

## **Application of Fuzzy-set And Multiple Approaches in Evaluation of Effectiveness of Agricultural Industry Enterprises Activities (As An Example of Animal Breeding of the Republic of Tatarstan)**

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**Effectiveness evaluation of agricultural enterprises' activities with the aim of formation of state subsidy politics. In the work it is used the theory of fuzzy-sets. In the current research it is considered the traditional methods of evaluation of financial and economic conditions of agricultural subjects, as well it is presented the results of activities effectiveness evaluation on the bases of sales profitability calculation (unprofitability) of agriculture producers of the Republic of Tatarstan. On the bases of calculated parameters of big and average enterprises it is suggested the criteria of complex evaluation taking into account regional aspect. Suggested methodology makes it possible to realize the analysis of commodity producers functioning efficiency taking into account the industry approach as well in view of types activities. Used at work evaluation tools form high quality new approach of conditions of budget allocations distribution, with the purpose of region food security provision. Suggested methodology has practical importance, as it is observed diversification of food demand in relation with demographic changes and in relation to this it has become topical question about effective governmental support implementation of all level agricultural producers.**

**Key words:** Analysis, Food security, Subsidy assistance, Activity effectiveness, animal breeding, agriculture.

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Nowadays, in the Russian Federation in all the levels it has been provided government support of agro-industrial complex (AIC) by means of provision of budget grants to producers, credit subsidies, compensation of leasing payments and etc. However, taking into account the tendencies of changes in the world community (demographic changes, phenomenal crop capacity with usage of gene engineering, creation of alternative fuel and its further development) there are needs in

capitalization of agriculture industry with the aim of attracting foreign investments and perspectives of powerful technological bases development producing huge volumes of food.

Nowadays, the Russian agro-business can develop only in the subsidized niches, and due to that the set of niches is changeable (influence is done by outside factors: fires, droughts, floods) the certain industries are unable to create their own private strategy. The reason of that is also the transfer mechanism of the agrarian industry: the federal budget creates preferences and depending on their state of things, it invests into one or another direction.

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Regular subsidizing of huge producers (in our case the regional ones) creates and enhance the problem of monopolization putting food security into dependence from some market participants limiting in so doing income parameters from new producers.

In the modern economic literature there are many different methodologies, that is why it is important to choose the optimal number of indexes which will reflect most accurately the management of subject activities. In the current moment the evaluation of socio-economical effectiveness of farming development program can be done in different ways: indicative method; method of integral coefficients; complex methods – “best life index” OECD, “UNO human potential development index. Mostly, the given methods are oriented on evaluation of social effectiveness of realized programs, at the same time the economic effectiveness evaluation comes to calculation and analysis of separately taken indexes. In the economic literature it is not sufficiently revealed methodology of complex analysis of agricultural enterprises activities effectiveness, mostly the statistic methods of analysis require deeper researches taking into account the industrial specification.

That resulted to that nowadays, by “effectiveness” term it is identified any effect which leads to enhancement of the considered indexes.

There are traditional methods of economic and statistical analysis of enterprises’ activities effectiveness being used depending on the target direction of the analysis. Those indexes can be presented in the form of absolute, relative and average values characterizing separate sides of the current financial situation of the economic subject. The indexes of liquidity, profitability, financial sustainability, business activity, riskiness and etc. can be referred to those indexes<sup>1-8</sup>.

However, the calculating results of the indexes reflect quantitative side of certain coefficients without qualitative component and in the case of agriculture, it is missing opportunity of indexes one-valued normalization being evaluated in the scope of analysis.

In the suggested by us research it is provided the methodology of activity effectiveness evaluation of animal breeding industry enterprises using fuzzy logic.

## Research results

In accordance with done research of Russian and foreign methods of evaluation of industry subject’s financial and economic condition it can be emphasized the following groups of its functioning effectiveness indexes:

- 1) Payment worthiness: coefficients of the current liquidity, correlations of debt and own funds, absorbing of fixed assets;
- 2) Riskiness; index of integrated risk, financial leverage, producing leverage;
- 3) Effectiveness of enterprise activity: profitability of assets, profitability of owners’ equity;
- 4) The main activity effectiveness: profitability of enterprise’s main activity, sales profitability, production assets turnover.

