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The innovation process development in dairy cattle breeding in Russia

El desarrollo del proceso de innovación en la cría de ganado lechero en Rusia

Marianne Ya. VASILCHENKO 1

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Content

ABSTRACT:
The Russian agriculture is characterized by the uneven diffusion of innovations and their different impact both on the industries and on standalone institutions. One of the cattle breeding sector development objectives is to identify the innovation-based production growth trends. The author's interpretation of the innovation diffusion theory in relation to dairy cattle breeding was based on the method of the innovative development indicator calculation, which allowed identifying trends and describing the innovation diffusion process in 68 regions of the Russian Federation in 2006-2014. Based on the standardization of the average milk yield per cow in agricultural organizations, the author identified five groups of regions, significantly different by the innovative potential and institutional structure; revealed some milk resources increase trends in groups of regions with account of the difference in the innovative potential of regions. Based on the stated assumption on the innovative resource balance of agricultural organizations, the author provides a predictive estimate of the marketable milk resources' growth by 2020.
Keywords: Agroindustry; innovation process; innovation diffusion; dairy cattle breeding

RESUMEN:
La agricultura rusa se caracteriza por la difusión desigual de las innovaciones y su diferente impacto tanto en las industrias como en las instituciones independientes. Uno de los objetivos de desarrollo del sector de la cría de ganado es identificar las tendencias de crecimiento de la producción basadas en la innovación. La interpretación del autor de la teoría de la difusión de la innovación en relación con la ganadería lechera se basó en el método del cálculo del indicador de desarrollo innovador, que permitió identificar tendencias y describir el proceso de difusión de la innovación en 68 regiones de la Federación de Rusia en 2006-2014. Con base en la estandarización de la producción promedio de leche por vaca en las organizaciones agrícolas, el autor identificó cinco grupos de regiones, significativamente diferentes por el potencial innovador y la estructura institucional; reveló que algunos recursos lácteos aumentan las tendencias en grupos de regiones, teniendo en cuenta la diferencia en el potencial innovador de las regiones. Con base en la suposición establecida sobre el equilibrio de recursos innovadores de las organizaciones agrícolas, el autor proporciona una estimación predictiva del crecimiento de los recursos de leche comercializables para 2020.
Palabras clave: Agroindustria; proceso de innovación; difusión de la innovación; cría de ganado lechero

1. Introduction

The research of innovative agriculture development is particularly important, since its main units (the commodity sector and the processing industry) are low-tech industries, in which there are significant options for technological renovation.

The livestock sector analysis should consider another characteristic feature of agriculture – the technological stratification over time. The technological stages change at a slow rate, and today it is one of the main obstacles to a sustainable development of the agroindustry. In agriculture, the share of organizations that have

reached the fifth or even sixth technological stage is extremely low.

The more relevant are the studies in the domain of economic conditions for innovations' implementation with account of the varying resource potentials and renovation paces of various industries and producer categories. The following points should be emphasized: the uneven diffusion of innovations, unequal conditions for innovative development, different susceptibility of agricultural actors to innovations.

The article deals with the study of the innovation diffusion in regional agrosystems on the example of the dairy cattle breeding sub-sector in Russia.

The increasing practical importance of such research is predetermined by the need to identify the strategic lines of development for certain territories and justify the adequate measures of state support for the use and diffusion of innovations in the agricultural sector.

The identified problems have been widely addressed in publications of Russian and foreign scientists.

Certain foreign authors (Labianca et al., 2016) noted the increasing role of innovations in the European rural areas' development, recognizing the undeniable importance of not only technological, but also social, cultural, and institutional innovations. The authors explain the insufficient diffusion of innovations through the lack of the regional development plans' coherence with the local governments' interests, as well as the innovative projects implementation complexity due to the lack of required funding.

Scientists of the All-Russian Research Institute of Agrarian Economics and Standards of the Russian Academy of Agricultural Sciences proposed the methodology for predicting the technological development of the beef cattle husbandry sub-sector. The methodology is directly related to the innovation process. The authors applied the forecast method based on the standard and target production indicators and suggested to use the technological development level indicator as one of them. This indicator allows estimating the current state and determining the technological development perspectives for the dairy and beef cattle, pig, poultry, and sheep breeding (Vinokurov, 2010, p. 30-32). Acknowledging the significant contribution of the authors in the development of the theoretical and methodological approaches to the analysis and forecast in the agricultural sector, we note, however, the possibility of using the indicators that reflect the innovative resource substitution of other factors, such as animal fodders. Previous studies have identified targets for innovative development of livestock breeding sectors, the comparison of which with the actual results will make it possible to determine certain innovative development indicators (Andryushchenko et al., 2010, p. 53-57).

According to S.Yu. Glazyev and V. Sukharev, the development of the new technological stage in Russia is constrained both by the insignificant scale and insufficient implementation of the existing technologies, and by the unpreparedness of the socioeconomic environment for their extensive use (Glazyev, 2009, p. 48-49).

Another unsolved problem is that the innovative development institutional factors are not accounted for. The identification of the economy readiness to perceive innovations is still a quite relevant issue (Sukharev, 2008, p. 15). The uneven territorial diffusion of innovations has been noted by a number of foreign researchers (Cheshire and Malecki, 2004, p. 83; Crescenzi et al., 2007, p. 673-709).

In our view, these approaches largely correlate with the theory of innovation diffusion, which develops the provisions of the regional placement theories. Diffusion is an integral element of the innovation process. According to the methodological approaches outlined in the innovation data collection and analysis guidelines (Oslo Guidelines): "Diffusion is the way in which innovations spread, through market or non-market channels, from their very first implementation to different consumers, countries, regions, sectors, markets and firms" (Mortensen et al., 2015, p. 23).

