METHODOLY FOR DETERMINING THE ECONOMIC EFFICIENCY OF SUSTAINABLE LAND USE MANAGEMENT (BASED ON THE EXAMPLE OF AGRICULTURAL LAND US)

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In a scientific report, the authors considered a methodology for determining the economic efficiency of agricultural land use. The analysis of the conditions of agricultural land use has been conducted and factors affecting the economic efficiency of agricultural land use have been identified. The authors paid special attention to studying the criteria and a system of indicators of sustainable land management economic efficiency. In addition report focuses on the role of agricultural land use planning and identifies the main planning and forecasting methods for determining the agricultural land use efficiency.
Keywords: economic efficiency, management, agricultural land use, land use, criterion of efficiency, indicator of efficiency, methods.

Purpose of the research: consideration of the methodology for determining the economic efficiency of agricultural land use, as well as criteria, indicators and methods of economic efficiency of sustainable land use management.

Objective of the research: agricultural land use.

Objectives of the research:

- suggest a methodology for determining the economic efficiency of sustainable land use management;
- suggest classification of factors affecting the agricultural land use efficiency;
- identify the role of agricultural land use planning;
- formulate the main criteria of sustainable land use management economic efficiency;
- develop a system of indicators of sustainable land use management economic efficiency;
- identify methods for determining the criterion of sustainable land use management economic efficiency;
- consider basic planning methods for determining the economic efficiency of agricultural land use.

Results of the research:

- the methodology for determining the economic efficiency of sustainable land use management has been suggested;
- an analysis of the conditions of agricultural land use has been conducted and the factors affecting the economic efficiency of agricultural land use have been identified;
- the most relevant criteria of sustainable land use management economic efficiency have been identified;
- profit multiplier is considered as a criterion of agricultural land use economic efficiency on the example of the Krasnodar region;
- an assessment of the land exploitation economic efficiency by agroindustrial soil groups and functional purpose on the example of Kanevsky district of the Krasnodar region;
- the classification of indicators of economic efficiency of agricultural land use management is proposed;
- developed a system of indicators of agricultural land use management economic efficiency;
- a methodology for determining the economic efficiency of agricultural land use is proposed;
- the role of agricultural land use planning is considered;
- the main planning methods for determining the economic efficiency of agricultural land use are identified;
- the tasks of the prospective development of agricultural land use were solved by the example of the Klinsky district of the Moscow region.

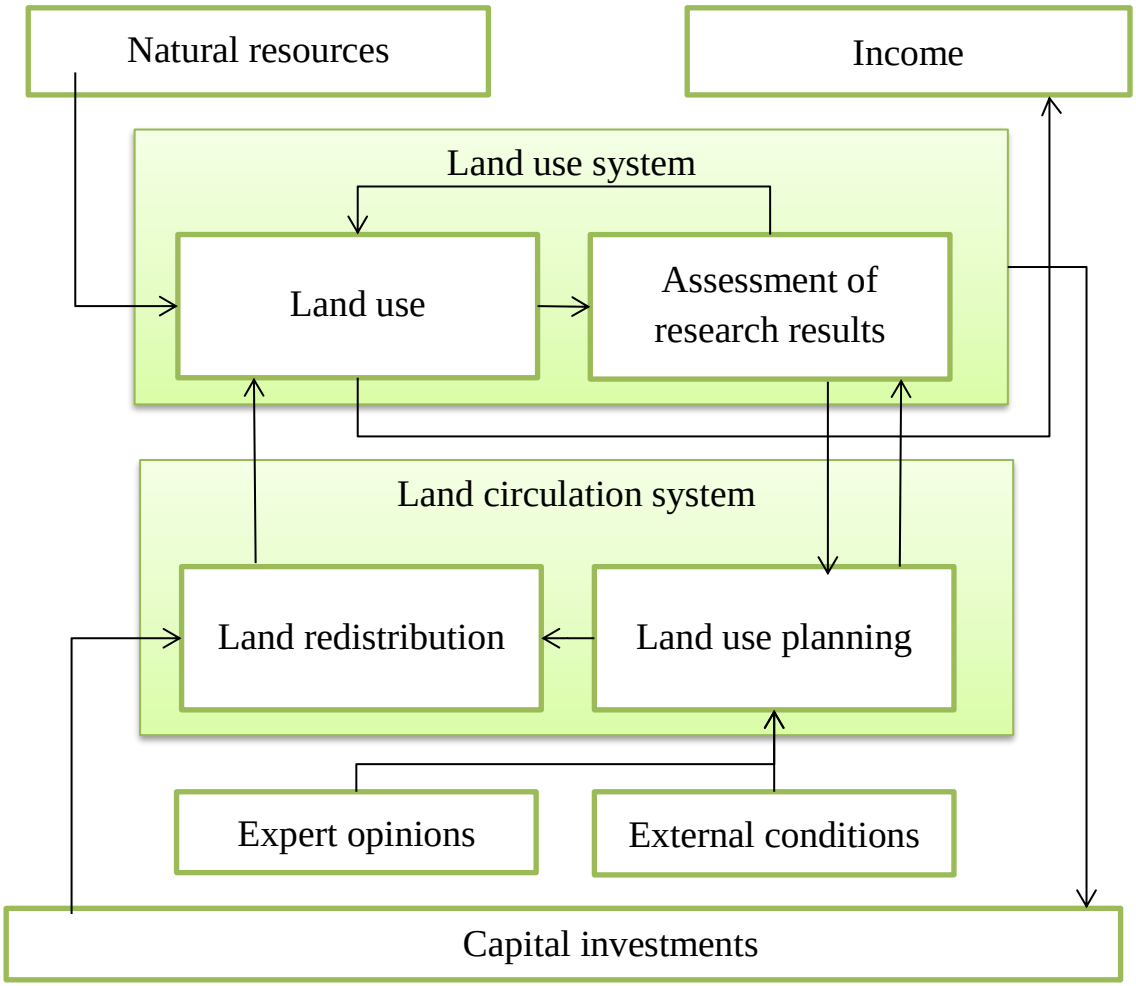
Introduction

The relevance of this study is due to the fact that in Russian Federation at present land management concepts that are not oriented towards sustainable land use are being developed at all administrative and territorial levels. This especially concerns agricultural land use.

