Assessing the Impact of Institutional Forms on Food Security

Nikolay S. BONDAREV

Ph.D. (in Economics)

Associate Professor

Head of the Department of Humanitarian Law Disciplines

FSBEI of Higher Education

Kuzbass State Agricultural Academy

12, Karl Marx str., Kemerovo, 650056, Russia

Galina S. BONDAREVA

Ph.D. (in Economics)

Associate Professor

Department of Humanitarian Law Disciplines

FSBEI of Higher Education

Kuzbass State Agricultural Academy

12, Karl Marx str., Kemerovo, 650056, Russia

Abstract

Established economic institutions that provide food to the population have different impacts on food security. The contribution and degree of influence vary depending on the type of institutional form that functions in the existing economic conditions. Assessment of impact of institutional forms on food security allows to reveal by means of methods of economic and mathematical analysis the degree of impact of each institution on security and to describe mathematically this dependence. The study developed and tested a methodology that determined the degree of influence of each subject (forms of management) on the level of food supply to the population on the basis of regression analysis. As a result of approbation of the methodology, the final regression model was obtained, which allowed to estimate the degree of influence of agrarian commodity producers' activity on the process of food supply to the population. As a general conclusion, it was determined that the food security of the territories of the Kemerovo Region - Kuzbass is most heavily influenced by personal subsidiary economy of the population, making a significant contribution to the production of basic foodstuffs. on the level of food supply to the population on the basis of regression analysis.

Keywords: institutionalism; institutional forms; food security; food supply; agriculture.

Introduction

Institutional forms form the basis for providing food to the people of the Territories and achieving food security. In order to assess the validity, models and conclusions have been superimposed on an integral food security indicator, thus limiting the impact on regional self-sufficiency. The different forms of institutions have different impacts on self-sufficiency and, consequently, on food security. Therefore, the purpose of the proposed methodology is to identify the impact of different types of institutions on food security formation and provision.

Methods

Due to the fact that institutional impact on food security may vary (depending on food groups), the author's methodical approach determines the degree of impact for each species by estimating the cumulative impact by calculating the weighted average institution-form of each species.

As a result, the institutional impact of the form institutes on food security is determined on the basis of the correlation dependence models and assessment of their quality indicators. The criterion for evaluation of the built models is the determination coefficient of (R^2). In case R^2 approaches "1", the degree of influence of production indicators of each institutional form on food self-sufficiency and, as a consequence, security is determined.

The following provisions have been used to build an institutional impact model on food security:

1. Food security depends on the output of agricultural institutions over a given period;
2. The relationship between food security and institutional output is logical and relatively sustainable.

Linear function of influence of institutional forms (institution-form) on food security is an economic-statistical model and describes the existence of a sustainable dependence of food self-sufficiency and, as a result, food security on the size of agricultural production by institutions-form of each type.

The information base for the construction of functions of influence of institutional forms on food security is the data of public statistical reporting, presented on the official website of the Federal State Statistics Service (Rosstat).

In this study, it is accepted that the proposed methodology for assessing the impact of institutional forms on food security is limited to the institutional forms of three types:

- agricultural organizations (legal entities in various organizational and legal forms),
- peasant agriculture and individual enterprise,
- personal subsidiary economy (personal subsidiary farms).

The review of scientific researches, practices, analytical calculations and approbation of the methodology allowed determining that the level of food security of a region with 99% probability depends on food self-sufficiency (linear and direct connection) (Ozcakmak, 2017; Kostyaev, Kostusenko, 2012; Bondareva, Bondarev, 2019; Wang, van Vliet, Pu, et al., 2019; van Meijl, Shutes, Valin, Stehfest, van Dijk, Kuiper, Tabeau, van Zeist, Hasegawa, Havlik, 2020). The Doctrine of Food Security of the Russian Federation clearly defines the borders for each food group, which should be ensured through own production, i.e. territorial self-sufficiency. This narrows the scope of the presented study down to an assessment of the impact of the form institutions to an indicator of self-sufficiency. The algorithm of determination of self-sufficiency is based on the calculation of the ratio on the basis of own per capita production data for each food group without taking into account production consumption and losses to a rational norm of food consumption that meets modern requirements of a healthy diet (Pershekevich, 2019; Peng, Berry, 2018). At the same time, by virtue of fixation of rational norm by corresponding normative-legal act, the rational norm is a constant value or in a range, for the purpose of research the calculation of self-sufficiency is determined on the basis of the lower boundary of established rational norms.

