ASERS

Journal of Environmental Management and Tourism

Biannually
Volume VIII
Issue 5(21)
Fall 2017
ISSN 2068 – 7729
Journal DOI
http://dx.doi.org/10.14505/jemt

ASERS Publishing

Fall 2017
Volume VIII
Issue 5(21)

Contents:

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http://www.asers.eu/asers-publishing
ISSN 2068 – 7729
Journal DOI: http://dx.doi.org/10.14505/jemt

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DOI : http://dx.doi.org/10.14505/jemt.v8.5(21).13

Organizational and Economic Mechanism of Fertilizer Application Technology Management as a Basis for Region's Progressive Development

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Suggested Citation:

Bondarenko, A.M., Lipkovich, E.I., Kachanova, L.S., Glechikova, N.A., Seregin, A.A. (2017). Organizational and Economic Mechanism of Fertilizer Application Technology Management as a Basis for Region's Progressive Development. *Journal of Environmental Management and Tourism*, (Volume VIII, Fall), 5(21): 1092-1100. DOI:10.14505/jemt.v8.5(21).13

Article's History:

Received September 2017; *Revised* September 2017; *Accepted* October 2017.

Abstract:

Relevance of the present paper stems from the necessity of harmonious interrelation between economy and society with due regard to economy branches' development and compliance with environment protection policy. The goal of the research is the formation of Organizational and economic mechanism of organic fertilizers' production and application technological processes management in the agricultural sector with grounding of strategic and tactic aspects. The main method of the problem resolution is represented with analysis and specification of theoretical provisions linked to technological processes' management. We have developed methodology for formation of organizational and economic mechanism of fertilizer application. As a result, the elements of the mechanism, which include resource and product model, multicriterion model for choosing production and fertilizer application technologies, model for planning of additional income from the application, have been differentiated by tactic and strategic management levels. Their implementation will provide an increase in the gross yield of basic crops and their cultivation profitability, which is the basis for progressive development of region.

Keywords: organizational and economic mechanism; management; technological processes; organic waste; resource saving; organic fertilizers.

JEL Classification: P40 ; Q10 ; Q13.

Introduction

Progressive development of a region involves a harmonious interrelation between economy and society under sustainable development of economy branches while complying with environment protection policy and increasing living standards of population. We consider the provision of worthy standard and quality of living is impossible without production of solid food commodities in volumes meeting population's demands. The specified task is being priority for agricultural sector of any country, including its basic branches, particularly, plant cultivation and cattle breeding, and should provide an increase in the crop yield and live- and poultry stock.

It is known that growth of live- and poultry stock is related to an increase in the volumes of organic waste that requires conversion using modern technologies, which should be environment-friendly on the one hand, and relatively inexpensive and providing using the convertibles in closed production cycle, on the other hand.

Both of these aspects of agricultural production branches' intensification should be considered interrelated as far as wastes of one branch represent raw material for another. Organic livestock wastes are the valuable material for production of organic fertilizers applied in plant cultivation. However, of definite importance is the organizational and economic aspect of interrelation between technological processes of cattle breeding and crop growing within the framework of implementation of production technologies and application of organic fertilizers that can involve both - agricultural enterprises and entities of other branches. These tasks can be performed either by one, or by several organizations, which implies there can be various levels of process management.

In article works which consider the organizational and economic mechanism of management of technological processes of use of fertilizers that is a basis of forward development of the region were studied. One of the main documents is the state standard specification 3.1109-82 interstate standard. This document establishes the terms applied in science, technique and production and definitions of the basic concepts in the field of technological processes which consists in targeted actions for change and definition of a condition of an object of the labor (GOST).

1. Literature review

Economic, organizational, technical transformations are necessary for development of the region. Use of new technologies and technique leads to effective management and development of the enterprise that influences results of work and body height of business economics, regions, the countries.

In such works as Sapogova it was investigated technical and technological modernization of fixed assets in agriculture which problem is development of the modern technologies, creation of conditions for large-scale introduction in agricultural production of hi-tech complexes of cars and an inventory; development of investment activity of the enterprises and agrarian and industrial complex organizations (Sapogova 2011).

