Efficiency Estimation Criteria of Agro-Industrial Systems in Post-Industrial Economy

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Abstract

The article reveals theoretical, methodological approaches to the selection of efficiency estimation criteria of agro-industrial systems under the conditions of post-industrial economy. Based on the provisions of system-based analysis and mechanism specialties and results of the agro-industrial production results under scientific and technological progress, the authors base primary efficiency estimation criteria selection provisions of agro-industrial systems. It has been proven, that efficiency estimation criteria of agro-industrial systems have to be developed based on such development principles as dynamics, probability, adaptability, manageability etc. The article determines and reveals basic and specific types of activities of major elements of agro-industrial systems (agriculture, stock farming, storage, processing, transportation and distribution). The article estimates the agro-industrial activity results under the conditions of postindustrial economy and particularities of their calculation. According to the authors, such results can be considered functional, economic, innovative-informational, social and ecological among others. Based on this the article studies methodological approaches to the selection of efficiency estimation criteria of agro-industrial production. This system of criteria includes basic and specific criteria, enabling to estimate its functional, economic, innovative-informational, social and ecological results.

Keywords: efficiency, criteria, agro-industrial systems, system-function analysis, functional efficiency, economic efficiency, innovative-information efficiency, social efficiency, ecological efficiency

1. Introduction

Up until this day the issues of efficiency estimation criteria of agro-industrial systems under the conditions of post-industrial economy have not been independently and deeply researched. Moreover there is no conclusive answer to the question what the modern agro-industrial systems efficiency is. Agribusiness system in terms of "complicating" the external economic relations can become a serious tool for Russia to develop the economy mills, as agro-system - the actual direction to diversify the economy monoterritory Russia (Kryukova et al., 2013; Kryukova et al., 2013; Kryukova et al., 2015).

There are several methodological approaches for estimating the efficiency of agro-industrial systems.

One group of authors view this category as performance of agro-industrial systems. Another points out the complexity of the category underlining the fact that it embraces various stages of production, various components as a whole and in particular. The third group of authors doesn't use the term "agro-industrial systems efficiency" independently but restricts itself to assessing the economic efficiency of agricultural production (Boev, 1990).

Some authors think that agro-industrial systems efficiency should be defined based on the level of achievement of set goals, where total interests from these goals should exceed total expenditures. Some economists have a one-sided view of efficiency stating that it is estimated only in physical units or units of currency.

The major part of researchers use indices that describe the economic efficiency of agricultural production in order to assets the efficiency of agro-industrial systems. The most important of these indices are: output of main agriculture and stock farming produce in physical units, gross yield, marketable output in units of currency calculated for 100 ha, for one man-hour or one employee; labor costs on production of main groups of agricultural produce, cost of production, rate of return. At the same time it is easy to notice that such an

efficiency estimation of agro-industrial systems concept based on the aforementioned indices is limited to assessment of economic efficiency of agricultural production (Curtzev, 1986).

The Russian research institute of agriculture proposed in the last 25 years the method of comprehensive efficiency assessment of agro-industrial systems which was based on three criteria: production and technological efficiency, production and economic efficiency and social-economic efficiency. (Radcliff-Braun, 2001) This method allowed to take into account not only economic efficiency but also the influence of innovative processes and their impact on development efficiency of agro-industrial systems (Hawken, 1999).

A variety of authors based the formation of comprehensive efficiency estimation criteria of agro-industrial systems on the project-based approach, which is founded on system-based methodology.

It is obvious that under the condition of agro-industrial systems in postindustrial economy, characterized by the usage of innovative technologies in agriculture, processing, transportation, storage and distribution of agricultural goods, assessment of efficiency of agro-industrial systems based on goal-achievement criteria and economic efficiency is no longer compatible with the demands of the contemporary world (Altukhov, 2010; Economika Regiona, 2008; Zaycev, 2012).

The goal of this article is to develop theoretical and methodological provisions of selection of efficiency estimation criteria of agro-industrial systems.