A system of sustainable agricultural land use should be formed under the influence of economic, social, legal, environmental, natural conditions of the territory.

S.A. Zhilin suggests introducing the existing system agricultural land use in the form of a scheme (Fig. 1) [12].

Fig. 1. The modern agricultural land use system



It should be noted that the modern system of agricultural land use is developing quite randomly. In this regard, capital expenditures increase and land use efficiency decreases.

According to S.A. Zhilin, to determine the direction of development it's necessary to determine the area of acceptable development of the land use system. It's necessary to model and determine the most profitable land redistribution. In addition, an increase in investment in environmental measures will make it possible to make the most efficient land use system. In addition, among the problems that need to be solved in the process of transition of agrarian sector to sustainable land use, it should be noted such as reproduction of soil fertility, introduction of a mechanism to stimulate land users, strengthening the national economic importance of land resources in solving social and economic problems in the agro-natural complex of the corresponding region, accounting for traditional forms of land use specific to a particular region and more. All these measures at all administrative and territorial levels should be implemented with state support.

In the general system of the main directions of ensuring sustainable land use, the complex of problems of increasing the economic efficiency of agricultural land use is of particular importance.

An important condition that must be met to ensure the existence of a system of sustainable agricultural land use is to increase it's economic efficiency.

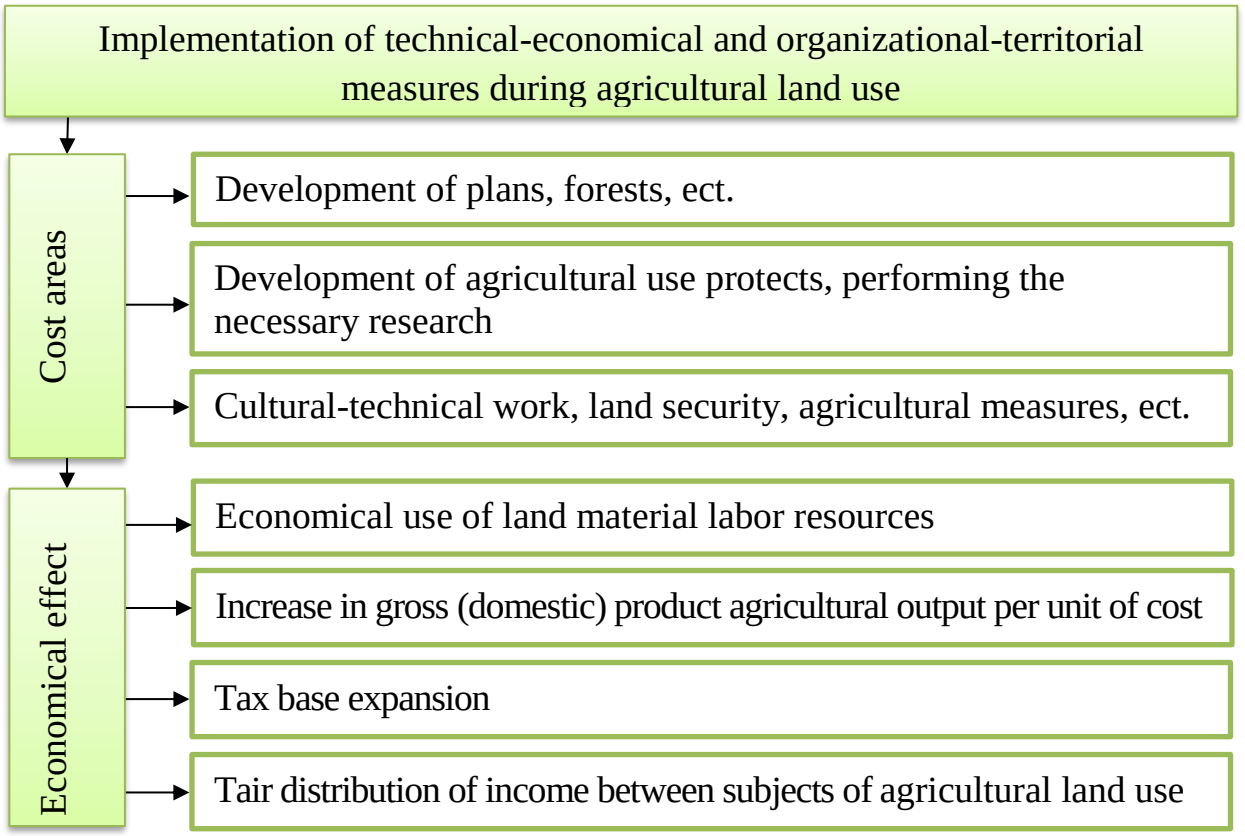
Economic efficiency shows the level of the implementation industrial relations in the field of agricultural activity. Land users to obtain and increase economic efficiency should receive more products from 1 ha of agricultural land at minimal cost.

So, according to N.P Kastornova and Y.V. Nuretdinova, «the economic efficiency of land use in agriculture should be understood as the level of the production on it, which is characterized by the quantity of products received per unit area» [6].

N.I. Ivanov notes that in the Russian Federation «economic efficiency is characterized by the creation of conditions for the inclusion of the resources in the economy of the country», the growth of land payments to the budget, the increase in gross domestic product, etc [5].

Fig. 2 shows the structural-logical diagram of the occurrence of the economic effect of agricultural land use, submitted by N.I. Ivanov.

Fig. 2. The structural and logical diagram of the emergence of agricultural land use economic effect.



In his opinion, the economic effect of agricultural land use can be achieved only in the following technical-economic and organizational–territorial measures:

- the state of agricultural lands has been studied, due to which lands that are used for the other purposes, are not put on cadastral records, violated, etc. will be revealed;
- involvement of all unused land ensured agricultural purposes in agricultural circulation;
- the borders of agricultural enterprises are streamlined with the aim of ensuring the stability of agricultural land use;
- land ordering, which will eliminate such the disadvantages of using land as a strip, wedging, etc., which in turn will increase the profit of agricultural enterprises;

- territorial zoning and natural-agricultural zoning in order to improve the structure of agricultural land;

- prevention of land degradation, ensuring their use by intended purpose.

