained lands
3. Land use efficiency: crop yields; cost of 1 metric center of fodder (grain) units; production of main products per 100 hectares of agricultural land; profit from the sale of crops per 1 hectare of agricultural land; profitability of crop production.

To approach the practice of determining of efficiency of the use of land resources, it is necessary to dwell in more detail on its factors on allocated functional subsystems and types of efficiency. The territory of Kazakhstan is mainly located in the steppe, semi-desert, and desert natural zones. Extensive development of agricultural production has left a mark in the form of land degradation and impoverishment of landscapes, more than 60% of the country is exposed to severe desertification, which leads to a reduction of soil fertility and, consequently, to the reduction of productivity of livestock and crop production.

Practically in all natural zones and regions of Kazakhstan, there is a tense ecological situation, therefore the problem of rational use of soil resources, reproduction of fertility, and their preservation from desertification should become an integral part of the national policy, the basis of sustainable economic development of the country. The current situation in the protection and use of land resources requires radical changes in land use. To ensure sustainable development, it is necessary to establish a land property right, which clearly defines the legal capacity of the subjects of land use and establishes the authority to own, use and dispose of land. Land tenure relationships should fully embody the environmental and economic components of land use, social relations, and processes. Ensuring this principle will contribute to the sustainable development of society (Zhildikbaeva, 2019).

The basis for the formation of sustainable land use should be the strict observance of the established ratios between disturbed and undisturbed areas. The undisturbed areas should be considered as a stabilizing factor, neutralizing anthropogenic impacts on the landscape. Particular attention should be focused on the implementation of sustainable development of land use through an integrated solution to the problems of ensuring the sustainable use of land. One of the important components of their solution is the optimization of land use.

The issue of optimal correspondence between the state of land resources and the legal regime of their use significantly affects agricultural lands. The abundance of land in the agrarian sphere, its irrational use, and low efficiency in agricultural production at enormous energy inputs are the obvious reasons hindering the process of transition of the agrarian sphere to its sustainable development and formation of effective land use.

Conclusions

The rational and efficient use of land resources is caused by changes in the content of land relations and the implementation of land reform. Since the main issues of the reform are the formation of multi-economic land use and parity development of various forms of ownership of agricultural land, the state management of land resources consists in the formation of a mechanism of rational land use, which allows influence the behaviour of subjects of land relations and ensures their effective functioning in specific natural conditions. Proposals for regulating the rational use of land have been developed which involve the effective use of economic mechanisms. Economic mechanisms include methods of economic incentives for rational land ownership and use, economic sanctions for mismanagement of land, reduction of soil fertility, as well as economic guarantees in the form of funding for land management activities and compensation payments.

The mechanisms of optimization are proposed: on the transition from a smallholding to medium and large land based on the organization of simple partnerships on joint land cultivation. The introduction of proposals into agricultural production practice on the enlargement of land use sizes of small peasant farms into simple partnerships with the obligatory application of zonal soil-protective technologies shortly will allow for increasing the intensity of land use (gross production per 100 ha of arable land) in the eastern region by 12.5%, in the south by 10%, in the west by 8%.

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