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THE OPTIMIZATION MODEL OF ORGANIC PRODUCTION IN AGRICULTURAL ENTERPRISES

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The analysis of the factors that affect the organic production efficiency are considered in the article. The optimization model of organic production in agricultural enterprises is done. It will increase organic production efficiency, provide the rational use of resource potential and maximize profit for agricultural enterprises. The volume of organic production will be increased.

Keywords*: optimization model, organic production, agricultural enterprises, productive efficiency.*

Introduction. Ukrainian organic farming has now reached a territory of 393 thousand hectares [10]. With the volumes of organic production still relatively low for such a big country as Ukraine, local organic farmers already produce most of the popular crops for the domestic market as well as for exports [12]. However, the economic efficiency of organic production isn't very high. Largely it depends on the balance of two complex areas − crop and livestock production. The current production structure in most agricultural enterprises doesn't correspond the rational use of resource potential. Therefore, there is a need to optimize organic production in such enterprises.

Analysis of recent researches and publications. The state of the organic production in Ukraine is analyzed by V. Artysh [2], O. Dudar [6], O. Kornitska [13], P. Skrypchuk, G. Shpak [14]. The problem of efficiency in agriculture is shown in scientific publications of V. Andriichik [1], G. Bryk [4], O. Berezivska [3] etc. Economic efficiency of agricultural enterprises in the system of organic farming is investigated by J. Jansky, I. Zivelova, P. Novak [9]. They describe problems, dedicated to satisfaction of increasing demand for organic food and make comparison of profitability of organic and conventional products.

Previously unsettled problem constituent. However, the factors that affect the organic production efficiency aren't well established. They play an important role in increasing of organic production profitability.

Main purpose of the article is to study main factors that affect the organic production efficiency and to find ways to increase it.

Results and discussions. Organic agriculture produces products using methods that preserve the environment and avoid most synthetic materials, such as pesticides and antibiotics [8]. The philosophy of organic food production maintains certain principles: biodiversity, ecological balance, sustainability, natural plant fertilization, natural pest management, and soil integrity. Since farms vary in product and practice, there is also a wide variety in how these principles are applied [11]. Organic agricultural enterprises receive annual onsite inspections and have to separate organic food from non-organic if they produce both.

Organic agricultural enterprises:

– preserve natural resources and biodiversity;

– use only approved materials;

– support animal health and welfare;

– do not use genetically modified ingredients.

Organic production efficiency depends on complex of natural, technological, social, organizational and economic factors. Natural factors include landscape, climate, soil and biological processes. Technological factors in crop production include cropping pattern, crop rotation system, tillage systems; in livestock − cattle feeding system, animal records keeping system. Social factors include high wages in organic farming, special education and ecological awareness.

Organizational and economic factors play special role in organic farming. Organic production efficiency depends on such economic factors, as saving resources, pricing and market formation. Organic farming systems rely on the management of soil organic matter to enhance. Organic farming generally falls within the accepted definition of sustainable agriculture. However, it is important to distinguish between the two, since organic products can be (unsustainably) produced on large industrial farms, and farms that are not certified organic can produce food using methods that will sustain the farm's productivity for generations. Some organic dairy farms, for example, raise cows in large confinement facilities but are able to meet the bare minimum requirements for organic certification, while a non-organic certified small farm could use organic guidelines and be self-sufficient by recycling all the farm's waste to meet its fertility needs [11].

One of the most significant ways to increase organic production efficiency is to build an optimization model which can show the best way to maximize profit [4]. The optimal combination of organic livestock and crop production will provide such development of production, at which inputs, land, labor and others resources could be

used most effectively. It helps to maximize the number of products with limited resources, to achieve the maximum possible economic efficiency increase by reducing costs conditions of scarce resources.

We investigated Two Ukrainian agricultural enterprises − Private Enterprise «Galeks-Agro» and Ltd. «Agrowest Group». The main focus of this companies is the production of organic certified livestock and crop production, the development of the organic market in Ukraine. From 2011 to 2013 the crop production had been certified the Swiss certification body Institute for Marketecology (IMO). According to the Standard Equivalent to Council Regulation (EC) 834/2007 and Commission Regulation (EC) 889/2008 products of company are approved by Bio Swiss additionally.

Specialization of Private Enterprise «Galeks-Agro» and Ltd. «Agrowest Group» is production of cereals and leguminous plants (seed, food and forage crops). Basic grown culture are spelt, wheat, millet, rye, oats, barley, buckwheat, maize, soybeans etc. Specialization of livestock is breeding of Simmental cattle for meat and dairy.

We suggest to build a mathematical model for these enterprises. The task is to optimize the structure under seed, food and forage crops, and to optimize the herd structure in two agricultural enterprises − Private Enterprise «Galeks-Agro» and Ltd. «Agrowest Group».

Development of optimization model is phased in a particular order [5, 7]:

1) problem statement and justification optimality criterion;

2) variables and constraints determination;

3) information collection and development of technical and economic factors and constants;

4) construction of a mathematical model;

5) economic analysis of different options.

Optimality criterion in our case is profit maximization.

$$Z = \sum_{j=1}^{n} c_j x_j \rightarrow max \quad (1)$$

where Z − objective function to be maximized; j − number of crop, livestock industry; i − number of resource or limitation; x_j − unknowns (crops area, number of livestock); c_j− gross output in money terms.