The consequence of the presence of a constant in correlation-regression dependencies is the absence of variation in the index, thus, the approbation of the methodology is limited to the study of the total volume of production by institute-form of each type and population, as consumers of the final product.

At approbation of the methodology to assess the degree of impact of institutional forms (institute forms) on food security research is limited by the factor of production, defined as C_{ij} , which accumulates the annual production of the industry (proposed by the authors) (Formula 1).

$$C_{ij} = C_{ij_o} + C_{ij_k} + C_{ij_l} \quad (1)$$

where, C_{ij_o} – contribution of the institute form "agricultural organizations" to the annual production of food groups;

C_{ij_k} – contribution of the institute form "peasant farms and individual entrepreneurs" to the annual production of food groups;

Cij_l – contribution of the institute-form " Personal subsidiary economy " type to the annual production of food groups.

The types of food groups are indicated by parameters:

Z_1 – winter and spring wheat;

Z_2 – field and protected ground vegetables;

Z_3 – potato;

Z_4 – milk production;

Z_5 – cattle and poultry production on slaughter at slaughter weight.

Thus, the mathematical designation of the function of influence of form institutes on food security will take a linear form.

Determining at the stage of approbation is the reduction of calculated indicators to a single measurement base: the fact of physical production (kilogram, tons, thousand tons, million tons); percentage ratio of contribution of each institute-form; rates of production growth - interest / coefficients.

In-depth research in the form of increasing the number of institute forms by type (open/closed joint-stock companies, limited liability companies, etc.) will take into account the degree of their impact on the total production for each food group and the basic equation will take the following form (proposed by the authors):

$$Cij = Cij_1 + Cij_2 + \dots + Cij_n \quad (2)$$

where, Cij_1 – contribution of the institute-form "1" to the annual production of food groups;

Cij_2 – contribution of the institute-form "2" to the annual production of food groups;

Cij_n – the contribution of the "n" form institute to the annual production of food groups.

The contribution of a form institute depends on the production of each institute and ultimately on their number, which can be reflected by the formula (proposed by the author):

$$Cij_1 = Cij_{1,1} + \dots + Cij_{1,n} \quad (3)$$

where, $Cij_{1,1}$ – first institute contribution;

$Cij_{1,n}$ – last institute contribution .

Approbation of the methodology of influence level estimation based on the author's algorithm includes the construction of regression models based on the selected indicators, taking into account the parameters "Standard Error", "t-statistics", "P-value" (if less than 15% - the coefficients of the obtained models are recognized as significant), the level of significance F (much less than zero - the reliability of the equation is good), "Lower 95%" and "Upper 95%"; determination coefficient (R)² - the value is high enough, then the equation can be used and the variables are determined correctly) (Bondareva, Bondarev, 2019; Thorburn, Boote, Nendel et al., 2019; Batukova Bagdasaryan, Belyakova, Vladimirova, Belyakov, 2019).

Primary Data Analysis

Approbation of the methodology was carried out on the materials of the Siberian Federal District and the Kemerovo Region-Kuzbass based on the data of the result of calculation of food self-sufficiency, structure and dynamics of production of the industry by categories of farms in the context of institutional forms.

While self-sufficiency indicates that agrarian production of territories is sustainable, the dynamics of production by categories of farms in terms of institutional forms demonstrates the degree of participation of forms of management in the production process and the formation of the basic basis for physical accessibility of food (Tables 1-4) (Rosstat).