An important stage in the development of accommodation theories was the study of the process of innovationsə creation and diffusion performed by E. Rogers, according to which a new idea or product is accepted by the market, and the rate of diffusion spreads from one consumer to another. The main groups of innovation consumers are characterized as innovators, early adopters, early majority, late majority, laggards (Rogers, 1995, p. 35).

Further development of the innovation diffusion theory took place in the publications of T. Hagerstrand. He proved the possibility to model the territorial innovation diffusion. According to his viewpoint, the innovation diffusion is the spatio-temporal process associated with the change of the leading industries within the framework of the Kondratiev cycles, the emergence of innovation centers, and the their diffusion rate in the economic space (Hagerstrand, 1967, p. 67). Models of technology diffusion are presented in the scientific publication (Aghion et al., 2001, p. 467-492).

At the same time, we should note the fact that innovative activity in low-tech and medium-tech sectors has been explored insufficiently (Mortensen et al., 2015, p. 39). It can be fully attributed to the dairy cattle breeding sub-sector in Russia.

Individual scientists consider it possible to apply the methodological principles of innovation diffusion in the study of technical and technological modernization trends in agriculture (Belov et al., 2016, p. 33). Hein K. associated the innovation diffusion process in the dairy farming in Germany mainly with the introduction and

use of automated milking systems, i.e. process innovations. The diffusion process that took place in 1949-1975, researched by him, allowed to conclude that the continuous replacement of old technology is possible only in the presence of distinct competitive advantages of technological innovations (including the cost-related) (Klaus, 2009, p. 36). Certain methodological principles of the innovation diffusion theory were approached in the studies of Russian scientists. For example, V.V. Kozlov and A.I. Ukolov used the provisions of the innovation diffusion theory in relation to the development of dairy cattle breeding in Nizhny Novgorod Oblast. It confirms the importance of this theory for the study of innovation diffusion in the agricultural sector. According to the author's view, the priority in the dairy production development in the region belongs to the targeted financial and technical (extension-service) support (Kozlov and Ukolov, 2015, p. 15).

In contrast to the above-mentioned authors, the specific feature of the author's approach resides in the use of the standardized method based on the proposed indicator of the dairy cattle breeding innovative development. The use of statistic data for a long period made it possible to identify the diffusion of innovations in this sub-sector, determine the list of innovatively active regions, as well as evaluate the capability of region groups with regard to the commodity milk resource formation.

2. Methodology

The innovation diffusion process is usually characterized by the number (or share) of actors involved in it at a specified point in time or by the volume (share) of products produced using the innovative technology.

At the same time, the insufficiently developed methodology for grouping regions by the innovation level of agricultural production considerably narrows down the innovative process quantification capabilities and makes it necessary to develop a new toolset for information analysis. In particular, we used E. Rogers' version to study the prospects of innovations in dairy farming. This choice is largely due to the fact that the application of innovations in this sector is determined by the variety of technological stages and the high labor intensity justifies the need for the labor substitution with innovative capital resources.

It is undoubted that innovations are one of the crucial factors of economic development and a number of researchers consider them in a broader regional context (e.g. Malecki, 1991; Davelaar, 1991; Hall et al, 1987; Husso et al, 1996; Kangasharju and Nijkamp, 1997).

Significant differentiation of agricultural companies by both the organizational and legal status and the technology level exists in regional agrosystems in Russia and determines their competitive positions in the market. This provision is to a higher degree true for the dairy cattle breeding, as agricultural organizations and farms actively implement innovations in technology. Enterprise groups formed by the innovative development index make comparatively homogeneous sets and can be considered as enterprises of the same type with all other conditions being equal (in the form of a quasi-corporation). The innovation diffusion in spatiotemporal terms takes place as a result of competition between various type corporations, as a result of which innovatively active actors improve their positions. The above-said allows applying the innovation diffusion theory to a region as a quasi-corporation that actively seeks a higher innovative ranking.

The author offered the technique to calculate the dairy cattle breeding innovative development indicator. It was assumed that innovation consumers are agricultural organizations and farms in regions of Russia, and the innovation diffusion rate is largely determined by the financial "safety margin," by the level of related industries' innovative development, as well as by the appropriate measures of state support for innovations both on the federal and regional levels. We calculated the index using the statistical method: the indicators were divided into 5 groups, for each of which the recommended shares were determined. The main groups of regions were identified based on the innovation development index values. The initial stage of the analyzed period (2006) coincides with the first year of implementation of the National Project of Agriculture Development, which was marked by a significant increase in the state support for agricultural producers. The proposed technique allowed allocating region groups by different innovation diffusion capabilities.

The inclusion of regions in the analyzed set was determined by the following restrictions: the milk production per capita should not be less than 100 kg; the agriculture share in the gross regional product should not be less than 3%.

We have proposed the milk production innovation index as the main classification factor. It is calculated as the ratio of the actual milk yield to the target indicator of cows that is set equal to 8000 kg. This rate can be achieved by using the innovative resources of animals (breeding stock), as well as the innovative technologies of cattle management and feeding. Although the proposed indicator indirectly reflects the use of innovations, its use made it possible to detect a certain correlation with the provisions of the E. Rogers' diffusion theory. The dedicated regional groups meet the criteria of innovation diffusion: "innovators," "early adopters," " laggards", etc.