According to V.L Anichina and A.S. Lutsikova, they see the economic effect of agricultural land use in the absolute result if agricultural activity, which expressed in the number of products produced and the change in condition lands [2].

I.V. Butko believes that the use of land resources, including agricultural land will become effective only if it makes it possible to combine «the economic interests of society as a whole, groups and individuals, solve social problems and avoid exceeding environmental restrictions» [4].

V.M. Trotsenko draws attention to the fact that in the process of determining the efficiency of agricultural land use must «take into account the need of people in certain volumes of production» [11].

The management system for sustainable agricultural land use requires the development of a methodology for determining the economic efficiency of such a system. It should be noted that many authors believe that determining the effectiveness of sustainable agricultural land use should be comprehensive and include such stages as:

- analysis of the main goals of land use;
- analysis of real estate cadastre;
- analysis of land relations;
- financial and economic analysis of land use;
- availability of an optimal land use structure;
- forecasting, modeling and optimization of land payments;
- development of recommendations and proposals to improve land use efficiency.

In our opinion, the determination of the economic efficiency of sustainable agricultural land management can be carried out in the following sequence:

1) analysis of agricultural land use conditions and identification of factors affecting the economic efficiency of agricultural land use;

2) definition of efficiency criteria, selection of indicators of economic efficiency of agricultural land use;

3) calculation of economic efficiency of agricultural land use;

4) agricultural land use planning.

Consider the methodology presented in stages and in more detail.

Analysis of agricultural land use conditions and identification of factors, affecting the economic efficiency of agricultural land use

The first stage of this methodology is necessary to identify problems that arise in agricultural land use. In addition, at this stage, factors affecting the efficiency of agricultural land use are identified. Based on the information collected, the main goals of agricultural land use should be determined and an assessment of the achievement of these goals should be made. In the process of the first stage, it’s necessary to identify compliance:

- actual use of the land by the type of permitted use;
- actual use of the land plot of the established category of land;
- actual use of the land by established restrictions and encumbrances;

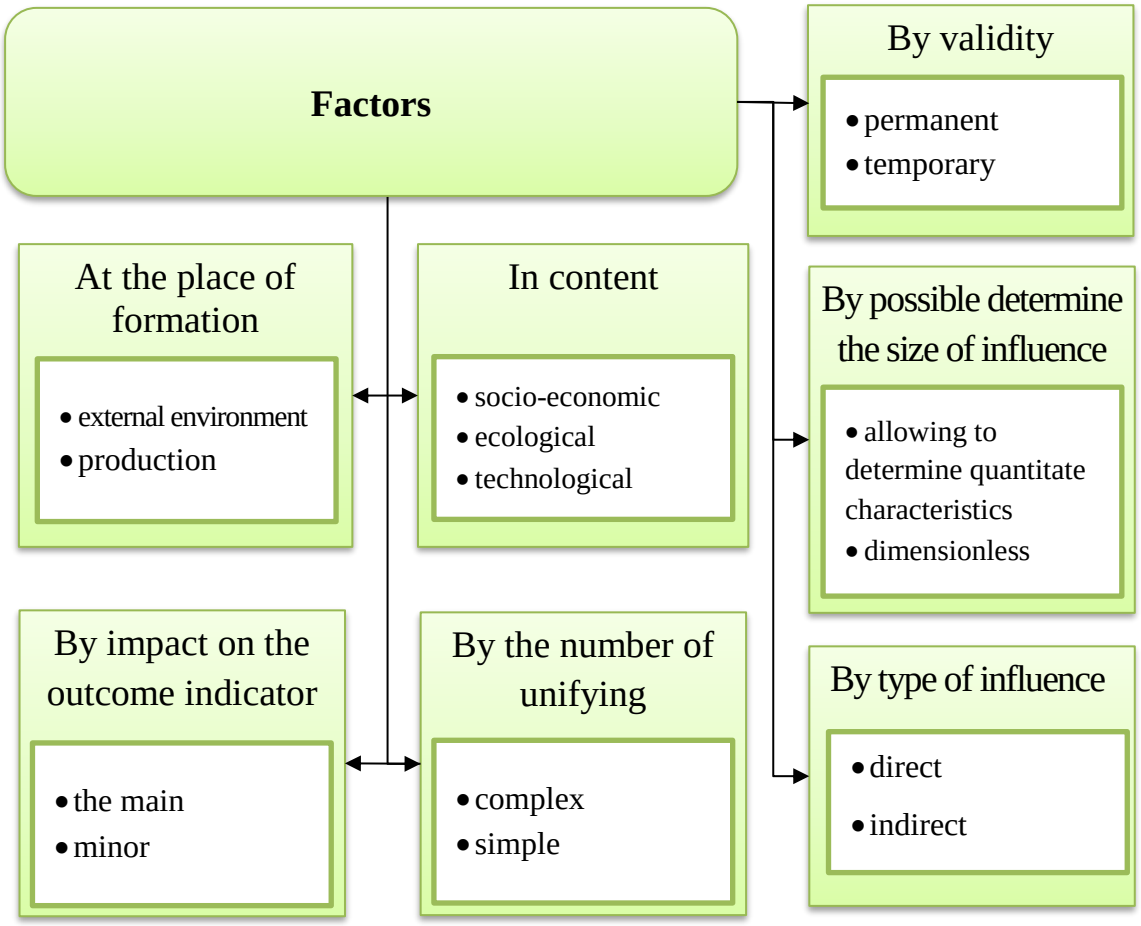
- type of real estate objects located on the plot;
- type of permitted use of the land plot.

In our opinion, sustainable land use is a combination of interrelated and interdependent factors ensuring the rational use of agricultural land.

Factors are divided by type of influence, if possible, determine the size of influence, by duration, by content, by place of formation, by place of formation, by the number of combining reasons and by the impact on the effective indicator. With the optimal use of all factors, it's possible to increase the efficiency of agricultural land use.