2. Methodology

The foundation of methodology for substantiating the efficiency criteria of agro-industrial production is in systems-functional analysis which was developed in the works of G. Spencer (Kon, 1979; Durkheim, 1938; Malinovskiy, 2005; Radcliff-Brown, 2001; Merton, 2006). The systems-functional analysis allows to take into account specialties and particularities of agro-industrial production under the conditions of post-industrial market economy. The systems-functional analysis reveals cooperation results between single elements of agro-industrial systems (production, processing, transportation, storage, distribution of agricultural produce), but also to determine their mutual impact and actual results of their interaction within agro-industrial systems (Savina & Stepanov, 2013).

Based on the goals of the research the authors used systems-function analysis methods (scenario method, collective ideas generation method, Delphi method). The Objectives Tree method was extensively used, which helped determine and specify goals, results and effects of modern agro-industrial systems functioning (Project Management Institute, 2000).

During the usage of the aforementioned methods of analysis, selection of agro-industrial systems efficiency criteria we considered the particularities of agricultural production and related industries. It was presumed that such particularities are determined by the need to implement quality efficiency assessment of agro-industrial systems and that significant difficulties brought about by agro-climatic, biological, economic and social processes make it more difficult to make conclusive qualitative estimates.

The development of hypothesis of comprehensive efficiency estimation criteria formation of agro-industrial systems demands solving of the three following objectives: specification of essence and scope of "agro-industrial systems efficiency" and substantiation of methodology of selection of efficiency estimation criteria of agro-industrial systems.

Meeting of these objectives based on the systems-function analysis was made in three main stages:

Stage I. Specification of contemporary agro-industrial systems models, their industry composition and particularities of technological, organizational and social-economic mechanisms;

Stage II. Development of the term "agro-industrial systems efficiency" and major results of their functioning based on systems-function analysis;

Stage III. Substantiation of major and specific efficiency estimation criteria of agro-industrial systems under the condition s of post-industrial economy; development of a systems of indices and instruments, specification of data-collecting forms and methods to analyze the agro-industrial production efficiency.

3. Results

3.1 Definition of Agro-Industrial Systems Efficiency

What is the notion of agro-industrial systems efficiency? It is known that the notion of "efficiency" is one of the basic economic notions which to this day does not have a unified generally accepted definition. In general approach it is characterized as performance of some process or event.

Based on this definition agro-industrial systems efficiency can be characterized as performance from implementation of technical, technological, organizational, economic and social measures directed to satisfaction of social needs in agricultural produce. However this definition does not allow to reveal neither the internal scope, not the agro-industrial systems efficiency formation mechanisms.

However, do not forget when you use this method of statistical disparities perception data that can complicate vocpriyatie information, we note that in this context to use the Russian units (Kaurova et al., 2013, Kaurova et al., 2014; Maloletko et al., 2015).

Agro-industrial systems efficiency is one of the more elaborate manifestations of efficiency, compared to its other types is a generalized definition taking in a whole range of separate and independent notions of efficiency. Only this systems-function approach to the notion will to some extent allow to reveal its scope. We also have to keep in mind that agro-industrial systems efficiency is determined not only by its internal characteristics as often erroneously perceived by researchers, but also the characteristics of its impact on the external environment. Thus, efficiency should be viewed not only as an internal but also as an external characteristic of agro-industrial system.

We understand agro-industrial systems efficiency as their performance. Scope analysis of agro-industrial systems efficiency demands to reveal major specific results of their functioning.

3.2 Essence of Criteria and Principles of Agro-Industrial Systems Efficiency Estimation

The substantiation of agro-industrial systems efficiency estimation is one of the central methodology issues. The selection of criteria is of crucial importance for the substantiation of the efficiency indices system of agro-industrial systems. Only after solving this issue can preconditions exist to maintain a single methodological and methodical foundation, provide mutual cohesion of agro-industrial systems efficiency indices both as a whole and its elements.

The criterion is usually understood as trait of principle that bases estimation, comparison, classification of objects or events. In general sense it should give the opportunity to come up with a generalized measure of development of the process in question, record its performance, reflect the scope of the process and be a standard of congruence between our perception and objective reality. It should reflect the goals of the phenomenon researched and ways of meeting them. Criterion of efficiency should have stimuli for development of research, for increasing its performance. This brings us to a crucial methodological conclusion that the efficiency criterion selection must be based on the essence of the economic category that reflects the phenomenon in question and not chosen at random.