By the given indexes it can be done the conclusion about the level of sustainability of analyzed economical subject if to know on which level of the life cycle it is, as the criteria will be different depending on the level. To identify those criteria it is required to reveal the factors which influence on the enterprise being on different stages of the life cycle<sup>9</sup>. Undoubtedly, the specification of subject activity also leaves its mark on the basic set of effectiveness indexes.

The researched field (agriculture) is subdivided into two huge sub-industries: plant breeding and animal breeding, in view of each there are specifics of functioning, that in its turn is required to take into account while forming indexes of activity effectiveness and the parameters of their evaluation.

The plant breeding includes breeding of the following main types of agricultural crops: grain crops (including corn), sugar beet, potatoes, rape. In the animal breeding field it is produced main types of production such as milk, cattle meat, meat of pigs, poultry meat, eggs. In accordance to that, the analysis of plant breeding activity effectiveness is possible by the indexes of crop capacity (c/ga), net profit on 1 ga of tillage and profitability, whereas in the animal breeding, the complex evaluation of producers’ activity effectiveness is identified by sales profitability. That is related to that in contrast with plant breeding while analyzing the gross product of animal breeding there are specific features stipulated by that the production process in animal breeding is continuous one, the

production is obtained within the whole year, its output depends less on climate conditions and more on work investment, forage and funds. Also, if in the plant breeding sowing of one crops leads to reduction of others, since limits of total areas, then in animal breeding it is possible increase of all types cattle if opportunities of cattle reproduction allow that, as well as forage and labor resources, premises and conditions of production specialization.

However, in view of great number of participants presence on the producers' market, comparable evaluation by the results of profitability of each enterprise is labor-consuming and subjective, in accordance to that it is suggested

by us, on the bases of the calculations results to introduce critical indexes by each type of produced goods using optimal minimax and minimax solutions. The calculation of profitability indexes is done for 2011 and 2012 (of milk producers – 339 and 355 enterprises correspondingly for the periods; cattle meat – 352 and 378 enterprises; meat of pigs – 117 and 97 enterprises; poultry meat – 15 and 17 enterprises; eggs producers – 9 and 10 enterprises). In the provided by them calculation it was used the data for 2 years. Undoubtedly, for making more accurate decisions it is required to study wider time lag, however our aim is to consider the suggested methodology.

**Table 1.** The results of calculation of sales profitability indexes (unprofitability) of agriculture producers around the Republic of Tatarstan for 2011-2012, in %

Year	Index	Milk	Cattle meat	Meat of pigs	Poultry meat	Eggs
2011	Minimum	-21	-77	-98	-42	-6
	Maximum	25	15	13	28	29
2012	Minimum	-135	-65	-67	-73	-7
	Maximum	60	16	25	24	53

According to the provided calculations in the Table 1, in some industries there are indexes of activity unprofitability, which is unreasonably to include them into identification of critical limits (standards), in accordance to that, the lower critical limit will be equal to zero. Thus, for analysis conduction we will introduce critical limits and linguistic variable "High index value" for each index of effectiveness:

- 1) Milk sales profitability,% – from <0; to >0.25;
- 2) Cattle meat sales profitability,% – from <0; to >0.15;
- 3) Pigs' meat sales profitability,% – from <0; to >0.13;
- 4) Poultry meat sales profitability,% – from <0; to >0.24;
- 5) Eggs sales profitability,% – from <0; to >0.29.

Corresponding membership functions of fuzzy numbers "High level" for each index is identified by the formula:

$$\mu_{jt}(a_{it}) = \begin{cases} 0, & a_{it} < \alpha \\ \frac{1}{\beta - \alpha} \cdot a_{it}, & \text{if } \alpha \leq a_{it} \leq \beta \\ 1, & a_{it} > \beta \end{cases} \quad (1.1)$$

where  $\mu_{jt}(a_{it})$  - membership function value of linguistic variable j index on i enterprise for t year;  $a_{it}$  – value of i economic index of enterprise for t year;

$\alpha$  – lower limit of critical values of economic index;  $\beta$  – higher limit of critical values of economic index.