Fig. 3 shows the classification of factors affecting the efficiency of agricultural land use.

Fig. 3. Classification of the factors affecting agricultural land use efficiency.



Definition of performance criteria, selection of indicators of economic efficiency of agricultural land use.

Criteria characterize the qualitative side of agricultural production and land use, how well it's results correspond goals. Efficiency indicators in quantitative terms express the degree of the correspondence. In the words, «the criterion is a sign on the basis of which the efficiency assessment is carried out» [1].

The criteria for the efficient use of agricultural land should be considered from different perspectives:

- from a position of national economic interest, the criterion of use lands of this category to meet the needs of the population in agricultural products of Russian production;

- from a position of economic interests of agricultural producers, the criterion is to obtain the greatest possible profit per unit of capital, which was spent on production;
- from the standpoint of the economic interests of consumers, the criterion agricultural land efficiency includes improving the quality of agricultural products and lowering their prices.

In the case, we are talking about criteria for economic efficiency (economic criteria). But besides this, you need to consider production, technological, environmental and social criteria. The importance of a specific criterion depends on the conditions of the agricultural production, the level of its development.

As notes D.K. Levchenko, «the application of technological criteria, social and environmental efficiency allows to give an assessment of the forms land tenure and land use are comprehensive and divers» [7].

Consider the example when, as a criterion for the economic analysis of agricultural land use, a profit multiplier (lat. Multiplicator – multiplying) was adopted, which is determined by formula 1 [9].

$$Kprof = SP/P \quad (1),$$

where is Kprof – profitability multiplier (indicator);

SP – standard price of agricultural land (rub/hectar);

P – profitability obtained by production agricultural crops (rub/hectar).

Table 1 presents the standard price of agricultural land located in the Kanevsky district of the Krasnodar Territory.

Table 1

The standard price of agricultural land located in the Kanevsky district of the Krasnodar Territory

№	Chiper of agrogroup	Standard price, rub/hectar			
		Arable	Stone fruit	Pomegranate	Vineyards
1	205е	14003,41	85241,88	75475,65	66302,64
2	205еж	8462,83	56346,35	31665,21	47116,21
3	206е	17349,91	80278,43	75024,74	83454,52
4	207дж	12114,33	34462,93	37095,98	37021,64
5	207е	7423,02	21262,38	32481,31	0,00
6	209е	35648,18	99095,13	90856,13	90653,17
7	104д	7751,97	0,00	0,00	0,00
8	133е	17725,67	40874,97	34097,24	0,00

Table 2 presents the calculation of net income for grapes, grains and stone fruits (seeds) in the considered area.

Table 2

Definition of net income for 2014-2016 in the Kanevsky district of the Krasnodar Territory

Product names	Square, hectare			Net income, thousand rubles			Net income, rubles/hectare		
	2014	2015	2016	2014	2015	2016	2014	2015	2016

Grapes and wine material	632,0	690,0	712,0	16,3	21,8	2146,8	13648,4	19990,2	39918,8
Cereal	452,0	521,0	405,0	746,1	590,0	1259,0	1672,9	1129,7	2874,9
Stone fruit Pomegranate	261,0	289,0	266,0	6073,5	5653,4	3546,2	23418	19664,0	13449,2
Total	1348,0	1505,0	1386,0	6826,0	6286,0	686,01	38702,0	40574,0	55743,0

The multiplier of profitability is dimensionless and therefore it is possible to compare its absolute values, its calculation presented in table 3.

Table 3

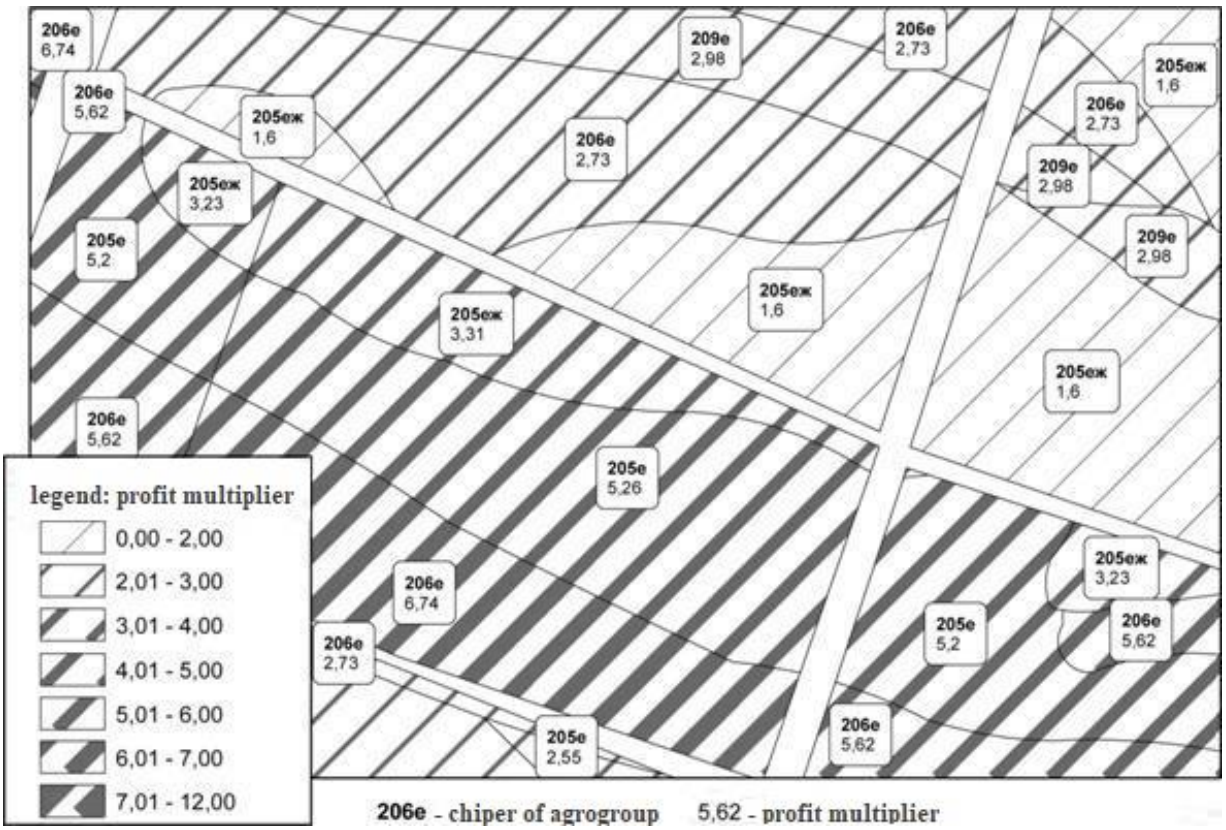
Multiplier profitability of operation of agricultural groups of soils in 2016