In the present study, we used the data on 68 Russian regions; 13 regions were not included in the considered set due to the insufficient representativeness by some indexes, which indicates a low level of dairy cattle

breeding development.

3. Results

The Russian agriculture is characterized by the uneven innovation diffusion and the varying susceptibility of innovations by sectors and institutions. The specificity of the agricultural production, including animal breeding, resides in the restricted area of technological innovation application. According to the calculations of scientists of the Moscow Timiryazev Agricultural Academy, about 1.5% of large agricultural companies and less than 0.5% of farms possess advanced equipment and technology. The share of organizations implementing technological innovation in agriculture is 2%, and the share of the processing organizations is 9.5% (Bautin, 2011, p. 44).

In the analysis of the livestock sector, it is necessary to take into account the technological stratification over time. Today, the insufficient change rate of technological stages is one of the main factors hindering the dynamic development of the agribusiness. In agriculture, an extremely low percentage of organizations are at the fifth and sixth technological stages (Bautin, 2011, p. 83).

The technological innovation diffusion in Russian dairy cattle breeding has been studied using previously identified methodological approaches. A statistical analysis allowed identifying two regions (Moscow Oblast and Leningrad Oblast) that have the highest innovation level in milk production, that remained constant within the entire period under study. In addition, the Republic of Karelia and Stavropol Oblast were included in the group, followed by the inclusion of Belgorod, Vladimir, Vologda, Kaliningrad, Kirov, Lipetsk, and Sverdlovsk Oblasts and the Krasnodar Krai in 2014. These regions formed a group of "innovators." The innovation index in this group is 70% or higher. Such a high indicator is largely determined by the use of such a critical innovation resource as the genetic potential. We find it reasonable to characterize it through the official statistics index “the share of breeding cows in agricultural organizations, farms, and individual enterprises.” In 2014, the indicator in the major part of the group regions exceeded 40%, and its highest value (75%) was registered in Leningrad Oblast. In addition, the innovators’ group is characterized by the homogeneity of the institutional structure, with the predominance of milk production in agricultural organizations: the group average share of milk production in agricultural organizations was 72%. It was higher than in other groups and supports the assumption on the innovative balance of resources in this category of farms.

Other regions were divided into the following groups: "early adopters' (the innovation index ranges from 60% to 69%); "early majority" (50% to 59%); "average" (30% to 49%); "laggards" (30% and less).

Based on the obtained values, regions were ranked by the innovation development level. Table 1 shows the results of the combinatory grouping of the Russian regions according to the quantitative level of the dairy cattle breeding innovative development in 2006, 2011, and 2014. A higher position of a region in the group describes a higher level of innovative development. The information allows determining active and passive regions in terms of innovation implementation, as well as tracing the innovation diffusion in the space-time aspect.

Table 1
Cross classification of Russian regions by the dairy cattle breeding innovation development level

Innovative development index	Region groups		
	2006	2011	2014
70% and more	Leningrad Oblast Moscow Oblast	Leningrad Oblast Republic of Karelia Moscow Oblast Stavropol Krai	Leningrad Oblast *Republic of Karelia* *Krasnodar Krai* Moscow Oblast *Stavropol Krai* *Kaliningrad Oblast* *Belgorod Region* *Kirov Oblast* *Sverdlovsk Oblast* *Vologda Oblast* *Vladimir Oblast* *Lipetsk Oblast*

60–69%	Republic of Karelia Krasnodar Krai Vladimir Oblast	Vladimir Oblast Krasnodar Krai Tyumen Oblast Tomsk Oblast Sverdlovsk Oblast Vologda Oblast Kirov Oblast Lipetsk Oblast Belgorod Oblast	*Tyumen Oblast* *Voronezh Oblast* *Udmurt Republic* *Ryazan Oblast* *Republic of North Ossetia-Alania* *Perm Krai* *Ivanovo Oblast* *Kaluga Oblast* *Mari El Republic* *Yaroslavl Oblast* *Tambov Oblast*
50–59%	Vologda Oblast Tomsk Oblast Sverdlovsk Oblast Stavropol Krai Tyumen Oblast Kirov Oblast Udmurt Republic Belgorod Oblast	Amur Oblast Republic of Tatarstan Udmurt Republic Ryazan Oblast Perm Krai Kaliningrad Oblast Republic of North Ossetia-Alania Republic of Mordovia Mari El Republic Kaluga Oblast Krasnoyarsk Krai Voronezh Oblast Chuvash Republic Nizhny Novgorod Oblast Orel Oblast Saratov Oblast Ivanovo Oblast Tula Oblast Kemerovo Oblast Yaroslavl Oblast	*Nizhny Novgorod Oblast* *Samara Oblast* *Republic of Tatarstan* *Republic of Mordovia* *Tula Oblast* *Saratov Oblast* *Krasnoyarsk Krai* *Amur Oblast* *Chuvash Republic* *Pskov Oblast* *Rostov Oblast* *Irkutsk Oblast* *Volgograd Oblast* Tomsk Oblast *Republic of Adygeya* *Kursk Oblast* *Kemerovo Oblast* *Kostroma Oblast* *Chelyabinsk Oblast* *Orel Oblast* *Penza Oblast* *Ulyanovsk Oblast* *Novgorod Oblast* *Omsk Oblast* *Republic of Khakassia*
30–49%	Lipetsk Oblast Ivanovo Oblast Mari El Republic Perm Krai Republic of Tatarstan Krasnoyarsk Krai Yaroslavl Oblast Nizhny Novgorod Oblast Kemerovo Oblast	Novgorod Oblast Irkutsk Oblast Omsk Oblast Pskov Oblast Rostov Oblast Kursk Oblast Samara Oblast Kabardino-Balkar Republic Tambov Oblast	Kabardino-Balkar Republic Altai Krai Novosibirsk Oblast Republic of Bashkortostan Tver Oblast Kurgan Oblast Smolensk Oblast *Orenburg Oblast* Bryansk Oblast