Let's first consider the mathematical model built for Private Enterprise «Galeks-Agro» (table 1). It contains 39 unknowns and 60 limitations. The main unknowns are area of agricultural crops and livestock animals by species, subsidiary − the total amount of material expenses. Production limitations include compliance rotation; production of commodity and forage crops; land resources.

Table 1. **Actual and optimized figures of organic production in Private Enterprise «Galeks-Agro»** (developed by the author)

Unknowns	Measure	Actual data, 2014	Optimal plan
Winter wheat area	ha	425	451
Spelt area	ha	1300	1300
Spring barley area	ha	264	350
Winter barley area	ha	45	40
Rye area	ha	176	113
Oat area	ha	161	150
Bean area	ha	500	450
Buckwheat area	ha	206	200
Millet area	ha	329	300
Soybean area	ha	52	45
Corn area	ha	84	110
Corn silage area	ha	220	180
Area under oat for grains	ha	280	250
Area under oat for hay	ha	506	500
Area under perennial grasses for haylage	ha	380	400
Green forage area	ha	80	137
Clover area	ha	618	650
Number of livestock	heads	1868	2046
Profitability of production	%	122,17	140,57

We made an economic analysis that shows the best way to maximize profit. Number of livestock has to be increased to 2046 heads. Area under winter wheat, spring barley, corn, perennial grasses for haylage, green forage and clover has to be increased. Area under winter barley, rye, oat, bean, buckwheat, millet, soybean, corn silage, oat for grains and for hay has to be reduced. It will increase profitability of production up to 140,57%.

Let's consider the mathematical model built for Ltd. «Agrowest Group» (table 2). It contains 32 unknowns and 56 limitations.

In Ltd. «Agrowest Group» the number of livestock has to be increased to 1398 heads. Area under spelt, winter barley, rye, soybean, oat for grains, perennial grasses for haylage and clover has to be increased. Area under winter wheat, spring wheat, spring barley, oat, bean, corn, corn silage and perennial grasses for hay has to be reduced. It will increase profitability of production up to 26,75%.

Calculations will promote rational combination of all sectors and sub-sectors in agricultural enterprises and thus ensure profitability growth. Savings in production costs creates additional opportunities for agricultural enterprises towards increasing competitiveness and therefore increasing financial and economic performance.

Table 2. **Actual and optimized figures of organic production in Ltd. «Agrowest Group»** (developed by the author)

Unknowns	Measure	Actual data, 2014	Optimal plan
Winter wheat area	ha	113	96
Spelt area	ha	150	170
Spring wheat area	ha	92	87
Spring barley area	ha	239	221
Winter barley area	ha	67	80
Rye area	ha	130	149
Oat area	ha	168	150
Bean area	ha	168	150
Soybean area	ha	14	20
Corn area	ha	350	316
Corn silage area	ha	90	81
Area under oat for grains	ha	260	289
Area under perennial grasses for hay	ha	30	27
Area under perennial grasses for haylage	ha	350	387
Clover area	ha	263	285
Number of livestock	heads	1372	1398
Profitability of production	%	22,92	26,75

Conclusions and further researches directions. We have analyzed that the use of economic and mathematical methods for agricultural enterprises allows redistribution of existing production resources in the most profitable industry. It makes possible to increase profitability of organic production. Using the optimization models for individual agricultural enterprises provides not only profitability maximization, but also helps to achieve additional environmental and economic effect − soil fertility renewal and preservation.

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МОДЕЛЬ ОПТИМІЗАЦІЇ ВИРОБНИЦТВА ОРГАНІЧНОЇ ПРОДУКЦІЇ У СІЛЬСЬКОГОСПОДАРСЬКИХ ПІДПРИЄМСТВАХ

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У статті проведено аналіз факторів, що впливають на ефективність виробництва органічної продукції. Побудовано модель оптимізації структури виробництва органічної продукції рослинництва та тваринництва у сільськогосподарських підприємствах, що сприятиме підвищенню ефективності їх виробництва. Це забезпечить раціональне використання ресурсного потенціалу сільськогосподарських підприємств, збільшення обсягів виробництва органічної продукції та максимізацію прибутку.

***Ключові слова**: модель оптимізації, виробництво органічної продукції, сільськогосподарські підприємства, ефективність виробництва.*

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МОДЕЛЬ ОПТИМИЗАЦИИ ПРОИЗВОДСТВА ОРГАНИЧЕСКОЙ ПРОДУКЦИИ В СЕЛЬСКОХОЗЯЙСТВЕННЫХ ПРЕДПРИЯТИЯХ

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В статье проведён анализ факторов, которые влияют на эффективность производства органической продукции. Построена модель оптимизации структуры производства органической продукции растениеводства и животноводства в сельскохозяйственных предприятиях, что будет способствовать повышению эффективности их производства. Это обеспечит рациональное использование ресурсного потенциала сельскохозяйственных предприятий, увеличение объёмов производства органической продукции и максимизации прибыли.

***Ключевые слова**: модель оптимизации, производство органической продукции, сельскохозяйственные предприятия, эффективность производства.*