№	**Chiper of agrogroup**	**Multiplier**			
		Arable	**Stone fruit**	**Pomegranate**	**Vineyards**
1	205е	4,56	4,79	5,10	3,40
2	205еж	3,25	3,24	3,18	1,30
3	206е	5,63	5,00	6,02	3,31
4	207дж	4,14	3,34	3,24	1,00
5	207е	3,00	2,52	2,48	0,00
6	209е	11,00	7,27	7,17	3,21
7	104д	2,16	0,00	0,00	0,00
8	133е	6,23	3, 23	3,11	0,00

The smaller the multiplier value, the correspondingly higher the economic efficiency of the operation of each soil agro group for a specific functional purpose and vice versa.

Thus, the 209e, 209g, 205e give the maximum effect under vineyards; 207e, 133e – maximum effect under the gardens; 104d – effective as arable land under crops. The results of our calculations can also be displayed in Fig. 4 using the ArcGis software package.

Fig. 4. Cartogram of visualization of the distribution of the profit multiplier



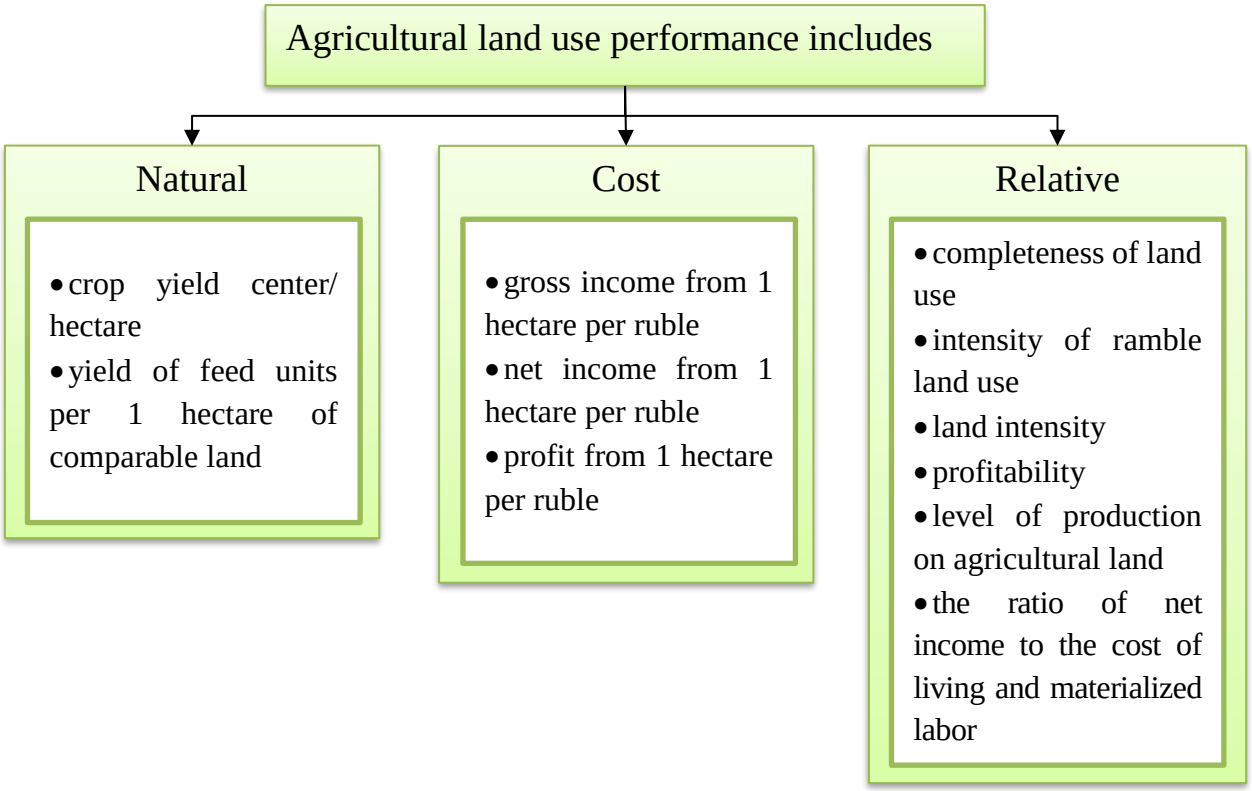
The obtained data can be used, for example, during reorganization or in case of expansion of the territory of agricultural land use.

The cost-effectiveness of sustainable agricultural land management should also be determined using various indicators. An indicator is a numerical characteristic of a property of an object, process or decision. The right choice of an indicator of efficiency is a prerequisite for making an operational and optimal managerial decision in the field if agricultural land use.

In the economic literature, attempts have repeatedly been made to find a general indicator (index), which would make it possible to simultaneously determine the economic efficiency of land use and the level of development of the economy as a whole. However, such indicators are very arbitrary. In other literature, specialists determined the economic efficiency of agricultural land use according to private indicators, such as gross and net income, profit per unit of land, gross output in monetary terms and other indicators. But as practice shows, it is advisable to determine economic efficiency according a system of indicators.

The system of indicators of the effectiveness of agricultural land use includes natural, value and relative, fig. 5.