	Voronezh Oblast Novgorod Oblast Republic of Bashkortostan Samara Oblast Kaluga Oblast Chuvash Republic Kaliningrad Oblast Kurgan Oblast Chelyabinsk Oblast Omsk Oblast Republic of Mordovia Tambov Oblast Altai Krai Ryazan Oblast Pskov Oblast Kostroma Oblast Penza Oblast Tula Oblast Kabardino-Balkar Republic Rostov Oblast Saratov Oblast Orel Oblast Amur Oblast Ulyanovsk Oblast Tver Oblast Irkutsk Oblast Novosibirsk Oblast Volgograd Oblast Republic of North Ossetia-Alania Astrakhan Oblast Smolensk Oblast Kursk Oblast Bryansk Oblast	Republic of Adygea Altai Oblast Kurgan Oblast The Republic of Khakassia Novosibirsk Oblast Kostroma Oblast Smolensk Oblast Chelyabinsk Oblast Volgograd Oblast Penza Oblast Republic of Bashkortostan Ulyanovsk Oblast Orenburg Oblast Altai Republic Tver Oblast Bryansk Oblast Chechen Republic Astrakhan Oblast	*Chechen Republic* *Altai Republic* *The Republic of Ingushetia* *Karachay-Cherkess Republic*
30% and less	The Republic of Khakassia Republic of Adygea Orenburg Oblast Altai Republic The Republic of Buryatia Karachay-Cherkess Republic Jewish Autonomous Oblast The Republic of Sakha (Yakutia) Transbaikal Oblast Tyva Republic The Republic of Dagestan Chechen Republic	The Republic of Buryatia Jewish Autonomous Oblast Karachay-Cherkess Republic The Republic of Sakha (Yakutia) Transbaikal Oblast The Republic of Dagestan The Republic of Ingushetia Tyva Republic	The Republic of Buryatia Jewish Autonomous Oblast The Republic of Sakha (Yakutia) Transbaikal Krai The Republic of Dagestan Astrakhan Oblast Tyva Republic

	The Republic of Ingushetia		

Source: It is compiled according to the official statistics of Rosstat (Russian Regions, 2010,2015).
In bold italics – innovatively active regions that improved their performance in 2006-2014
and were moved to a group of a higher level of milk production innovation
(Regions of Russia, 2010; Regions of Russia, 2015).

In 2014 the group of "early adopters" included Voronezh, Ivanovo, Kaluga, Ryazan, Tambov, Tyumen and Yaroslavl Oblasts, the Mari El Republic, Udmurtia, the Republic of North Ossetia-Alania, and Perm Oblast. Most of these regions are making significant contribution to the development of the dairy industry. For example, Voronezh Oblast was 8th largest manufacturer of milk in Russia in 2014; Udmurtia was 11th; Tyumen Oblast was 21th; Perm Krai was 24th. The genetic potential of the animals is also quite high: the share of brood cows in the total dairy livestock exceeds 20% (except Krasnodar Krai).

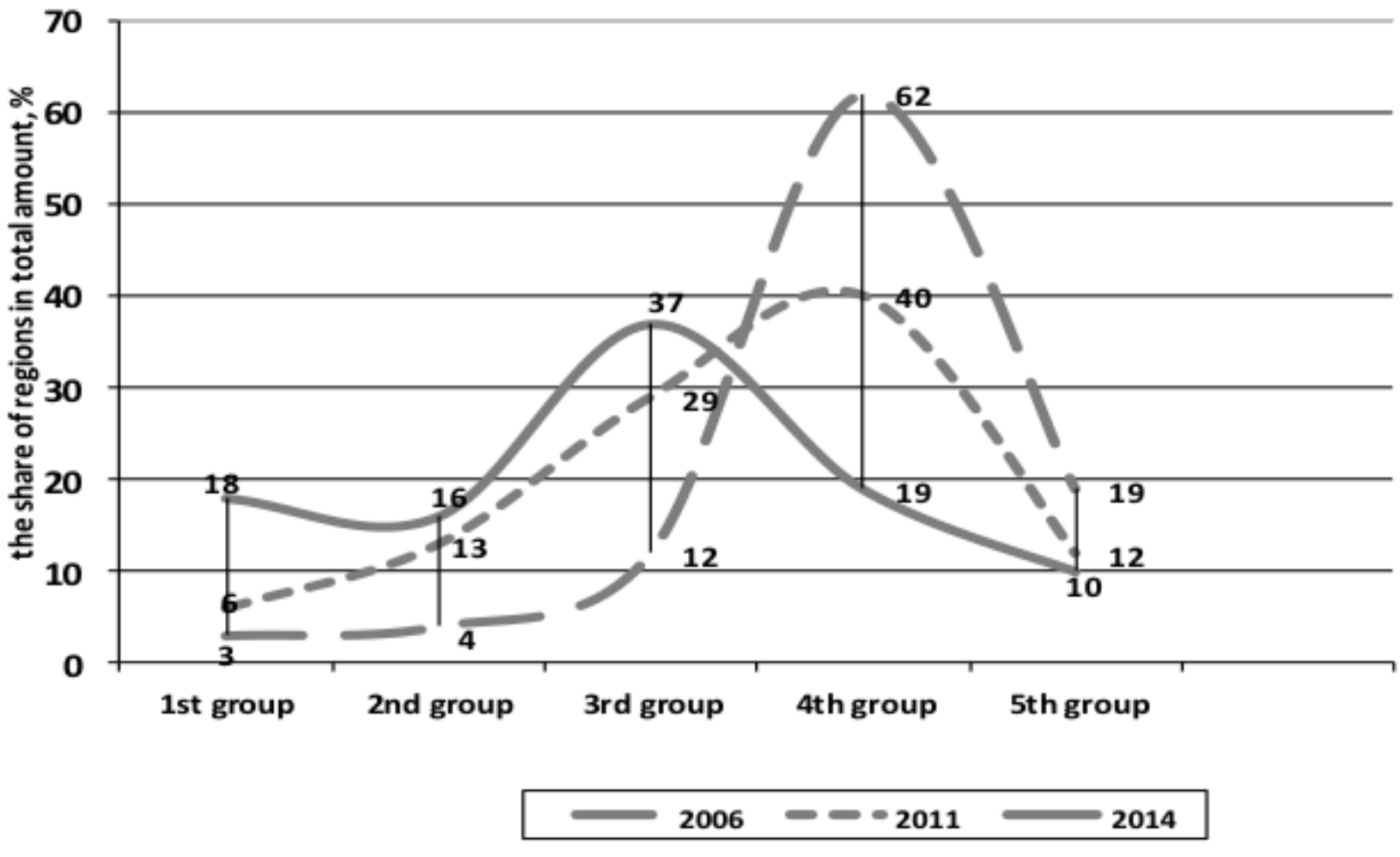
21 regions of the Russian Federation are included in the “early majority” group. It should be noted that almost all regions (except Tomsk Oblast) have moved into this group gradually since 2006, leaving the “average” and “laggards” groups. A typical example is Saratov Oblast. In 2006-2011, it was in the “average” group, and in 2014 it moved to the group of “early majority,” that uses innovations more actively. It is characteristic that in the last analyzed period, the value of the indicator in the marked area approximated to the average value (61%), whereas in 2006 there was a significant lag from the average level in Russia.

