Resource Economy in Agriculture

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Abstract. Alternative resource-saving technologies used in agricultural production in small peasant farms and private smallholdings are considered in the article.

1. Introduction
Agricultural lands of Miratorg Agribusiness Holding in the Russian Federation cover over 600,000 hectares. In the country it takes the third place among the agricultural holdings. In the Bryansk region Miratorg Agribusiness Holding is the major agricultural producer. The agricultural firm possesses a great variety of energy-saturated tractors and wide-coverage tillage units. At the same time, intensive technologies with the required mineral fertilizers and agrochemicals are introduced to obtain high yields of the cultivated crops. This approach is economically feasible; however, some private producers are striving to obtain environmentally friendly farm products in the least resource-intensive manner. Small peasant farms and private smallholdings set the task to apply small-sized machinery and mounted implements. In this way they solve the problem of resource-saving in the crop production.

2. Materials and methods
Resource economy in agriculture implies the production of high-quality goods with minimal inputs of material, technical, financial and labour resources, providing rational use of natural resources, at that. The scientists assessed, in agriculture the annual loss of the fertile topsoil is about 26 milliard tons. About 10% of the world's arable lands are in Russia. However, according to agricultural census in 2016 about 40% of farmland in Russia is not used. It should be noted that in 2019 peasant farms and household plots accounted for about 42%. At the same time, the leading industry is crop production; the share of animal husbandry is about 45%.

In the Central Federal District, livestock farms account for 51%, while the farms producing crops make up 49%. As for the types of farms, corporate farms account for more than 50%, household plots are about 35%, and the share of peasant farms is 10%. In the peasant farms the grain production occupies about 30%, and potato growing is about 13%.

According to the scientists, the agro-climatic potential in Russia is significantly lower than that, for instance, in the United States and Germany.

Domestic agriculture is characterized by high energy intensity, infeasible matching of technical, technological and energy resources, and high natural energy consumption.

The researches by the scientists and practitioners prove that resource-saving agriculture involves reducing the number of soil treatments, preserving crop residues, following scientifically substantiated
crop rotations, and providing farmers with optimal variants of running their households that minimize the risk of economic losses. In addition, it is efficient to replace single-operation machinery with multifunctional ones for high adaptation to probable conditions of crop cultivation by rapid working bodies replacement. It is worth mentioning that the traditional technology of crop cultivation includes 15-16 operations, while the minimum technology is about 11-13 operations, and the number of operations does not exceed 10 with no-till farming.

Currently, the digital transformation is said to become the trend in the development of agriculture. For instance, the adoption of the module "Agro-solutions" will significantly improve labour productivity. Creating the resource "Land of Knowledge" is aimed at forming digital competencies among agricultural producers. Modern precision agriculture technology implies the use of global positioning system (GPS), geographic information system (GIS), yield monitor technologies, remote sensing, etc. GIS is used for mapping lands, climatic and hydrological conditions, agrochemical data, plant conditions, etc. Recently, CNH Industrial has developed the NH Drive system, which allows robotizing practically any tractor, combine or other agricultural machinery to make them work offline 24 hours a day. A farmer can control the operation of such a machine using a personal computer, a tablet or a smartphone with the corresponding software installed. In addition, precision agriculture has also been enabled by unmanned aerial vehicles.

At present, there are about 1 175 thousand hectares of arable lands in the Bryansk region. There are 700 agricultural producers and 250 thousand private smallholdings. Over the past 3 years there has been an increase in agricultural production. The Bryansk region is among Russia's TOP-5 in grain yields. The peasant farms and private smallholdings show high results. An effective work on resource-saving is carried out in crop production. However, the agricultural machinery is updated mainly due to the foreign ones. The organizational and economic mechanism of resource-saving, as a system of interrelated measures, is aimed at increasing the efficiency of use and stimulating the saving of material and technical resources.

The first way to solve the problem is to use mini tractors. However, mini tractors of Chinese and Belarusian production are not reliable in operation; new mini tractors of Japanese production are expensive. Motor cultivators of any production are too labour-consuming and, therefore, not very profitable. Thus, the most optimal solution is to purchase Japanese machinery after 10 years of service. The machinery of the famous Japanese company "Toyota", Kubota mini tractors, in particular, is the most preferable since there is no shortage of their spare parts asale. As for the mounted implements, the most energy-saving one is a milling cutter, in contrast to traditional ploughs [1-9], due to their additional tractive resistance and poor soil mixing when tilling.

3. Results
The Japanese milling cutter is repairable (figure 1, on the left; figure 3). It improves the tractor's drawbar horsepower, and well turns and mixes the soil. It prevents the tractor's slipping; and, moreover, the cutter enables the tractor to move on when it is into a skid. Therefore, it is recommended to apply a Kubota mini tractor with a milling cutter of Japanese production, since it does not only cut, but also turns the soil.

To consider the problem of resource-saving in a comprehensive way, it is advisable along with the tractors equipped with a milling cutter to apply a whole series of machinery of the same production: tractors with mounted implements, mowing machines with a hopper filler (figure 1, in the centre), and a combine harvester (figure 1, on the right). The application of the tractors of the same production company makes it possible to cut down expenses on spare parts due to their compatibility (figure 2).
Figure 1. Kubota mini tractors with a milling cutter and a hopper filler; a combine harvester.

Figure 2. Kubota mini tractor with trailer.
These tractors' fuel consumption per unit of arable lands is much less than the consumption of energy-saturated tractors. The repair mostly with the change of bearings and stuffing boxes of the cutter (figure 3) is rather cheap. If consider the prices for the plough and the cutter, and their repair, they are also at least two times lower.

![Figure 3. The cutter disassembling when repairing.](image)

The system of covering winter rye and wheat seeds fall is tested. It is carried out immediately after harvesting. The depth of seeding of winter crops ranges from 2 to 7 cm and depends on the structure of the soil and its humidity. This method should be widely used, since currently no combine can harvest the grain without loss. Significant saving in seed material and repeated tillage considerably reduce the cost of production and lessen the wear of equipment [10]. It is rational to appropriately treat the soil on the second-fourth day after harvesting; in this case the grain yield is much higher as compared to the traditional sowing.

4. Discussion

When restricted to self-seeding, the number of weeds increases many times and, at the same time, a smaller grain is formed, since the ear can get fewer nutrients from the untreated soil. The deep plowing at 20-23 cm can result in waste of fuel and root system growing into a greater depth, not in the surface soil layer being more fertile, thus leading to worse nutrition of the plant and to an increase in infestation of crops.

It should be noted that the grain sown by such an unconventional method undergoes natural selection, since the best-filled grain falls from the ear to the soil surface.

When applying this method the infestation of grain crops may be higher than with the traditional sowing; however, such crops can be used for green fertilizer (sideration) or as green fodder. The hay can be dried up to 40% faster and used for domestic animals as fodder and later for litter. The manure with such litter can be used as a fertilizer after composting. In this case the fertilizer contains 30% less weeds than after green manuring.
5. Conclusion

Resource economy implies the optimal inputs of material and technical, financial and labour resources. The organizational and economic mechanism of resource-saving is a kind of interrelated measures aimed at increasing the efficiency of use and stimulating saving of the resources.

Food security and environment protection, improvement of the standard of living by raising the income of peasant farms and private smallholdings are the main objectives of a sustainable farming system in the country.

The experience has proved that the recommended alternative method with pre-sowing treatment and self-seeding at that allows obtaining 2-3 times higher yields in comparison with the traditional sowing of winter crops; it results in less infestation than after winter rye and wheat sowing.

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