Based on everything previously stated agro-industrial systems efficiency can be defined as maximization of solving the problem of satisfying the needs of population in agricultural produce, and processing in agricultural industry under set resources or optimal costs of resources while preserving the environment, solving the problems of social development and increasing the level of innovative-informational development systems of agro-industrial production. This criterion of efficiency would provide a general notion of efficiency in technical, technological, organizational, social, economic, innovative-informational and ecological processes in agro-industrial systems that produced qualitative and quantitative changes, that took place in agro-industrial system at a specific period in time (Merton, 2006).

Agro-industrial systems efficiency criterion is one of the most elaborate forms of notion of efficiency, in relation to its other forms being the most generalized category creating within a whole range of independent definitions of efficiency. Only this system-functional approach to the category allows, to a degree, reveal its scope. We have to bear in mind that agro-industrial systems efficiency is determined not only by its internal characteristics, as often perceived by many researchers but also external environment impact characteristics. So the efficiency should be viewed not only as internal but also as external characteristic of agro-industrial systems functioning.

As agro-industrial systems efficiency criteria provides a generalized characterization of final results, then they pose as unified standard for all levels of hierarchy of agro-industrial systems (federal, regional, production level). However it is immensely difficult to estimate the social-economic development efficiency by one synthetic criterion, for the agro-industrial system contain a multitude of components. This requires a system of corresponding criteria which reflect many sides of agro-industrial systems efficiency.

The research shows, that development of agro-industrial systems efficiency criteria under current conditions should be based on the following methodological principles:

- Inclusion of agro-industrial systems specific functions;

- Commercialization and self-supporting, according to which production of agro-industrial systems must be based on market mechanisms, establishing self-financing and self-supporting;

- System-based approach to assessment of agro-industrial systems efficiency.

The principle of inclusion of agro-industrial systems specific functions. The essence and major goals of agro-industrial systems objectively determines the need to use the functional approach while selecting efficiency assessment criteria.

In our research function is understood as the role carried out by the object in a particular field of activity under certain rules.

Thus, according to the systems-function approach the major goal of agro-industrial systems functioning is satisfaction of social needs, primarily societies' needs in agricultural produce and processing industry in raw materials.

The principle of commercialization and self-support of agro-industrial systems. During development of agro-industrial systems efficiency estimation criteria one has to consider specifics of their functioning determined by the duality and contradiction of the functioning mechanism: as an economic system supplying common good and market economic system acting upon commercial stimuli.

The principle of system-based approach to agro-industrial systems result estimation.

In accordance with this principle agro-industrial systems are an accumulation of interlinked lines of business (profit and non-profit) during which specific results appear – functional, economic, innovative-informational social, ecological etc. (Stepanov, 2014).

3.3 Algorithm and Results of Substantiation of Agro-Industrial Systems Efficiency Criteria Assessment

Substantiation of agro-industrial systems efficiency estimation criteria was made based on the Objectives Tree method. This method allowed to determine the whole system of interlinked agro-industrial production results. Construction of Objectives Tree was founded on inclusion of objective laws of development of agro-industrial systems in post-industrial economies.

Objectives Tree construction procedure was carried out by a group of trained experts (specialists and scientists) from agro-industrial field, well versed in the problems of organization, economy, management, particularities of implementation of technology in contemporary agro-industrial complex.

Step-by-step division of goals and results of agro-industrial systems allowed to model a comprehensive system of links, interconnections between results and effects that form during agro-industrial systems functioning.

However Objectives Tree construction does not end with determination of results of agro-industrial systems functioning under the conditions of post-industrial economy. The choice of significance and priority of results and consequences in agro-industrial production may be viewed differently. There lies the problem of choice within the Objectives tree the most significant results of agro-industrial systems functioning in post-industrial economy.

This problem is solved by performing a comparative analysis of all the agro-industrial systems functioning results and choosing the most significant and viable.

The assessment of relative significance of agro-industrial systems functioning results was made based on intermediate decisions on all the levels and elements of the Objectives Tree taking into account their importance for the elements of the higher hierarchy.

Based on the methods used such assessments are given as unit fractions so that the sum of all elements will equal one.

Such expert assessments of the level of functioning results significance both of singular elements and agro-industrial systems as a whole were carried out by groups of experts in several rounds.