For 2006-2014, the “average” group included eight regions. Others moved to groups with higher rates of innovation. For example, Orenburg Oblast, the Republic of Adygea and Altai improved their positions, moving from the category of “laggards” to “average.”

The “laggards” group is not numerous. In 2014, it included only seven regions: Astrakhan Oblast; Republic of Buryatia, Dagestan, Sakha (Yakutia), Tuva, Trans-Baikal Krai, and Jewish Autonomous Oblast. These regions are characterized by lower milk production levels, which allows making the conclusion that they lack innovative development. For example, in 2006-2014 Astrakhan Oblast, the Republic of Tuva, TransBaikal Krai, and Jewish Autonomous Oblast did not use the innovative resources of breeding livestock.

The study results revealed certain trends in the innovation diffusion at the regional level. The group composition changes largely depend on the innovative projects implementation scale. The substantial growth of the “innovators” group for 2006-2014 years can be explained by active implementation of new investment projects, reconstruction and modernization of production in the Central Federal District, the majority of regions in which joined this group in 2014 (On progress and results…)

Figure 1
Diagram of the innovations diffusion in the dairy cattle breeding in Russia



From 2006 to 2014, the population of the “laggards” group decreased from 13 to 7 regions, and of the “average” group from 42 to 13 regions. The regions that left those groups joined groups with higher rates of innovation: the “early majority” group’s population increased from 8 to 25 regions; the “early adopters” group’s population from 3 to 11, and the 10 regions were included in the “innovators” group, so that the total number

of regions in this group reached 12.

The graphical interpretation of the innovations diffusion in dairy farming is presented in Figure 1.

During the first period of comparison 3% of the regions are assigned to the first group, 4% - for the second, 12% - to the third; 62% - to the fourth; 19% - to the fifth group. During the second period – 6%; 13%; 29%; 40%; 12% of the regions respectively, and during the third period – 18%, 16%, 37%, 19%, 10% of the regions.

