Proceedings of the 2021 International Scientific Conference 'Economic Sciences for Agribusiness and Rural Economy'
No 5, Warsaw, 24 May 2021, pp. 56–61

ISBN 978-83-8237-073-7
ISSN 2658-1930
eISSN 2658-1965

DOI: 10.22630/ESARE.2021.5.7

METHODOLOGY FOR ESTIMATION THE EFFICIENCY OF AGRICULTURAL LAND IN RUSSIAN FEDERATION

Stanislava Kontsevaya, PhD[1]; **Rolan Albornoz**, Full Professor[2];
Svetlana Kontsevaya, PhD[3]; **Luboš Smutka**, Full Professor[4]

ABSTRACT

Paper devoted estimation of the efficiency of agricultural land in the Russian Federation. Land is the main production factor in agriculture, hence it is important to know the effective usage of land. Land efficiency could be evaluated in different ways. In this paper, it was suggested to use as factors – feed units received from 1 ha arable land, amount of growing production in fair price in 1 ha, gross and net profit per 1 ha. Also, methodology suggested calculating potential yield and the potential cost of arable land, using a score of soil quality. The paper aims to suggest a methodology of economic efficiency. Case study base on agricultural company Kolos, Russia.

Key words: land assets, economic efficiency, ecological efficiency, criteria, methods, soil quality
JEL code: Q12

INTRODUCTION

The land is a main agricultural production facility and a primary spatial base for the production of material benefits. The specific features of the land which differ it from the other agricultural means of production are:

- land is utilised as an instrument of labour and an object of labour simultaneously;
- irreplaceability with other means of production;
- land is the basis of agriculture which intertwines the economic reproduction process and biological and natural ones;
- multiple usages of the same plot of land for making biological assets (plants) etc.

Lands, utilised in agriculture, are considered commercial ones and they comprise tilled fields, grasslands, hayfields, cattle run, lands for perennial plantings, lands for artificially impounded bodies in pond-fish farming (Alborov, Kontsevaya and Kontsevoy, 2020). The owners of these commercial lands get economic benefits represented by crops and for this reason, commercial lands may be considered land assets. These assets will bring sufficient benefits if they are used efficiently. Efficient land use is part of the country's food security (Ostaev et al., 2021).

[1] Corresponding author: Kamycka 129, Prague, Czech Republic, skonsevaya@pef.czu.cz, +420 224382076
[2] Corresponding author: Sverdlova 30, Izhevsk, Russia, ralborov@izhgsha.ru, +7 3412598617
[3] Corresponding author: Sverdlova 30, Izhevsk, Russia, skonsevaya @izhgsha.ru, +7 3412598617
[4] Corresponding author: Kamycka 129, Prague, Czech Republic, smutka@pef.czu.cz, +420 224382076

The efficiency of utilisation of land assets or agricultural lands depends on many factors but the main one of them is the establishment of appropriate land utilisation that comprises the creation of a local base for land cleanup, improvement of farming standards, and productivity of agricultural commercial lands, complete and reasonable utilisation of each type of commercial lands and rational arrangement of agricultural production.

Agricultural land estimation devoted plenty of research papers. Antropov and Komarov (2018) suggested to divide agricultural land into clusters according to economic efficiency. They suggested using factors as wheat harvest per 1 ha, amount of contracts for rent and sale, rent fee, and amount of tax. Svitin (2019) in his book argues that the main factor with influence land management is the level of technology, international conventions, and agreements, land policy inside the country. Lerman and Shagaida (2007) mention that Russia has a specific problem in the land market as high level of bureaucracy, corruption, and unclear procedures for land trading.

Wallace and Williamson (2007) mention that countries with developed markets create opportunities for commodification unrestrained by the volume of available land. The multiplication of land interests and layering of opportunities create the virtually unlimited potential for secondary and derivative markets.

Despite the common socialistic past of Russia and Poland, Poland has a significant important difference from Russia – the tradition of private ownership. Marks-Bielska (2013) mentions in the research that even under a command and quota system, private ownership was the dominant form of ownership. However, Poland has a similar problem with agricultural land to Russia. Despite the governmental effort and agricultural land protection, there is a huge loss of agricultural and forest land that is converted to other uses (Kurowska et al., 2020).

Sources of data for analysis could be the agricultural accounting statements of the farm (Kubascikova et al., 2019), internal documents, statistical data of soil fertility.

The paper aims to suggest a methodology of economic efficiency. Case study base on agricultural company Kolos, Russia.

MATERIALS AND METHODS

Efficiency extent of agricultural land utilisation depends on unconditional execution of all agrobiological and technologic procedures of manufacturing of the agricultural products on these lands, strict fulfilment of preliminary developed and introduced systems of crop rotation, fertilizers, active-adaptive technologies of cultivation of agricultural plants, gathering, transportation, storage and utilisation of obtained agricultural products.