The mechanism of management of technological processes provides complete organizational and economic approach. In the conditions of the composite period of a transitional economy there were problems of rational use of natural, production, financial, labor, raw material and other resources of the organizations that is bound to the amplifying influence of backbone economic and communicative factors in regional development.

Knowledge of theoretical bases, substances and contents of technological processes and systems in agrarian economy, branch features and regularities of technological development, the organizational and economic mechanism of management allows not only to be guided easier in the composite economic environment, but also to form efficient technological systems (Sapogov 2011).

Many scientists studied questions, the bound to management of technological processes. Among them methodological questions were considered J. Heyg, R. Akoff, A.N. Engelgard, J. Martino, V.V. Dick, F. Kotler, A. Marshall, *et al*. Problems of a substance of technological systems, their formations and development are investigated in V. V. Miloserdov's works, A.A. Nikonov, A.I. Altukhov, S.Yu. Glazyev, S.A. Zhdanov, A.N. Kashtanov, *et al*. Effectiveness of agrarian production was studied by V. F. Bashmachnikova, A.P. Zinchenko, E.N.

Krylatykh, I.G. Ushacheva, N.M. Morozova, A.A. Mindrina, *et al*. Professor V. Z. Mazloyev in the works defines a substance of the organizational and economic mechanism as set of the interdependent economic levers and methods of impact on production, exchange, distribution and consumption of products (Mazloev 2005).

According to professor N. R. Kurkina, the organizational and economic mechanism connects the economic and organizational elements reflecting economic interests and organizational structure of economic entities in a process of manufacture, exchange, distribution and consumption.

In works of Alley and Vanlauwe questions of a role of fertilizers in integrated management of nutrients of plants are considered. They consider that integration of organic and inorganic sources of nutrients has to be considered also in the context of the common production of crops which includes the choice of grades of crops, pest control, effective use of water and other aspects of the integrated management of farms (Alley and Vanlauwe 2009).

2. Materials and Methods

During the work aimed at a detailed study of matters of organizational and economic mechanism of fertilizer application technology management as a basis for region's progressive development various methods and materials were used. Theoretical and methodological basis of the research is represented with results of scientific and practical studies by national and foreign authors in the area of organization, economic and technological processes' management.

In our opinion, one should consider the methodology of formation of organizational and economic mechanism of fertilizer production and application technology management an aggregate of methods, models developed on their basis and means of their realization with determination of main organizational principles, economic efficiency criteria and management tasks aimed at selecting optimal management impacts and elaboration of forecasting scenarios for technological processes' development.

The main task of logical sequence in elaboration of methodological grounds for formation of organizational and economic mechanism of fertilizer production and application technology management includes studying of methods and means and choosing optimal ones of them for obtaining new knowledge in the form of forecasting variants of development.

The methodology for creation of organizational and economic mechanism of fertilizer production and application technology management can be realized in three directions:

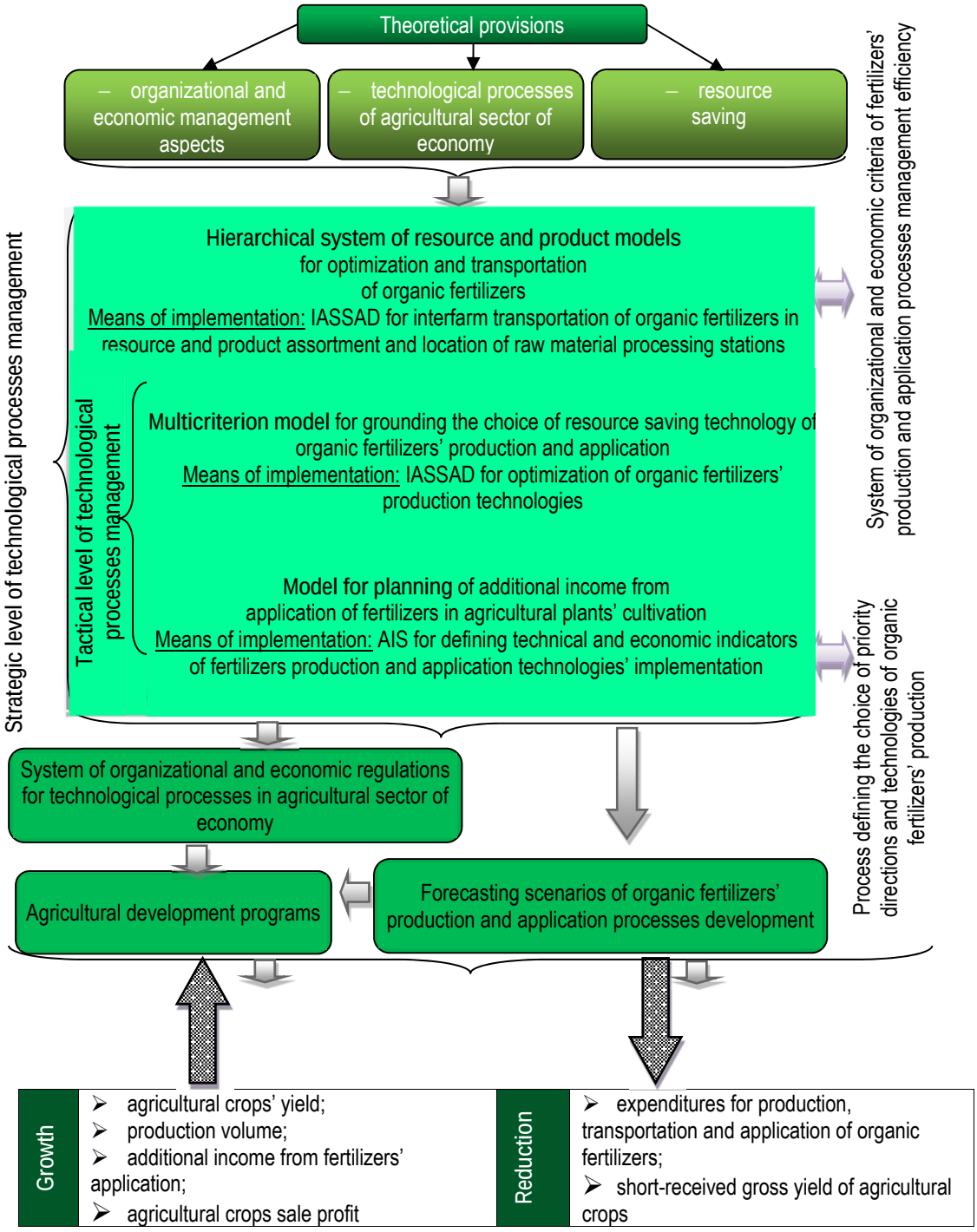
- development of a multistage system of management of resource and product models for enterprise optimization and transportation of organic fertilizers with raw material processing stations management;
- formation of a multicriterion model for grounding the choice of fertilizers' production and application technologies;
- grounding of a model for planning additional income from fertilizer application in agricultural plants' cultivation.

Thus, with the account of aggregate of all the directions of suggested methodology realization we have defined strategic and tactic levels of technological processes' management. The tactic level is defined within agricultural organization (Figure 1).

Within the framework *of the first direction* we determine available resources for implementation of technological processes in terms of production and application of mineral and organic fertilizers. The resources in the present case are considered organic waste taken from cattle breeding and plant growing branches intended for processing, primarily, the manure of livestock and poultry enterprises being basic raw material for organic fertilizers' production, and also such materials as straw, cuttings, biologically active supplements, etc. Besides, in the context of this aspect we consider labor resources and basic facilities (process compartments for production capacities arrangement, raw materials and end products storage, technical means and technological equipment).

The closed cycle of organic fertilizers' production process management realized in the hierarchical system of resource and product models provides optimization of interfarm, intercluster, interregional and interzonal expenditures for transportation of organic wastes and fertilizers.

Figure 1. Organizational and economic mechanism of organic fertilizers' production and application technological processes in the agricultural sector of economy



The hierarchical principle implies application of the system of models at different levels of territorial and zonal division, *i.e.* the elaborated models are being equally effective at both - the level of separate agricultural enterprises and the level of country's regions.

At the same time, the principle of closed cycle of organic fertilizers' production process management is closely related to the hierarchical principle, as far as, on the one hand, it implies basing of subsequent levels' research results on calculations and groundings of previous levels, and, on the other hand, the higher levels of the hierarchy are being generators of management decisions subject to fulfillment at lower levels.