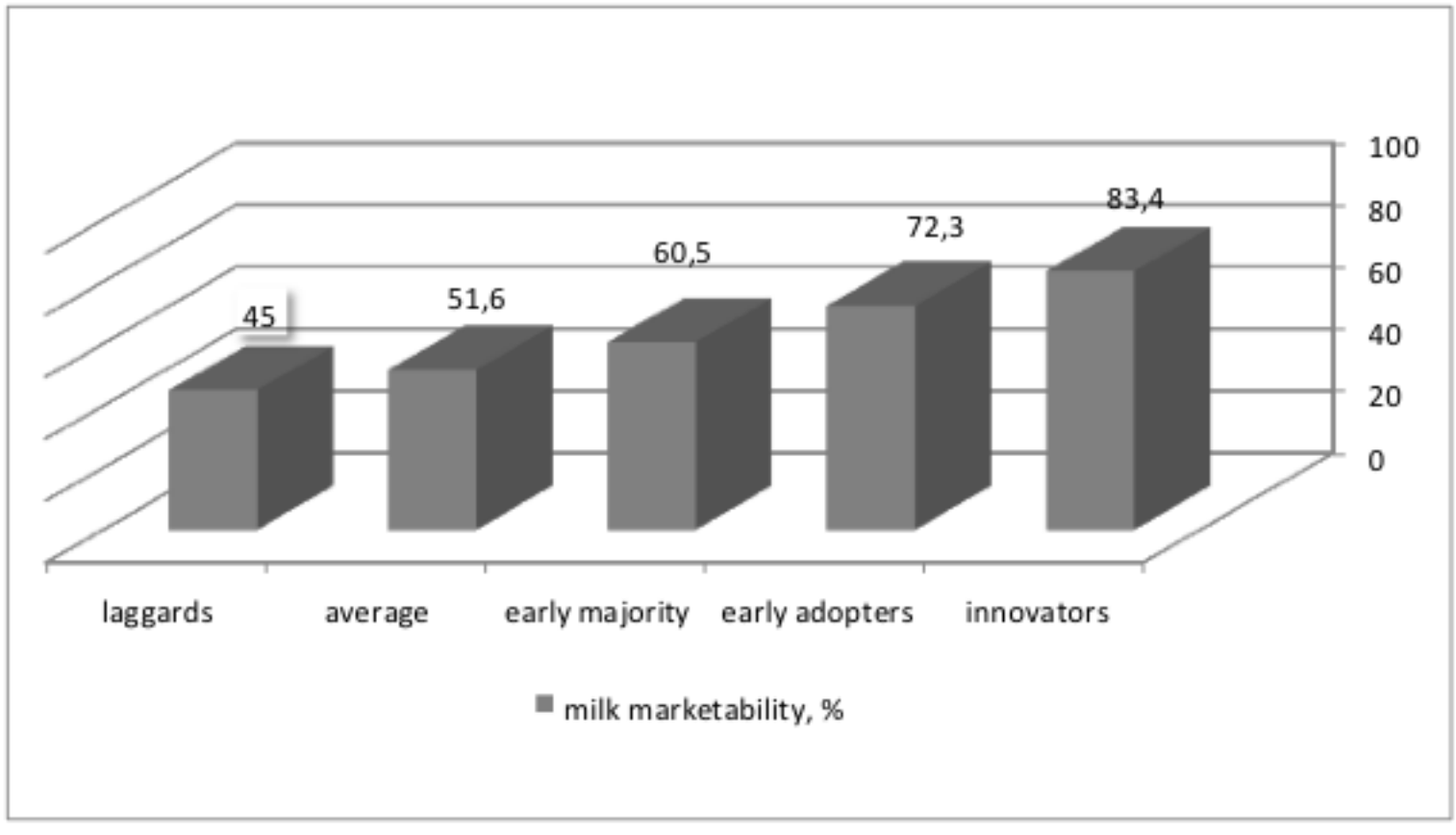
The curves' configuration characterizes the nonlinear nature of the innovation diffusion. When we compare the processes in 2006, 2011, and 2014, we can observe their more uniform diffusion in 2014. With a certain degree of conditionality, it can be assumed that in 2011-2014 the distribution took place according to E. Rogers (Rogers, 1962, p.26). It is correlated with the measures of state support within the framework of the State Program of Development of the Agribusiness to 2020. In particular, the government granted subsidies to agribusinesses per 1 kg of milk, subsidies for the maintenance of breeding stock and for cattle breeding support, as well as refinancing rate subsidies. In this regard, the most popular areas of state support are the measures facilitating the increase in the share of dairy products produced using innovative technology. These measures can better ensure an increase in the milk production.

There are numerous factors and constraints that influence the innovation diffusion. They are detailed in the source publication (Mortensen et al., 2015, p.84). In addition to financial constraints, typical for almost all kinds of innovations, the role of the institutional structure heterogeneity is very important in Russian dairy cattle breeding: the share of households in the production of milk is 46–47%. This factor certainly determines the coexistence of different technological structures. Moreover, the formation of a new technological stage by creating mega and robot-assisted farms is still at an early phase. In particular, the share of mega farms is only 5% of total production, and the robot-assisted machinery is used only in 1% of the total number of dairy farms of the country. It should be noted that the support for the dairies' robot automation process is an additional measure of support included in the 'green box' of the WTO, that assumes the formation of unlimited "credibility" to this process intensification.

Neoclassical researchers in their scientific publications proved the undeniable impact of innovation on the economic growth (Solow, 1953, p. 14). However, it should be noted that general diffusion may occur if the new equipment is better than the previous in all respects. Innovative substitution (including the value-for-money factor) takes place under the condition of equality of relative prices and relative productivity. The process of the automated dairy plants implementation in Germany (1949-1985) took long time due to the predominance of the price factor that partially devalued the relative advantages of the new technology implementation (Klaus, 2009).

The above allows to conclude that the calculation method for the innovative dairy farming development indicator allows identifying the most important factors of innovation diffusion in the regional context, assessing the innovative potential of the industry, and defining the strategic directions of individual territories' development. Moreover, the classified region groups form an information matrix as a basis for developing predictive models for the innovative differentiated areas' development.

Figure 2
The milk marketability level in all farm categories, 2014



Source: It is compiled according to the statistics of the Ministry of Agriculture of Russia and the Federal State Statistics Service (Dairy industry, 2016)

To support the assumption, the author provides a forecast of dairy cattle breeding development in the Russian Federation until 2020. The forecast covers five groups of regions in terms of milk production innovation rate. One of the most important estimated figures is the marketable milk resource value, which is estimated with account of the milk marketability level in various farm categories (Figure 2).

Significant differentiation was revealed in the milk marketability index in corresponding region groups. Undoubtedly, the "early adopters" and "innovators" demonstrate a higher level of marketability (72.3% and 83.4%, respectively). It is attributable to an appropriate institutional structure with a predominance of agricultural organizations, which are the main suppliers of raw milk for processing.