Fig. 5. Indicators of agricultural land use efficiency



In a system of indicators that reflect the level of effectiveness agricultural land use includes the following groups:

cost indicators that include the result of agricultural production and agricultural output in value terms;

natural indicators, which include the volume of production products per unit area, etc;

relative indicators, which can, for example, include the share of agricultural land in the total area of land resources.

Table 4 presents the indicators of economic efficiency of sustainable land management, including revenue and expenditure.

Table 4

Indicators of economic efficiency of agricultural land use

Profitable part	**Costly part**
Coefficient of efficiency	Current expenses, rubles
Land value, rubles	Capital expenditures, rubles
Land tax and rental income, thousand rubles/hectares	The cost of depreciation of fixed assets, rubles
Gross regional product, thousand rubles/hectares	Land development costs, rubles
Strandard price of agricultural land, rubles	Production losses, rubles
Profitability of agricultural production, %	Speciefic weight of certain types of land cadastral works, %
Cost of agricultural products, rubles/hectares	Number of jobs, units
Gross regional product, thousand rubles/hectares	Investment project cost, rubles
Productivity, center/hectares	Working hours, hours
Production cost, rubles	Current expenses, rubles
Cost recovery, rubles/rubles	Wage, rubles

Coefficient of investment efficiency in agricultural land use, rubles	Material costs, rubles
Differential rental income from objects of agricultural land use, rubles	Investments and fixed assets, rubles
Net discounted income,	
Internal rate of return, rubles	

Calculation of the economic efficiency of agricultural land use

Various approaches can be used to determine the economic efficiency of agricultural land use. It is possible determine the coefficient of agricultural land use efficiency (C_{land}) through the ratio of the actual value of the effective indicator of agricultural production (P_{act}) to its estimated value (P_{est}) by the formula:

$$C_{land} = P_{act} / P_{est}, (2)$$

where is Pact – actual value of the effective indicator, rubles/hectares;

Pest – estimated value of the effective indicator, rubles/hectares;

Accordingly, the coefficient of efficiency greater than unity indicates the effectiveness of agricultural land management, and coefficient of efficiency less then unity indicates inefficiency.

Also, the economic efficiency of agricultural land use can be determined through land productivity and land intensity. Where land productivity is the ratio of the value of gross agricultural output to the value of land. It's determined by the formula (3):

$$L_{ret} = GP / Lv, (3)$$

Where is L_{ret} – land return;

GP – value of gross production of agricultural;

Lv – agricultural land value.

But land intensity, in turn, is an indicator opposite to land return. It's calculated by the following formula (4):

$$L_{cap} = Lv / GP, (4)$$

B.I. Smagin considers it rational to express economic the effectiveness of the agricultural land use in the volume of gross or commercial products of agricultural production per unit of land area and calculated by the formula (5) [10]:

$$E = GP (CP) / S, (5)$$

Where is E – economic efficiency of agricultural land use;

GP – value of gross agricultural production;

CP – value of commercial agricultural production;

S – square of agricultural land.

The next indicator of economic efficiency agricultural land use is gross and net income per unit of land. In this case, economic efficiency is determined by the formula (6):

$$E = GI (NI) / S, (6)$$

Where is E – economic efficiency of agricultural land use;

GI – gross income, which is determined by subtracting from the cost of gross output material costs;

NI – net income, which is the difference between the value and cost of gross output, or the difference between gross income and wages;

S – square of agricultural land.

In order to obtain an objective assessment of the effectiveness of use agricultural land in a certain territory, it is necessary to comprehensively consider these indicators. For this, developed an integral indicator of agricultural efficiency land use (Z), which is calculated by the formula (7):

$$Z = (\sum a_j * I_j) / m , (7)$$

Where is, I_j – j – value of agricultural land use efficiency;

a_j – weight coefficient, which determines the significance of a particular indicator;

m – number of indicator selected for assessment.

According to the calculation results, agricultural land use can be divided into 4 groups: with high efficiency of use; with sufficiently efficiency of use; with low efficiency of use and with inefficient use.

Agricultural land use planning

In Russia, the need for planned developments in all areas of the national economy has recently increased. This is especially true for land management. Planning increases the degree and accuracy of managerial decisions in the agricultural land use system.

The main objectives of agricultural land use planning are resource assessment and determination of organizational, economic, social and environmental measures necessary for the implementation of a particular land use opinion.