In the first round they estimated and specified industry goals, goals and results of agro-industrial systems functioning. The primary assessment was given here to the specific results of agro-industrial systems functioning on all levels of the Objectives Tree. This work was carried out by experts individually as a result of which each could eliminate a result on the grounds of insignificance or could add some more viable results.

The second round proposed a collective discussion of experts' opinions on the list major agro-industrial systems' functioning results with the following individual quantitative assessment of their relative significance. If after the second round the experts did not arrive at a unanimous decision and there were differences between the experts'

assessments then the procedure of defining agro-industrial systems' functioning results would carry on in the next round until the experts arrive at a relatively unified decision on the problem in question. After the assessment of relative significance took place the experts determined methodological approaches to assessments of positive or negative consequences of obtained results.

The final selection of agro-industrial production efficiency criteria was made based on a comparative estimation of relative significance of agro-industrial systems' functioning results provided by the group of highly qualified experts (Rutzkoy & Kozitskiy, 1988).

The research indicated that under the conditions of industrial revolution and ongoing development of post-industrial society, information economy the criteria complex of agro-industrial systems efficiency estimation should take into consideration all actual consequences of agro-industrial systems functioning and primarily functional, economic, social, ecological results (Hawken, 1999).

The criteria system founded on the principles of system-function approach allows to account for and assess external effects and their influence on the stability of agro-industrial systems activity. This assessment without a doubt should be carried out on all hierarchy levels, by specific agro-industrial systems activity results, by major elements' functioning results (Van den Bergh Jeroen, 2010).

Research results performed based on the system-function analysis approach pointed out all of the specific agro-industrial systems functioning results: functional, economic, innovative-informational, social, ecological (Miller, 2009).

Functional result of the agro-industrial systems activity is reaching a stable growth of production, sustainable satisfaction of the societies' needs in agricultural produce and raw materials. Such results reflect the level of realization of main strategies of agro-industrial production development as consequent to the realization of the national agro-industrial policy (Altukhov, 2008).

Economic results of the agro-industrial systems activity is realized through its ability during the functioning process produce economic effect. Economic results are attributed directly to the process of production of agricultural produce and is one of the main indices of agro-industrial systems efficiency.

Along with functional and economic results there are other forms of agro-industrial systems' performance. One of them is effective development of agro-industrial systems based on stable growth (Alekseeva, 2013).

Under the conditions of information and postindustrial economy there are other agro-industrial systems' functioning results. Their particularity is determined by specific character of obtained results during the course of functioning. Such results include innovative-informational, social and ecological results.

Innovative-informational results characterize the level of usage fruits of scientific-technological progress and highly-effective information technologies during the course of agro-industrial systems' functioning.
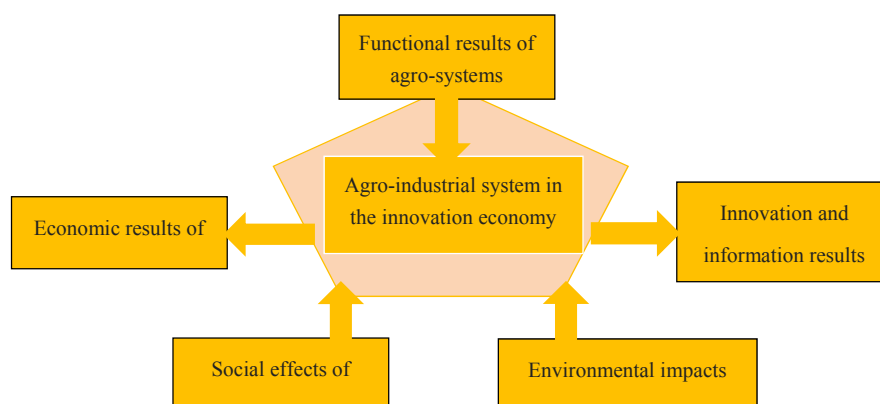

Figure 1. The main results of the functioning of agro-systems in the innovation economy

Social results of agro-industrial systems' activity are reflected in working conditions, standard of living of producers of agricultural goods and also of workers employed in servicing agricultural production, level of development of such non-producing subsystems as culture, healthcare, services etc. these results may have a significant impact as they, in the end, determine the attitude of people towards each other, their labor activity and

effective production development in agricultural production and serve to provide the agricultural industry with new workforce.