Prediction calculations showed that if the level of milk marketability in the first three groups is brought to the same level as in the "innovators" group, it would allow selling more than 5.5 million tons every year. The implementation of such a scenario is possible only in the long term, because it would require radical changes in the structure of the state support rendered for dairy producers, promoting the innovation diffusion and use. In the medium term, focusing on the 2020 (as the final stage of the State Program of Development of the Agricultural Sector until 2020), one would expect a selective growth in regions with a high share of agricultural organizations, compensating the insufficient level of production in farms and households.

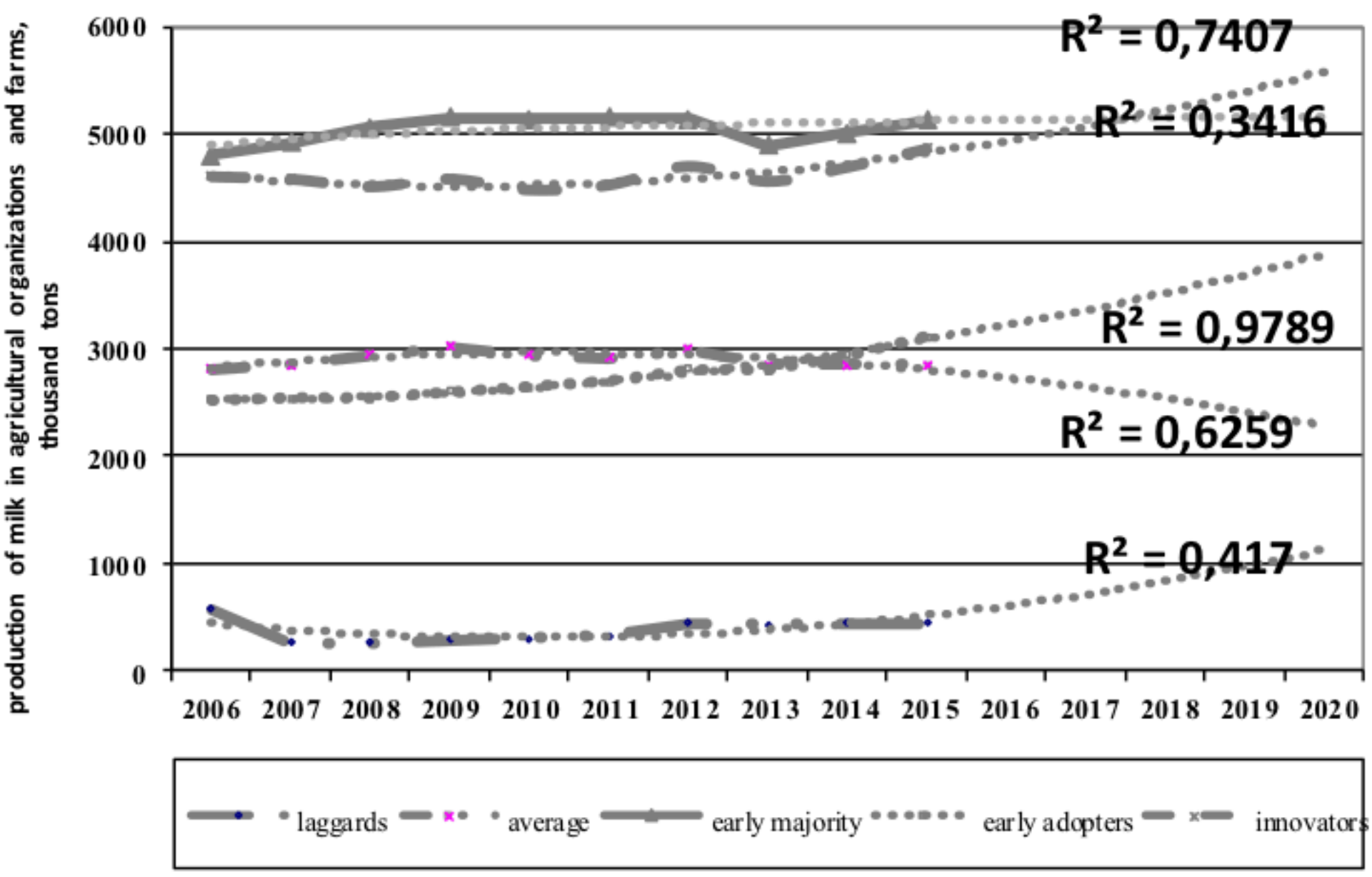
We calculated the predicted value of milk output in 2020 in agricultural organizations and farms for a five-year period based on the polynomial trend equations (the trend was selected by relevant indicators of adequacy) (Table 2).

Table 2
Importance evaluation of the region groups' development models

Regions groups	R2 (linear trend)	R2 (polynomial trend)
"laggards"	0.0596	0.417
"average"	0.0051	0.3416
"early majority"	0.5048	0.5048
"early adopters"	0.9044	0.9789
"innovators"	0.3674	0.7407

We preformed the calculation with account of the growth (decline) rate of the milk production in agricultural organizations and farms in 2006-2014 in region groups with different innovation level in milk production. We assumed that the structure of milk production by natures of households in 2020 will not undergo significant changes and remain at the level of 2014. The forecast of milk production in agricultural organizations and farms in the region groups with different innovation level is shown in Figure 3.

Figure 3
Forecast of milk production in agricultural organizations and farms in Russia



Provided the production trends remain the same in 2006-2015, the gross milk production in agricultural organizations and farms of the above groups will increase by 7.9% and reach 18 million tons within 2006-2020. As we compared the 2020 targets by household groups, we failed to reveal any correlation between the milk production innovation level and the economic growth, as the innovation effect manifests itself after a certain time. The greatest increase in milk production will take place in the "laggards" group (by 2.5 times) and in the "early adopters" group (by 24.5%).