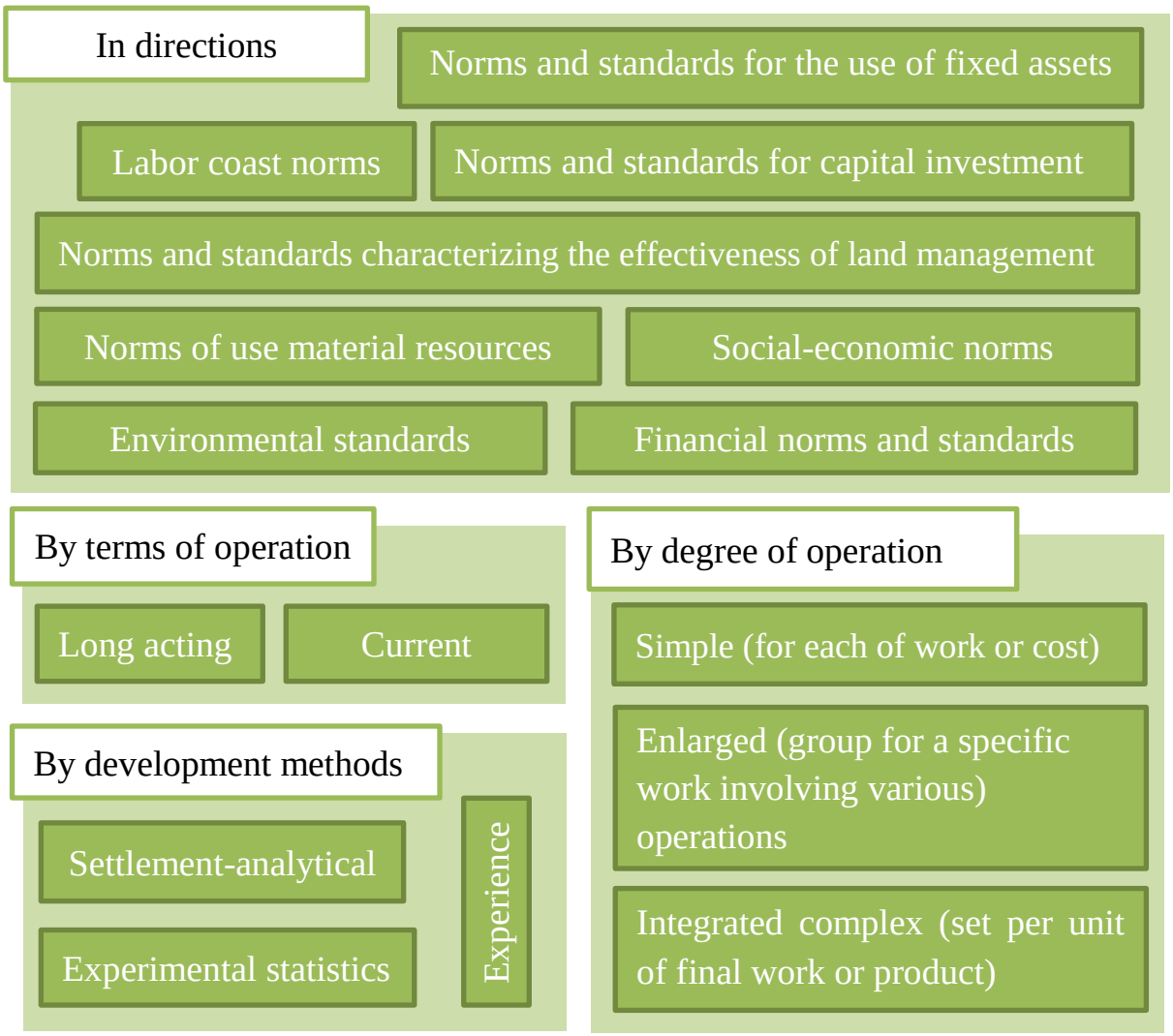
V.G. Bryzhko agricultural land use planning for agricultural development agricultural land use and «the determination of the means to achieve the predicted result of the rational use of agricultural land».

Various methods can be used to manage agricultural land use and determine economic efficiency. Planning methods are methods for preparing planned alternatives or one version of a plan for approval by a body of decision maker. Among the planning methods, you can use the following planning methods: regulatory; balance sheet, program-targed.

The normative method is one of the main planning methods in the land use system. It's essence lies in the feasibility study of planning documents using norms and standards that act as regulators. With the help of norms and standards, resource requirements, indicators of their use are calculated, the most important economic proportions are substantied. For planning agricultural production, the following types of norms and standard are used (Fig. 5):

1. the cost standards of material and technical resources;
2. norms of labor cost and wages;
3. output standards (there are no exact standards, but the normative ratios of different types of products by crops or animal species are used);
4. rates of natural loss of production;
5. personal consumption standards.

Fig. 5 Classifications of norms and standard



In conditions of economic instability, the role and importance of the normative method in planning use of land resources and real estate is increasing. Therefore, one of the most important tasks is to increase the requirements for the development of systems of norms and standards, and to improve it.

One of the most important planning methods is the balance method, implemented through a system of balances. Balances are divided into three main groups: material, value and labor.

Material balances are used to establish material proportions at different administrative and territorial levels and are developed in physical units (hectares, tons, meters, pieces, etc.). An example of material balance is land availability and distribution reports, table 5.

Table 5

The forecast land balance of the Lyubertsy district of the Moscow region for the furure

Land fund category	Actual situation		At the end of the planning period	
	hectares	%	hectares	%
Agricultural land	2118	14,6	2040	14,1
Settlements land	5364	37	5450	37,6
The lands of industry, power engineering, transport, communications, radio broadcasting, television,	1982	13,6	1986	13,7

information technology, land for space activities, land of defense, safety and land for other special purposes				
Land of specially protected areas and objects	12	0,01	12	0,01
Forest fund land	5005	34,5	5005	34,5
Water fund land	7	0,1	7	0,1
Stock land	22	0,2	10	0,07
Total	14510	100,00	14510	100,00

In value balances, all indicators of value are expressed in monetary form. An example of cost balances is any financial plan of an agricultural enterprise.

The book value method is used to calculate value added.

The calculation of value added (VA) makes it possible to evaluate the effect of agricultural land use and is produced by the formula (8):

$$VA = (GP – MC – DD) + (VE – VB) , (8)$$

Where is, GP – value of gross agricultural production;

MC – material cost;

DD – depreciation deductions;

VE – land value at the end of the year;

VB – land value at the beginning of the year;

Value added is distributed among participants in land relations, as a result of which the effect of agricultural land use for each of them (Figures 6, 7).

Fig. 6 The distribution of value added between participants in land relations when renting land