The management task of the first direction in the methodology elaboration is the equalization of level of fertilizers' provision of agricultural areas for the purpose of increase and recovery of soil fertility under conditions of observing ecological safety during manure utilization.

Formation *of the second direction* in elaboration of organic fertilizers' production and application process management methodology resolves in choosing technology of organic fertilizers' production. On the basis of calculated information obtained from the first direction we choose the most promising technologies and processes of fertilizers' production by the criterion of operational costs minimization and maximization of profit from organic fertilizers' application.

The instruments of the present direction of fertilizers' production and application process management methodology are represented with:

- multicriterion model for grounding the choice of fertilizers' production and application technologies;
- IASSAD for optimization of organic fertilizers production technologies (certificate of state registration of PC program No. 2015612873, the Russian Federation).

The management tasks of this direction are optimization of machine-tractor park of subject of research for realization of technological processes pertained to chosen organic fertilizers' production and application technology. The choice of resource saving technology of organic fertilizers' production and application promotes safety manure utilization and increase of cattle breeding and plant cultivation branches' profitability.

For the cases of using multicriterion model for grounding the choice of fertilizers' production and application technologies and IASSAD for optimization of organic fertilizers production technologies at a particular enterprise we have chosen a rational resource saving technology of organic waste processing, formed resource base for its implementation (equipment, labour resources, raw materials, etc.). The choice has been performed based on two criteria: the minimum expenses for implementation of the technology and the maximum profit from the sale of organic fertilizers produced by means of chosen resource saving technology.

The third direction of methodology elaboration consists in determining of organic fertilizers production prospects and combined application of mineral and organic fertilizers. The instruments here are represented with the model of planning of additional income from fertilizers' application in crops cultivation with block-type arrangement of information and the automated information system (AIS) for defining technical and economic indicators of fertilizers production and application technologies' implementation (certificates of state registration of PC program No. 2013660442 and 2014611846, the Russian Federation).

The management tasks of this direction are the increase of cattle breeding and plant cultivation branches' profitability, as the result of application of rational fertilization system and increase of soil fertility. At the same time rational utilization of fertilizers reduces soil disturbance and its pollution with chemical means.

The model for planning of additional income from fertilizers' application in cultivation of agricultural plants is optimized by the criterion providing maximum additional earnings from sale of crops paid for fertilizers. The AIS for defining technical and economic indicators of fertilizers production and application technologies' adoption deals with analysis and assessment of several crop cultivation technologies by the following criteria: plant cultivation products' net cost, net sales income profit and production profitability.

3. Results and Discussion

To create theoretical foundation in the modern context of organizational and economic development and management in agricultural sector we should form aspects of implementation and approaches to technological processes' management and reveal their economic nature. It should be noticed the general definition of technological process is stated in GOST 3.1109-82 that says "technological process is a part of production process containing actions focused on change and (or) defining of labour subject state" (GOST 3.1109-82 2012, 98).

Mazloev V.Z., Sapogova G.V consider that technological process comprises a basis of any production process and is being its most important part related to gradual change of production subject state, most often - with processing of raw material and its converting into end product (Mazloev *et al.* 2010, 241).

In such a way, we consider technological processes of organic fertilizers production an aggregate of technological operations on processing of organic waste as alternative source of resource saving for the purpose of obtaining of brand new product - the organic fertilizers implemented within the framework of unified technology with the use of technical means, labour and other resources.

Technological processes of organic fertilizers' application should be considered an ordered set of operations on preparation, transportation and application of fertilizers to soil for increase of its fertility and agricultural crop yield, as well as actions on the sale of organic fertilizers for getting additional income by agricultural organization.

Technological processes' management is considered by authors a goal-oriented action on implementation, stabilization and/or improvement of technological processes system for reaching a planned result.

On the assumption of the suggested definition we can point out the following key elements as part of technological processes' management:

- accumulation, processing, storing and transfer of information about system of technological processes;
- elaboration of management decisions on implementation, stabilization and/or improvement of the processes;
- formation of managerial influence for performance by management subject;
- analysis, assessment and control of results of management decisions performance.

The goal of technological processes' management in agricultural sector is the adaptation of technologies to dynamically changing factors of external and internal environment for increase of cattle breeding and plant cultivation branches' profitability by means of resource saving technologies application.