4. Discussion

The author based the interpretation of the innovation diffusion theory in relation to dairy cattle breeding on the innovative development indicator calculation method, allowing identifying trends and describing the process of innovation diffusion in 68 regions of Russia in 2006-2014. We assumed that the higher productivity of cows depends on use of innovative production resources, particularly on process innovations. Based on the standardization of the index of annual milk yield per cow in agricultural organizations, five groups of regions, having significant differences in the innovation potential and institutional structure, were distinguished.

The proposed method allowed ranking Russian regions by the milk production innovation level in agricultural organizations and tracing the innovation diffusion in the space-time projection. Over the nine-year period, there was a significant change in the region groups, where the vast majority of regions moved to a higher group as they reached a higher innovation level. The innovation diffusion rate depends on the environment susceptibility (in this case, the agricultural system). The existing diffusion barriers (Rogers, 1962; Mortensen et al., 2015, p. 48) in dairy cattle breeding in Russia are mainly of financial nature and are largely determined by the investment activity level and the extent of the existing facilities' modernization. From a practical standpoint, innovative development indicators are useful for developing a regional innovation policy, whereas the long-term goals and priorities of the economic development can determine the particular efforts to be applied.

It is obvious that the new technological stage formation can be activated provided the government takes the innovation support measures. Currently, the Russian agricultural sector requires an effective mechanism for the creation, development, introduction, diffusion, and use of the innovation potential (Potapov, 2011, p. 11). Foreign researchers also indicate their interest in addressing this issue. The inconsistency of the purposes of regional policy of rural area innovative development and the interests of local authorities in Apulia is noted in studies (Labianca et al., 2016, p. 38-46). Innovations are considered not only from the perspective of technology, but also in social and cultural terms. Smith and Osborne (2008, p. 96) suggest using the interpretative phenomenological analysis for solving innovation-related problems in the management system at the regional level. Other authors (Labianca et al., 2016, p. 38-46) used the method of descriptors in the

analysis of the innovation dominant in the Apulian rural area development programs.

The strategic management method that allows determining the degree of coherence of long-term goals and objectives (including innovative character) with the action course and resource support based on the balanced scorecard is in demand. This definition is justified by the authors (Kaplan and Norton, 1992, p. 44). The above method is used in the preparation of program documents of the industries, facilities, and areas development at both national and supranational levels (e.g. the Common Agricultural Policy of the EU). The implementation of innovative strategies within the framework of the Common Agricultural Policy is carried with account of the effective use of local resources, which particularly relevant for the development of disadvantaged rural areas (Dax and Oedl-Wieser, 2016, p. 16-18).

Innovative solutions are in the focus of the agricultural policy of Germany, and the innovation activity costs increase annually. In 2012, the German Agricultural Innovation Partnership (DIR) was established to support the most effective innovative projects. Its goal is to promote the innovative projects' implementation (Agrarpolitischer Bericht, 2015).

The situation concerning strategic management of the innovative activity in the agricultural sector of Russia faces greater challenges. In order to determine the degree of compliance with the basic principles and methods of strategic management, the author compared targets and indicators of the State Program of Agricultural Development and Regulation of Agricultural Markets of Products, Raw Materials, and Food for 2013-2020. The conclusion that the strategic management principles in the sub-program of technical and technological modernization and innovative development are poorly abided by. First of all, they are primarily affected the interests of crop industry. Secondly, the task to create and develop the institutional environment that is necessary for the development and widespread use of innovations was not properly explained and adequately supported by resources. Thirdly, there is no correlation between the sub-program's goal (the creation of favorable economic environment conducive to innovative development and investment attracting in the industry) and the indicators used.

5. Conclusion

Such an indicator as the number of completed investment projects does not distinguish the priorities of individual industries. Consequently, there is no structural balance of investment resources. We believe the innovative development of livestock breeding should be characterized using additional indicators in policy documents: the share of products produced by innovative technologies; the index of production innovation with respect to certain types of products (Vasilchenko, 2015, p. 86-90).

The latter indicator can be successfully used to determine the innovative development stages and this was confirmed by this study.

The research results revealed certain trends in the innovation diffusion at the regional level. Between 2006 and 2014, the "laggards" group shrank from 13 to 7 regions and the "average" group collapsed from 42 to 13 regions. The excluded regions joined the higher innovation rate groups: the "early majority" group grew from 8 to 25 regions; the "early adopters" group grew from 3 to 11 regions, the "innovators" group increased by 10 regions, and total number of regions in this group reached 12.

On the basis of the assumption about the innovative balance of agricultural organizations' resources (the genetic potential, feed, and animal welfare), the author presented a predictive estimate of the marketable milk resources' growth by 2020. We revealed certain growth trends in milk commodity resources in region groups with account of the inter-regional differentiation of the innovation potential.

Without stating it as exclusive, we treat this research as very useful, as it gives grounds for making strategic decisions regarding the regional agricultural systems' development with account of the innovative capacity implementation and effective use of production resources. We intend to continue our research on this topic, focusing on the development of regional innovation diffusion mechanisms.

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1. Candidate of Economic Sciences, Associate Professor, The Innovation Lab Development of the Manufacturing Potential of Agro-industrial Complex, Institute of Agrarian Problems of the Russian Academy of Sciences; Saratov, Russian Federation, E-mail: vasil4enko@yandex.ru

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