To estimate agricultural land utilisation efficiency, an indicator framework is offered. Its indicators should be integral elements of land utilisation management in agriculture.

These indicators are reasonably subdivided into four groups in Table 1: (1) common indicators of land utilisation efficiency, (2) indicators of economic efficiency of land utilisation, (3) indicators of ecological efficiency of land utilisation, (4) indicators of crop production area utilisation (Bodrikova, Kontsevoy and Shlyapnikova, 2020, Knyazeva et al., 2020).

RESEARCH RESULTS AND DISCUSSION

The efficiency of utilisation of agricultural lands depends on the reclamation level of overall land area and plowed of commercial lands:

a) Reclamation level of overall land area by an agricultural company:

$$reclamation_j = \frac{land\ agricultural_j}{land\ total_j}, \quad (1)$$

where:

reclamation – coefficient of reclamation of overall land area (%),

land agricultural – an area of agricultural lands, i.e. arable land, pastures (ha),

land total – an overall area of lands belonging to the company (ha).

Table 1. Indicators of utilisation efficiency of agricultural lands

1. Common indicators of land utilisation efficiency	2. Indicators of economic efficiency of land utilisation	3. Indicators of ecological efficiency of land utilisation	4. Indicators of crop production area utilisation
1.1. Gross output by types of products (hwt) 1.2. Gross output by types per 100 ha of tilled field: (a) in hwt; (b) in RUB 1.3. Production measured by fair value or by transfer price per 100 ha of commercial land (RUB) 1.4. Productiveness of 1 ha of hay fields and cattle run (hwt) 1.5. Total productiveness, hwt of fodder unit from 1 ha of: (a) commercial land (b) tilled field	2.1. Gross output per 1 employee in crop farming: (a) in hwt; (b) in RUB 2.2. Production of specific kinds of products per 1 employee in crop farming (hwt) 2.3. Gross output estimated at transfer price per 1 person-hour (RUB) 2.4. Return on assets ratio – production is estimated at transfer price per average annual value of capital stock in crop farming (RUB) 2.5. Material productivity – production is estimated at transfer price per average annual value of the standard stock (RUB) 2.6. Land productivity (RUB) 2.7. Energy sustainability index per 1 ha of crop production area	3.1. Capital/output ratio – the opposite value of return on assets ratio (RUB) 3.2. Materials – output ratio – the opposite value of material productivity (RUB) 3.3. Labour intensity of production of specific types of products (person-hour) 3.4. Expenditure of specific types of material resources in physical units: (a) per 1 ha of crop production area; (b) per production 1 hwt of product 3.5. Total energy consumption per 1 ha of crop production area (thou. MJ) 3.6. Resource and energy consumption of fodder from 1 ha of fodder production area (thou. MJ) 3.7. Land consumption (RUB)	4.1. Profit margin from 1 unit of crop production area (RUB): (a) in commercial output production (b) in fodder production 4.2. Profit from 1 unit of crop production area (RUB): (a) in commercial output production; (b) in fodder production 4.3. Production costs per 1 ha of crop production area (RUB) 4.4. Crop yield of plants from 1 ha of crop production area (hwt) 4.5. Energy yield in the crop from 1 ha of crop production area (thou. MJ)

Source: own study.

b) Plowed level of agricultural commercial lands:

$$ploughness_j = \frac{land\ arable_j}{land\ agricultural_j}, \quad (2)$$

where:
ploughness – plowed level of agricultural commercial lands (%),
land arable – arable land for the cultivation of arable crops (ha),
land agricultural – an area of agricultural lands, i.e. arable land, pastures (ha).

c) Coefficient of the utilisation of tillable lands that is the extent of involvement of these lands into agriculture:

$$TU_j = \frac{land\ arable_j}{land\ tillable_j}, \quad (3)$$

where:
TU – coefficient of utilisation of tillable lands (%),
land arable – arable land for the cultivation of arable crops (ha),
land tillable – agricultural land, which can potentially be bearable.

To calculate such indicators as land productivity and land consumption, an agricultural company should define (establish) in-house (economic) price of a given type of agricultural land using a formula (Kontsevoy, 2016):

$$internal\ cost_j = (length \cdot feed\ unit \cdot oats\ price) + \\ + improvement, \quad (4)$$

where:
internal cost – in-house operation (economic) price of 1 ha of a given plot of land: tilled field, cattle run, grassland, hayfield (RUB),

length – suggested duration of the efficient (productive) period of the natural fertility of a given plot of land (tilled field, cattle run, grassland, hayfield) under the extensive condition of its utilisation (without fertilizer treatment, liming of soil, erosion-preventing activities, etc.) (years),

feed unit – output of all types of products (main, joint-cost, and secondary products) from 1 ha estimated in fodder units over 3–5 years averagely (hwt of fodder units),

oats price – market (sales) price of 1 hwt of oat in a farm unit over an accounting period (RUB),

improvement – total costs for recultivation (melioration) of soil estimated per 1 ha of a given plot of land (RUB).