There are various definitions of "organizational and economic mechanism", however authors of the research agree with Russian scientists asserting the organizational and economic mechanism of management can be elaborated just in case one knows theoretical foundations, regularities of technological development, peculiarities of formation of technological processes within the framework of a branch and a region (Krylatykh *et al.* 2015, 238).

Professor Mazloev V.Z. defines the nature of organizational and economic mechanism as an aggregate of interrelated economic levers and methods of influence on production, exchange, distribution and consumption of products (Mazloev 2005, 37-40).

At the same time in the opinion of professor Kurkina N.R. the mechanism combines economic and organizational elements reflecting economic interests and organizational structure of economic entities within the process of production, exchange, distribution and consumption (Kurkina 2012, 18-31).

When studying management of technological processes under conditions of resource saving and defining key elements of organizational and economic mechanism, we state a term of organizational and economic mechanism of resource saving management.

Organizational and economic mechanism of resource saving management (OEMRSM) is a complex of interrelated organizational, economic and management procedures aimed at the increase of effectiveness of application and actualization of material and technical resources' saving, resource saving technologies implementation, and also production of agricultural products with minimum expenses in monetary and volume terms.

The OEMRSM includes:

- system of usage accounting indicators, consumption analysis and determination of main trends in development of technological processes in agricultural sector;
- study of advanced national and foreign experience in OEMRSM;
- improvement of methods of economic appraisal of resource saving equipment, technologies and ways of production and economic grounding of application of cattle breeding and plant cultivation wastes;
- methods of planning and forecasting of resource saving at various management levels;
- financial and credit affairs on resource saving stimulation;
- improvement of pricing policy in agribusiness industry aimed at saving of material and technical resources;

- interfarm self-supporting relationships on resource saving;
- managerial measures on resource use;
- systems of economic standards regulating resource saving.

The most appropriate measures on economic stimulation and feasible elements of economic mechanism are introduced on the basis of economic efficiency calculations for agricultural, processing and servicing enterprises of country and the volume of annual economic effect or losses for them (Bannikova *et al.* 2015, 344-353; Prokhorova *et al.* 2016, 159-164).

The calculations are performed by two criteria: the increment in profit or reduction of production prime cost under minimization of consumption of resources, which are appraised in natural and monetary terms or by total expenses for energy (*i.e*. by converting of all used resources to energy equivalent). OEMRSM is implemented at four levels: federal, regional, municipal and the level of separate agricultural entity (Kapitonov *et al.* 2017).

Thus, on the assumption of conducted researches we can conclude that technological process is oriented at economic nature of management, which is expressed in two aspects: the reduction in expenditures for agricultural goods production on the one hand, and increase of profitability from the sale of these goods on the other hand (Savkin 2014, 142-144; Zakharova *et al.* 2015, 1-7).

The main recommendations within the framework of the first aspect (reduction in expenditures) are: application of innovative resource saving technologies for realization of technological processes; activation of practical use of closed cycle mechanism - when wastes of one branch are being a raw material for another branch; application of new high yielders of agricultural plants and high-productive breeds of farm animals; the use of new improved equipment for technologies implementation.

The basis of resource saving agricultural policy is comprised of the application of low-waste or zero-waste technological processes performed with use of modern technologies and technical means providing complex processing of raw material (manure) with getting of high quality end product (organic fertilizers), which increases profitability of plant cultivation branch, significantly reduces harmful environmental impact and improves ecological situation in areas of cattle breeding enterprises' location (Tatarkina *et al*. 2008, 98; Chereshneva and Tatarkina 2015, 1040).

The second aspect is comprised of development and application of set of agricultural goods production economic efficiency indicators. Effectiveness of production process is the economic category that reflects a wide complex of conditions linked to functioning of production powers and production relations that in the aggregate provide expanded reproduction, the content of which can be represented by capital cycle stages (monetary – the creation of production conditions, productive – the production of goods, marketable – the sale of products). Each of these stages has its functional area and goal, the degree of reaching of which defines effectiveness of each stage and agricultural production in general (Nechaev *et al.* 2009, 46-54; Alley and Vanlauwe 2009, 61).

The interaction in realization of above-mentioned elements allows us to form organizational and economic mechanism of organic fertilizers production and application management comprised of systems of various levels (Figure 1).