The data, presented in Tables 5 and 6, will allow estimating the impact of institutional forms on food security by livestock production in their context (Rosstat).

Table 1. Gross dues of food groups of the institute-form "agricultural organizations", thousand centners

Type of food group	Year														
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Siberian Federal District															
Z₁ Winter and spring wheat	61727.7	57681.8	68391.4	64400.4	86835	64274.8	65812.9	37788.7	59602.2	53467.1	57361.1	58818.4	57642.032	59313.651	58060.591
Z₂ Field and protected ground vegetables	2017.4	2024.7	2295.4	2355.1	2340.9	1988.5	2441.3	2009.5	2054.8	1905.4	1982.4	2270.6	2099.8	1989.1	2122.2
Z₃ Potato	1713.3	1995.5	2066.1	2589.7	2723.5	2852.9	3581.9	2829.1	3224.8	3654.4	3985.1	4272.9	4298.7	4361.33	3823.3
Kemerovo Region-Kuzbass															
Z₁ Winter and spring wheat	3872.9	3748.9	4482.1	4581.8	5062	3746.4	3441	1190.5	2192	2274.8	2561.9	2410.8	2610.4	2697.5	2534.7
Z₂ Field and protected ground vegetables	427.93	434.63	533.62	570.9	566.1	454.7	641.7	435.2	444.5	468.3	506.3	498	462.8	382.1	413
Z₃ Potato	445.92	512.76	618.12	719.2	814.5	780.5	1045.2	534.5	715.7	863	1010.5	1020	985.1	970.04	1017.84

The largest volumes of production of grain crops of the institute-form type "agricultural organizations" are due to the high technologic efficiency of this direction of activity and, as a consequence, profitability. In its turn, the institute-mold of the type "personal subsidiary economy" has the opposite tendency - non-productive labor and low marketability of the industry products (Bondareva, Bondarev, 2019; Don, Rodriguez, Saka-Helmhout, Makhija, 2017; Nelson, Bogard, Lividini et al., 2018). It should be noted that this fact is not an obstacle for such a significant contribution of the institute-mold of the type "personal subsidiary economy" in the production of potatoes and vegetables, as the traditional specialization of farms.

Table 2. Gross dues of food groups institute-form "peasant (farm) households and individual entrepreneurs", thousand centners

Type of food group	Year														
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Siberian Federal District															
Z_1 Winter and spring wheat	20427.6	23248.1	29919	26859.3	40075.9	28240.1	31375.3	15882.3	32557.1	28555.9	34400	37032	34625	36452	37997
Z_2 Field and protected ground vegetables	450.57	588.86	646.52	545.7	565	504.5	728.9	494.3	672.2	537.3	722.04	886.9	908.4	969.2	1071.4
Z_3 Potato	602.41	910.95	852.45	1156.5	1300.6	1372.4	1883.4	1356.9	1764.3	2040.2	2433.8	2882.7	2799.8	2983.1	2801.2
Kemerovo Region-Kuzbass															
Z_1 Winter and spring wheat	2855.5	2857.7	3679.9	3993.6	4854.1	3522.8	3387.6	1251.2	2016.3	2198.2	2638	2402.4	2503.8	2601.8	2588.1
Z_2 Field and protected ground vegetables	8.42	9.51	39.71	40.1	42	33.7	29.9	8.9	17	28.2	57.3	45	63.8	55.4	96.2
Z_3 Potato	131.69	210.8	183.3	286.9	360.6	410.5	524.1	175.2	357	398.7	429.1	516	562.7	577.2	548.3

Table 3. Gross dues of food groups of institute-form "personal subsidiary economy", thousand centners