Estimation of commercial land utilisation efficiency may be fulfilled by the integrated index of efficiency:

$$itegrated\ land\ use\ efficiency = \frac{harvest_j}{land_j}, \quad (5)$$

where:

integrated land-use efficiency – total amount of output (obtained) of crop farming products estimated by fair value (thou. RUB),

harvest – sum of all produced agricultural products of crop production at fair value (thou. RUB),

land – area of commercial land in a farming unit (ha).

The integrated index of efficiency should be analysed dynamically. As it is seen in Table 2 integrated indicator of the efficiency of commercial lands in a farming unit tends to decrease. Hence, management and leading specialists should pay much attention to the improvement of land utilisation, increase soil fertility with the introduction of adaptive landscape-specific agriculture.

One of the methods to increase land utilisation efficiency in agricultural companies (farming units) is including unused lands into agricultural activity, improvement of natural utilised lands, and increasing fertility.

Commercial land areas may be increased by recultivation of scrublands and transferring previously used lands to commercial ones. The other way to improve the utilisation of lands is improving the quality and fertility of soils of commercial lands including tilled fields.

Among the abovementioned indicators, field size should be highlighted especially as its shape influences the utilisation of modern agricultural equipment and tools.

The efficiency of tilled land utilisation and other commercial lands may be estimated by gross profit and net profit from 1 ha and total area:

$$gross\ profit\ per\ ha = \frac{\sum fair\ value_j - direct\ cost_j + general\ cost_j}{arable\ land_j}, \quad (6)$$

where:

gross profit per ha – gross profit from 1 ha of tilled field (RUB),

Σ*fair value* – the amount of fair value of totally obtained products (including secondary products) of all agricultural plants (thou. RUB),

direct cost – the number of direct costs (excluding salary budget) of plant production (RUB),

Table 2. Estimation of utilisation efficiency of agricultural lands on agricultural company Kolos, Russia in the period 2017–2019

Indicator	2017	2018	2019	2019 in % of 2017
Gross output of crop production estimated by fair value (thou. RUB)	125 568	92 758	95 956	74.4
Area of commercial land (ha)	5 728	5 728	5 728	100.0
Integrated indicator of efficiency (thou. RUB)	21.9	16.2	16.8	76.7

Source: own calculation.

general cost – the total amount of general production cost and general business cost of crop farming (RUB),
arable land – area of a given type of commercial land (ha).

$$net\ profit\ per\ ha = \frac{gross\ profit\ per\ ha_j - salary_j}{arable\ land_j}, \quad (7)$$

where:
net profit per ha – net profit from 1 ha of arable land (RUB),
salary – salary budget including social expenditures in crop farming (RUB),

The above-mentioned indicators may be calculated per 1 ha of the cultivated area of specific kinds and types of agricultural plants regarding water quality.

So, efficiency estimated by net profit from 1 ha of the cultivated area of grain crops may be calculated according to the following equation:

$$net\ profit\ land_j = BP \cdot B\left(FV - PC\right), \quad (8)$$

where:
net profit land – net profit from 1 ha of grain crop fields (RUB),
BP – the price of 1 score of soil quality of the given area of crop estimated by crop yield of grain crops (hwt),
B – quality score attributed to given cropland in an agricultural company (scores),
FV – fair value of 1 hwt of grain in farming unit,
PC – the prime cost of 1 hwt of grain in farming unit (RUB).

The efficiency of land utilisation in agricultural companies depends on many internal and external factors which are used for system analysis and results of this analysis help take scientifically based, reasonable, and prompt, and strategic decisions on land utilisation. Such factors as improvement of technical equipment and large-scale mechanisation of land processing, implementation of modern technologies of plant cultivation; introduction of fertility increasing activities; improvement of quality of production resources (machinery, seeds, fertilizers, etc.); rational utilisation of material and labour resources in crop farming; implementation of modern types of job arrangement and labour remuneration; observation of scientifically based systems of crop rotation and fertilizer treatment, etc. can be used for system analysis.