Implementation of considered directions at strategic and tactic levels of organizational and economic mechanism of organic fertilizers production and application management is as follows.

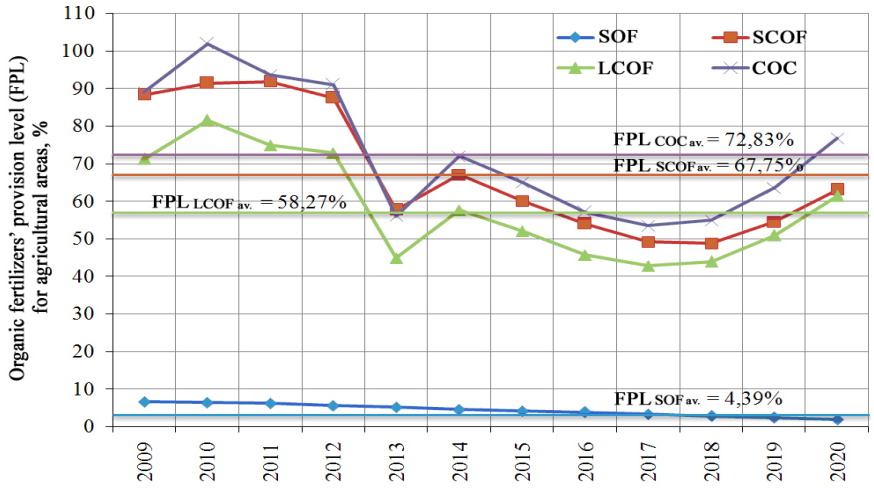
The strategic level of organizational and economic mechanism of organic fertilizers production and application management provides their implementation through the interaction of an aggregate of agricultural enterprises. Implementation of technological processes and organic fertilizers production technologies provides adoption of managerial decisions on the increase of organic fertilizers provision, fitting out with technical means and other resources, transportation of fertilizers and organic wastes for their processing. The specified managerial decisions are adopted within the framework of performance of integration processes related to consolidation of agricultural organizations for the purpose of formation of developed production infrastructure and provision of the enterprises with organic fertilizers (Figure 1).

The tactic level of implementation of organizational and economic mechanism of process management implies provision of particular agricultural entity with the necessary amount of mineral and organic fertilizers.

The presented elements of organizational and economic mechanism of management provide increase of organic fertilizers provision level (FPL) with the use of various types of organic fertilizers, which is the background for growth of agricultural plant cultivation profitability. As a part of the study we have calculated the FPL for the period of 2009-2015 and made a forecast of dynamics of FPL changes in 2016-2020. The forecast was made using the method of extrapolation of trends' lines with calculation of averaged FPL value in considered time interval (Figure 2). The FPL for agricultural areas with application of solid organic fertilizers (SOF) makes at average 4,39%, for liquid concentrated organic fertilizers (LCOF) – 58,27%, for solid concentrated organic fertilizers (SCOF) – 67,75%, for concentrated organic compost (COC) – 72,83%.

The implementation of technological processes of concentrated organic compost production from organic wastes, which are widely available at agricultural organizations of the Rostov region, is the most promising. In case of full processing of organic wastes into COC the level of organic fertilizers' provision by 2020 will make 76,64%, which will provide profit in the amount of 10 924 mln. rbs. bulk yield of crops will make 11 718 mln. roubles, short-received bulk yield – 1 357 mln. roubles, while profitability of crops cultivation will make 64% (at the present time it is 30-35%). It should be noticed that expenses for production and transportation of full volume of concentrated organic compost makes 794,73 mln. rbs., which denotes effectiveness of implementation of main elements of organizational and economic mechanism of organic fertilizers application process management.

Figure 2. The level of organic fertilizers' provision of agricultural areas according to analytical data of 2009-2015 and forecast data for 2016-2020 (by the example of the Rostov region)



Conclusions

On the basis of conducted researches we have formed a complex of models and automated means of their realization that provides grounding of location of organic wastes processing stations, calculating expenses for realization of processing technologies and defining income from crop cultivation with application of produced organic fertilizers based on the system of organizational and economic efficiency criteria and the management process of choosing priority directions and technologies of organic fertilizers production. An aggregate of the suggested models allowed us to develop the system of organizational and economic regulation of technological processes in the agricultural sector of economy, implementation of measures within which will promote increase of profitability, creation of conditions for effective use of land, water and other renewable natural resources, as well as increase of soil fertility to optimal level.