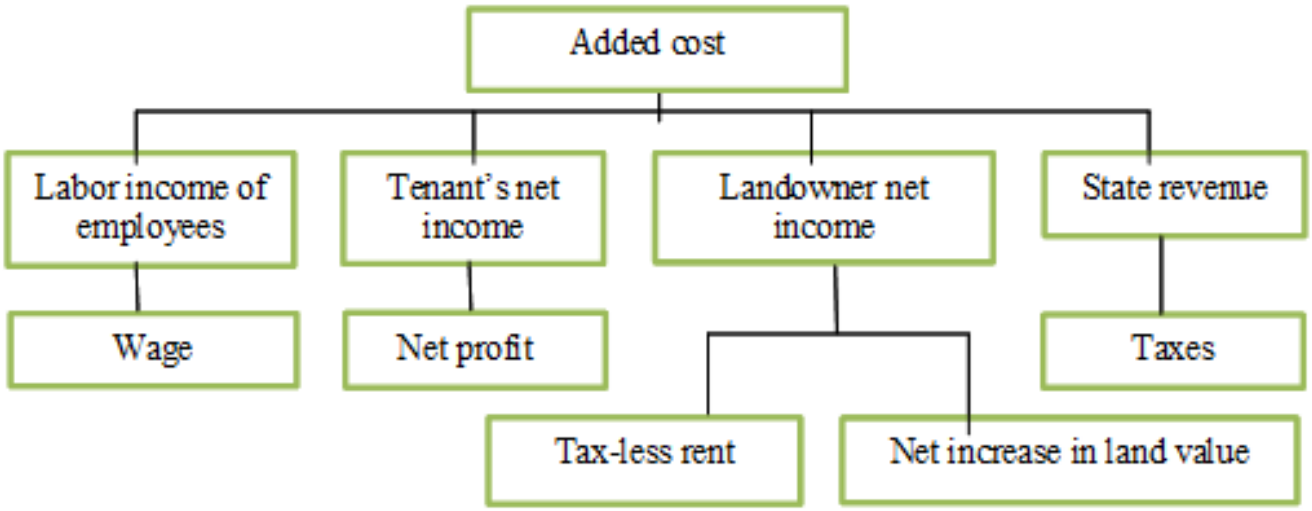
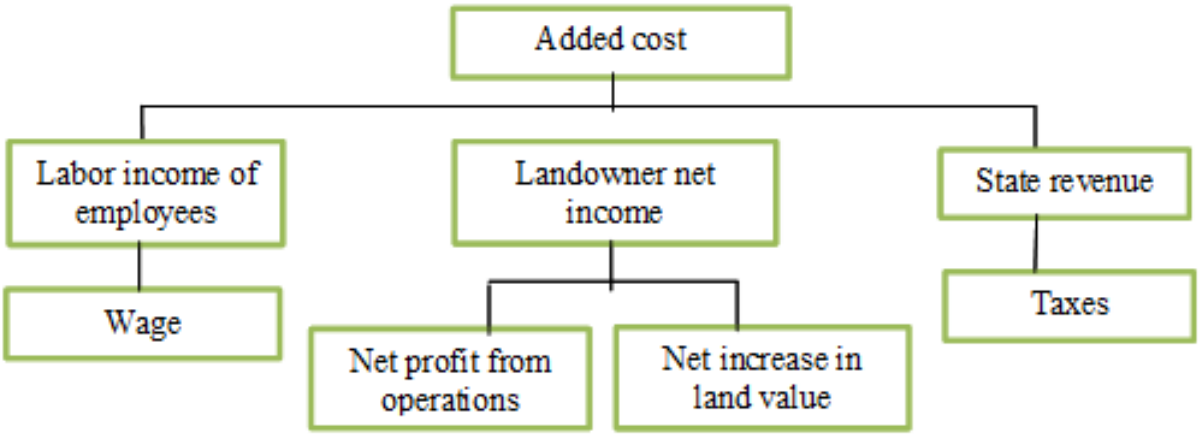


Fig. 7 Distribution of value added by land owner



The cash flow method can be used to assess the economic efficiency of agricultural land use in the reproduction of land resources, for example, in the process of liming acidic soils.

When applying the cash flow method, for example, such an indicator of economic efficiency as the «internal rate of return» is used, which will indicate the advisability of carrying out certain activities in the course of agricultural activity.

Labor balances represent a system of balances that reflects the process of reproduction of labor resources, reveals their presence, their need, composition, reserves at different administrative and territorial levels [8].

In the planning of agricultural land use, the following main balances are clearly distinguished: labor, material, energy, financial.

The disadvantages of the balance method include the high complexity of the collection and processing of source information.

The program-target method is used to develop targeted programs in the field of land and property relations and is based on the choice of the goal and the development of several options for interlinked economic and social development programs at various administrative and territorial levels. An example of the application of the program-target method for the development of agricultural land use at various administrative and territorial levels is the creation of federal target programs «Sustainable development of rural territories (2014-2020)».

In solving the problems of preparing optimal plans, that is, the best according to all criteria, you can use mathematical programming. Mathematical programming to determine the effectiveness of agricultural land use can solve the following problems:

- tasks on the optimal plan of agricultural production;
- transport tasks;
- tasks for the prospective development of agricultural land use.

We will solve the problem of the prospective development of agricultural land use in Klinsky district of the Moscow region. To begin with, a forecast of technical and economic indicators was made. Using three different methods: the coefficients of relative efficiency, the R. Meintoffel method and the graphical method, the most acceptable variant of the prospective

development of the Klinsky district was selected. Table 6 present the calculation of the coefficients of relative efficiency.

Table 6

Indicators of relative efficiency for maximizing criteria

Indicators	Maximum options		
	Gross output	profit	Profitability level
Gross output value	1000	0,674	0,890
Profit	0,026	1	0,986
Profitability level	0,027	1	1
Total indicator of relative efficiency	1,051	2,883	2,877

Next, we consider using the method of R. Meintoffel when comparing the indicators of the relative effectiveness of the optimal plans table 7.

Table 7

Indicators of the relative effectiveness of optimal plans, calculated by the method of R. Mantoiffel

Indicators	Difference between the smallest value and others values time series			Percentage differences to the greatest line differences		
	maximum			minimum		
	Gross output	profit	Profitability level	Gross output	profit	Profitability level
Gross output	708,60	15	0	100	2,12	0
Profit	0	665,60	663,80	0	100	99,72
Profitability level	0	12,95	12,95	0	100	100
Indicators of relative efficiency	-	-	-	100	202,10	199,72

The peculiarity of this method is to calculate the difference between the smallest value and the remaining values of the time series. In the future, the percentage of differences to the largest difference in the row is already calculated. By the maximum value is percent on an economic indicator, we choose the most optimal for us. In our example, we prefer maximum profitability and maximum profit.

The selected option for the prospective development of agricultural land use should be relatively stable over time.

Summing up, it should be noted that the scientific and practical tasks of rational agricultural land use should be solved on basis of:

- an integrated approach to the economic use of agricultural land;
- identifying sources of increasing the efficiency of the formation of agricultural land use;

- determination of the most effective organization and management of agricultural land use in a particular region or municipality for the best use of this particular combination of natural resources and conditions in their relationship an interdependence.

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