Ecological results are a natural result of social-economic systems' activity under the conditions globalization of industrializing economy. They appear as a direct impact of agro-industrial systems' activity on the condition of the environment, its preservation and rational usage levels, rate of pollution of agricultural produce with nitrates and other harmful elements (Patrick ten Brink, 2011).

The main results of the functioning of agro-systems in the innovation economy shown in the Figure 1.

4. Discussion

Agro-industrial systems efficiency criteria must take into consideration country's social-economic and social-politic situation. Today the reformation of the agricultural production in Russian Federation is carried out on the principles of re-orientation of agro-industrial complex towards self-sustaining and import substitution (Stepanov & Zotova, 2012).

Thus during the research the authors were able to determine basic and specific agro-industrial systems efficiency estimation criteria.

Basic agro-industrial systems efficiency criteria can be defined as maximization of solving the problem of satisfaction of societies' needs in producing high-quality agricultural produce with set resources or optimal labor and funds expenditure, while maintaining the environment and solving the problems of rural social development. Such efficiency criteria provides a unified definition of agro-industrial system production measure, recording results of its activity.

Based on this provision other specific agro-industrial systems' efficiency estimation criteria under the conditions of formation of innovation economy are:

a) Agro-industrial systems functional efficiency criterion, describing the level of achievement of agro-industrial system's functioning goals;

b) Economic efficiency criterion, characterizing the level of resource expenditure on agro-industrial systems' single unit production;

c) Innovative-informational criterion is devoted to reflect the level of innovations used in agro-industrial production, technology and above all information technology;

d) Social efficiency criterion describing how the level of agro-industrial systems' production development allows to solve the problems of creating the needed conditions and workplace safety, increasing the standard of living of agro-industrial systems workers;

e) Ecological efficiency criterion characterizes how agro-industrial systems' functioning sustains the environment.

Agro-industrial systems' efficiency under the conditions of innovation economy – is the effectiveness of their performance which allows to create a new type of agro-industrial systems' – cumulative synergy effect.

Agro-industrial systems' synergy efficiency is the major summarizing result. Such efficiency takes place in cumulative effect significantly exceeding total results of singular types of efficiency (functional, economic, social, ecologic). Synergy effect is reached by combining the aforementioned results.

5. Conclusion

It is obvious that the next stage of agro-industrial systems efficiency criteria substantiation problem development will be substantiation of actual possibilities and viable boundaries of various indices usage, describing functional, economic, innovative-informational, social and ecological efficiency.

Practical importance of agro-industrial systems efficiency criteria selection is very significant and encompasses the possibility of their direct usage defining and substantiating efficiency of agro-industrial systems on different hierarchy levels and assessing the viability and efficiency of making managerial decisions.

As agro-industrial systems' efficiency criteria provide a generalized expression of the final functioning goal they are practically sole criteria for all hierarchy levels and all subsystems. At the same time it is clear that agro-industrial systems efficiency assessment is quite to carry out with just one synthetic criterion for the system consists of a multitude of components. On this basis one needs a set of criteria, reflecting various sides of agro-industrial systems' efficiency.

When justifying the agro-industrial systems' efficiency assessment indices, we propose that their usage should provide:

Interconnection of criteria with all of the totality of indices; achievement of interrelation of general and particular efficiency indices;

Reflection of major characteristics of agro-industrial systems functioning results;

Compatibility and thorough agro-industrial systems' efficiency estimation on different hierarchy levels (region-enterprise);

Calculation of functioning efficiency of all subsystems (agriculture system, cattle farming system, social subsystems etc.);

Comparative assessment of single-type agro-industrial systems' efficiency, functioning in similar climatic and economic conditions;

Determination of the most rational variants of scientifically developed systems;

Detection and assessment of impact from introduction of complex of measures to increase agro-industrial systems efficiency.

As the prevailing majority of efficiency indices are determined by the sum of effect of its ratio to the expenditure, the primary value is given to solving the problem of what indices describing the effect and expenditure should be the foundation of assessment and should determine possibilities of using these indices to solve the problem.

Development of the set of agro-industrial systems' efficiency estimation indices based on the aforementioned principles is an elaborate and labor intensive problem.

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