Growth of above-listed economic criteria of effective implementation of technological processes is sustained with elaborated forecasting scenarios of organic fertilizers production and application processes development that denote the increase of gross yield of main agricultural crops and profitability of their cultivation being the basis for region's progressive development. The elaborated organizational and economic mechanism can be applied in

countries with developed cattle breeding under conditions of low organic fertilizer provision of agricultural lands with account of requirements of modern policy of resource saving and ecological safety.

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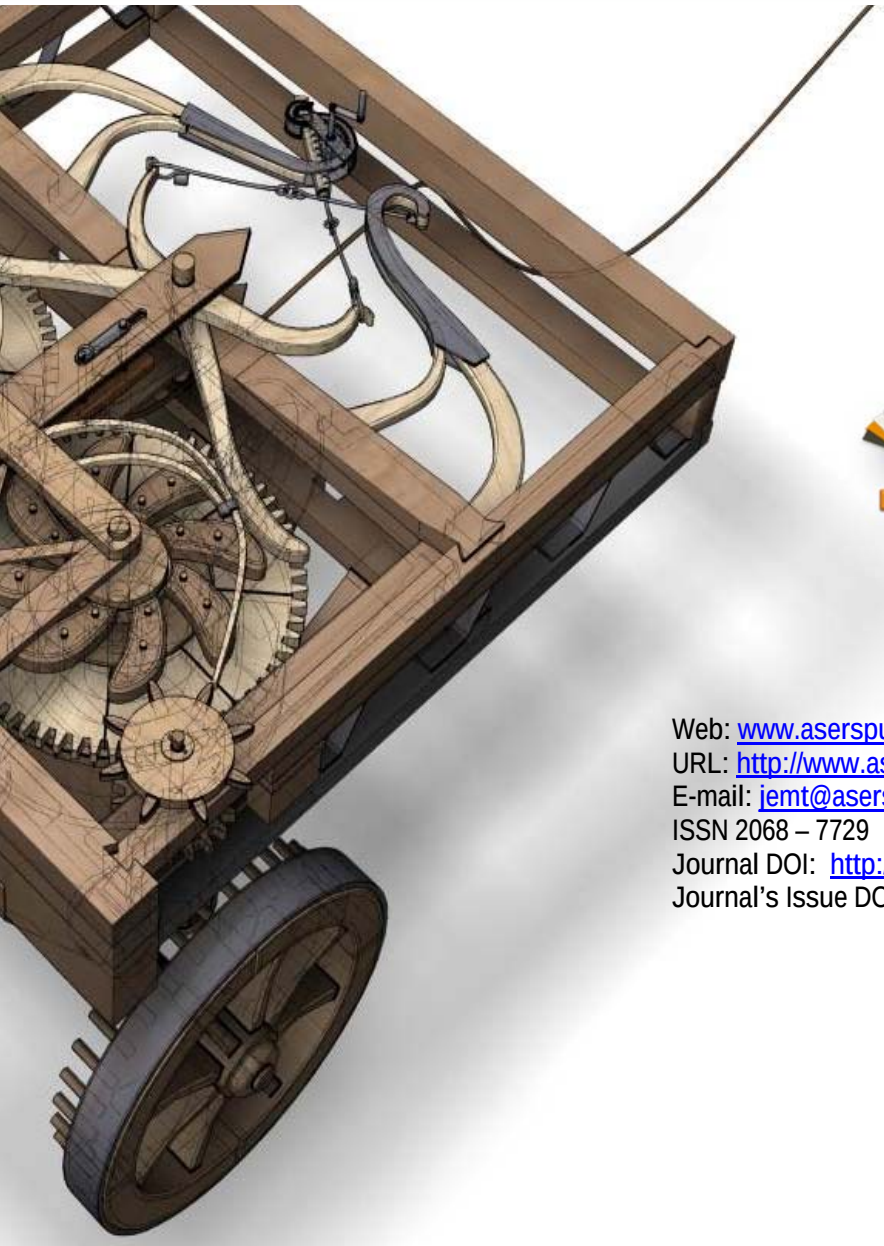

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