As a result, we will obtain fuzzy value of the complex evaluation of productive activity effectiveness of region enterprise. Membership function can take the value from zero to one, the value equals one means that the enterprise carries high-performance business.

Results dephase of the of fuzzy complex evaluation we will conduct by the rule following

**Table 2.** Results dephase of the of complex effectiveness index of enterprise activity

Fuzzy value of complex evaluation of activity effectiveness	Linguistic description of agriculture producer
[0;0.2)	Ineffective
[0.2; 0.4)	Low effective
[0.4;0.6)	Quite effective
[0.6;0.8)	Effective
[0.8;1]	Highly effective

from the rule of dephase of separate effectiveness indexes provided in Table 2.

In whole, by the Republic of Tatarstan

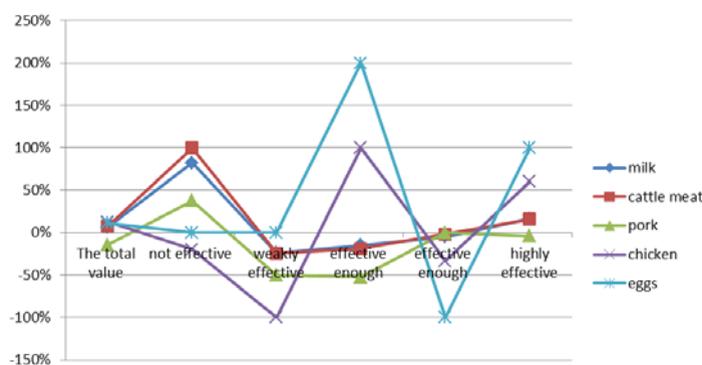
for 2011-2012 years it is obtained the following results by the effectiveness of goods producers, presented in Table 3.

**Table 3.** Effectiveness of agriculture producers' activity by types of produced goods in 2012

Production type		Total agriculture producers doing business of current production type		Ineffective		Lower effective		Quite effective		Effective effective		Highly effective	
		2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Animal breeding	Milk	343	365	34	62	63	48	60	51	58	55	128	149
	Cattle meat	354	382	36	72	65	49	63	51	58	57	132	153
	Pigs' meat	118	101	16	22	22	11	19	9	12	12	49	47
	Poultry meat	16	18	5	4	1	0	2	4	3	2	5	8
	Eggs	9	10	3	3	0	0	1	3	3	0	2	4

Necessity in forming of provided above table (mentioning quantity of enterprises) is based on that the evaluation of food independence of region depends on quantity and activity effectiveness of all the subjects of the Republic's management (for more qualitative analysis the results are presented in terms of types of produced goods). Also the given tables can be the source of information while budget formation. So, for example, during the development of the strategy of poultry

meat production increase it makes sense to evaluate quantity of the present enterprises of sub-industry (including taking into account level of monopolization), for more accurate sums dotation distribution it is reasonable to focus on certain districts of the Republic (as in extended option according to the data from the table there is an opportunity to see the results of certain business functioning).



**Fig. 1.** Growth rate for 2012/2011 by the quantity of the Republic of Tatarstan enterprises in the animal breeding industry in view of production types and activity effectiveness indexes, in %

The calculated by us indexes make it possible to state that the greatest share of "highly effective" enterprises dominates among pigs' meat producers. Profitability indexes of the current sub-industry is 20-25%, from our point of view, it was exerted a primary influence on this by the following

factors, such as: creation of favorable investment climate in the sector of industrial pig breeding during the last five years, rational customs and tariff regulation, introduction of tax remissions as well as subsidizing of investing credits. Reduction of businesses number, engaged in pigs breeding

on 17 units (tab. 3) is caused by prices growth on combined feed and risks epizootic tendency in the republic by African pig plague (APP) to diffuse scattering. In accordance to that, it was developed and implemented a program “Prevention of bringing and spreading APP on the territory of RT in 2014-2016”. During the half of 2013, the growth rates of pig breeding industry thanks to huge regional industrial enterprises (“Kamskiy Bekon”, pig complexes HC “Ak Bars, TatMitAgro, AF Leninogorskoe) was 14% (+5.7 ths tons).