Estimation of land assets utilisation is recommended to fulfil in the agricultural company by comparison with leading companies and potential indicators should be established:

a) Crop yield of a plant from 1 ha (hwt):

$$potential\ yield_j = price_j \cdot score, \quad (9)$$

where:
potential yield – potential crop yield of a plant from 1 ha in a compared group of farming units,
price – the price of 1 score of estimation of soil quality by crop yield in leading (top) farming units (hwt),
score – average score of estimation of soil quality in a compared group of farming units.

b) Prime cost of 1 hwt of agricultural plant crop:

$$potential\ cost_j = PSQ_j \cdot score, \quad (10)$$

where
potential cost – the potential prime cost of 1 hwt of plant crop in a compared group of farming units (RUB),
PSQ – the price of 1 score of estimation of soil quality by production costs of 1 hwt of plant crop in the leading group of farming units (RUB),
score – average score of estimation of soil quality in a compared group of farming units.

c) Utilisation of capabilities of tilled field estimated by crop yield:

$$utilization = \frac{potential\ yield_j}{actual\ yield_j}, \quad (11)$$

where:

utilisation – level of utilisation of capabilities of tilled field estimated by crop yield from 1 ha in a compared group of farming units (%),

potential yield – potential crop yield from 1 ha (hwt),

actual yield – actual crop yield from 1 ha (hwt).

CONCLUSIONS

Practical application of the abovementioned indicators provides a high extent of objectivity, authenticity, and reliability of estimation and analysis of agricultural land utilisation efficiency in any agricultural company. Such estimation and analysis of land utilisation efficiency should be made to obtain relevant information in the system of land management and utilisation in agricultural companies.

This methodology can be used for management purposes in agricultural companies. It is easy to use and can be used in any agricultural company without additional training. The methodology was approbated on agricultural company Kolos, Russia.

Acknowledgements

The paper is a part of the internal research project 2021B0002 'The post-Soviet region in the context of international trade activities: opportunities and threats arising from cooperation', solved at the Department of Economics, Faculty of Economics and Management, Czech University of Life Sciences in Prague.

REFERENCES

1. Alborov, R., Kontsevaya, S., Kontsevoy, G. (2020). Assessment of productivity and profitability of land assets (lands), Management of the efficiency of land resources. In: Materials of the II National Scientific and Practical Conference on March 16, 2020. Izhevsk State Agricultural Academy Publishing House, Izhevsk, pp. 3-8.
2. Antropov, D., Komarov, S. (2018). Analysis of the effectiveness of land management in the region based on the application of the methodology of complex (cluster) zoning of territories (on the example of agricultural land). International Agricultural Journal Mezhdunarodnyy selskokhozyaystvennyy zhurnal, 5, pp. 16-19. https://doi.org/10.24411/2587-6740-2018-15069
3. Bodrikova, S., Kontsevoy, G., Shlyapnikova, A. (2020). Environmental efficiency of land assets in agriculture. Management of the efficiency of land resources. Materials of the II National Scientific and Practical Conference on March 16, 2020, Izhevsk State Agricultural Academy Pubfishing House, Izhevsk, pp. 79-83.
4. Knyazeva, O., Zobin, O., Antonov, E., Zakharova, P. (2020). Methodological aspects of assessing the social efficiency of the use of land assets. Management of the efficiency of land resources. In: Materials of the II National Scientific and Practical Conference on March 16, 2020. Izhevsk State Agricultural Academy Publishing House, pp. 161-166.
5. Kontsevoy, G. (2016). Razvitiye upravlencheskogo ucheta i kontrolya biologicheskikh i sovokupnykh zatrat v selskom khozyaystve [Development of management accounting and control of biological and total costs in agriculture]. Krasnodar [printed as manuscript].
6. Kubascikova, Z., Tumpach, M., Juhaszova, Z., Turebekova, B., Saparbayeva, S. (2019). Contextual Non-financial Information Analysis of Annual Reports. In: 16th Annual International Scientific Conference on European Financial Systems, pp. 334-344.
7. Kurowska, K., Kryszk, H., Marks-Bielska, R., Mika, M., Len, P. (2020). Conversion of agricultural and forest land to other purposes in the context of land protection: evidence from Polish experience. Land Use Policy, 95, 104614. https://doi.org/10.1016/j.landusepol.2020.104614
8. Lerman, Z., Shagaida, N. (2007). Land policies and agricultural land markets in Russia. Land Use Policy, 24 (1), pp. 14-23. https://doi.org/10.1016/j.landusepol.2006.02.001
9. Marks-Bielska, R. (2013). Factors Shaping the Agricultural Land Market in Poland. Land Use Policy, Elsevier, 30, pp. 791-799. https://doi.org/10.1016/j.landusepol.2012.06.003
10. Ostaev, G., Mukhina, I., Alexandrova, E., Belokurova, E., Titova, L. (2021). Development of a methodology for determining financial security of rural areas. Revista De La Universidad Del Zulia, 12 (32), pp. 70-86. https://doi.org/10.46925//rdluz.32.06
11. Svitin, V. (2019). Land administration. Vol. 1. Theoretical and methodological foundations [Upravleniye zemelnymi resursami. T. 1. Teoreticheskiye i metodologicheskiye osnovy]. Belorusskaya nauka, Minsk.
12. Wallace, J., Williamson, I. (2007). Building land markets. Land Use Policy, 23 (2), pp. 123-135. https://doi.org/10.1016/j.landusepol.2004.07.003