According to the data from Table 3. it can be emphasized that in the Republic there is a quite small number of businesses being engaged in production of poultry meat (and as a result, eggs): 16-18 enterprises. That makes it possible to conclude about monopoly of the current industry. Activity effectiveness of the enterprises producing poultry meat in 2012 has significantly grown. So, if in 2011 share of “ineffective” enterprises was 31%, then in 2012 the given index has decreased by 22%, however it has increased the share of enterprises with “highly efficient” activity indexes – by 3 units (in total 44%). The present phenomenon, from our point of view, is the result of realization of governmental support measures 2008-2012, particularly, the great value had governmental measures on stimulation domestic producers such as decrease of quota on poultry meat import, provision of subsidized credits. The poultry farming industry has also developed mostly thanks to huge investments done by producers into modern production clusters, into integration and increase of effectiveness. However, closing demand of own market does not cancel task to increase industry competitiveness and entrance into foreign markets.

In the activities of enterprises being engaged in production of cattle meat, in general it is observed a positive dynamics by the activity effectiveness indexes. That fact also indicates about increase in number of production enterprises by 28 units (Table 3.). The rest 60% enterprises practically evenly spread between the indexes of “ineffective”, “lower effective”, “quite effective” and “effective” activity (in average by 15%).

Volume of daily milk realization produced by the Republic enterprises is the biggest among regions of Russia. Analysis of activity effectiveness indexes makes it possible to conclude that the

leading enterprises in the industry are not fully engaged in production, it is indicated the fact that relative growth of “ineffective” enterprises was 82% (in absolute relation 28 units), then in total by the industry the growth of milk producers was only 6% in 2012 in relation to 2011.

Analyzing the effectiveness of animal breeding industry activity and considering the reasons of profitability decline indexes it is useful to take into consideration the industry functioning in VTO conditions. By the results of first half year 2013 in monetary terms, the export of food products and agricultural raw materials has dropped by 19,3% – from \$6,35 bln to 5,13 bln, while import increase it increased by 5,9% – from \$15,8 bln to 16,8 bln [10]. In accordance with official statistic information it was registered decline of total positive financial result activity of RF agricultural organizations by 54% in the first half year 2013 (till 22 bln rub.). Amount of losses has increases by 2.1 times – up to 24,4 bln rub. As a result, the share of loss-making enterprises in agriculture has grown from 23.6 up to 26.7%. In accordance to this, every fourth agricultural enterprises in Russia works making loses and in the absence thereof structural changes in the market conjecture while in continuation of the current tendencies the biggest part of those enterprises will become a bankrupt during 2-3 years. As a result, Russia can lose up to 10% of produced agricultural goods.

The suggested by us methodology gives opportunity to see the whole picture in the APC industry, that in its turn should be taken into consideration while forming governmental politics of subsidizing to developed directions of middle and small forms of businesses development with the aim of regional food security provision as an element of risk reduction.

## CONCLUSIONS

Thus, drawing conclusions, it can be mentioned that in the Republic of Tatarstan there are several enterprises undertaking a role of “monopolist” with the share of 70% produced goods<sup>11</sup>. However, the results of our calculations indicate that subsidizing of such organizations is effective. Thus, from the federal and regional budgets it has regularly been appropriated funds but being not always used effectively.

The food security depends on successfulness of less 2% producers activity that is the substantial risk for the Republic in the whole. It is necessary to support small and middle agriculture producers for competition stimulation and production volumes growth.

The suggested in the work methodology is the modern tool for complex evaluation of effectiveness of agriculture industry producers' activity in general, and can be used as an effective tool for evaluation of both quantitative and qualitative sides of the researched business subjects' activity.

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