	Year														
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Siberian Federal District															
Z₁ Winter and spring wheat	595.48	624.3	670.7	598.6	893.5	596	666.2	393	510.8	464.3	492.03	506.1	489.3	498.1	502.6
Z₂ Field and protected ground vegetables	12711.3	11389.8	12104.6	13268.8	13834.3	13106.2	13775.2	13497.2	13249.2	12858.4	12845	12847.7	12815.9	12836.6	12809.3
Z₃ Potato	47120.9	46339	43799	47434.7	50130.1	50566.6	52985.1	40602.6	48352.1	47609.3	46822.3	46313.2	46921.4	46134.3	47075.7
Kemerovo Region-Kuzbass															
Z₁ Winter and spring wheat	8.17	11.14	38.4	61.1	48.5	109.5	72.3	41.5	66.5	69.3	110.65	70.8	82.4	79.1	74.2
Z₂ Field and protected ground vegetables	1126.3	1269.2	1269.2	1610.3	1640.8	1648.6	1776.8	1812.2	1766.9	1766.9	1758	1859.7	1809.7	1780.2	1873.7
Z₃ Potato	4370.4	4351.9	4271.8	5562.2	5562.2	5574.5	5776.5	4487.8	5437.3	5597.2	5597.3	5505	5532.1	5281.4	5262

Table 4. Production of milk (Z4) by institutional forms, thousand tons

Institute- Form	Year														
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Agricultural organizations															
	2230.5	2171.0	2177.0	2238.4	2250.7	2239.8	2320.8	2284.6	2090.6	2158.5	2159.0	2135.2	2134.6	2157.4	2180.3
Kemerovo Region- Kuzbass	169.4	179.8	186.7	186.2	173.6	164.0	169.4	158.0	143.4	148.9	153.9	155.4	160.4	164.6	168.7
Peasant farms and individual entrepreneurs															
Siberian Federal District	129.9	140.7	155.9	173.1	188.0	206.2	192.8	195.6	202.3	215.1	233.7	274.1	316.9	320.7	324.4
Kemerovo Region- Kuzbass	24.2	24.9	25.0	31.3	35.9	33.7	28.2	26.7	23.1	24.0	22.5	25.3	26.9	28.6	27.0
Households of population															
Siberian Federal District	3086.5	3109.9	3201.6	3259.2	3216.8	3183.4	3212.2	3102.6	3006.3	3015.7	2993.8	2869.6	2767.9	2887.9	2871.8
Kemerovo Region- Kuzbass	213.5	210.3	220.7	222.4	214.3	198.5	199.3	197.8	202.4	203.1	203.7	201.6	200.5	201.8	202.4

Table 5. Cattle and poultry production at slaughter weight (Z5) by institutional forms, thousand tons

Institute- Form	Year														
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Agricultural organizations															
Siberian Federal District	431.8	438	459.1	473.4	465.6	504.3	536	582.7	603.5	613.2	622.3	643.5	666.4	689.2	712.1
Kemerovo Region- Kuzbass	27.6	27.9	36.6	40.6	45.7	54.8	58.1	61.5	65.8	64.3	69.3	72.0	76.2	80.4	84.5
Peasant farms and individual entrepreneurs															
Siberian Federal District	23.0	25.9	28.7	31.2	33.4	35.2	35.5	38.3	40.6	41.4	41.9	46.3	50.1	53.8	57.6
Kemerovo Region- Kuzbass	1.7	1.9	2.1	2.6	2.7	2.3	2.4	2.0	1.9	1.7	1.7	1.7	1.7	1.7	1.7
Personal subsidiary economy															
Siberian Federal District	371.8	362.7	395.2	444.4	497.8	506.4	519.1	524.1	514.4	507.5	495.5	484.3	468.2	452.1	435.9
Kemerovo Region- Kuzbass	27.3	27.7	28.7	26.9	27.4	24.4	24.2	24.2	21.3	22.8	22.7	22.1	22.0	21.7	21.5

As can be seen, animal production (meat and milk) is more concentrated in institutional forms such as personal subsidiary economies and agricultural organizations.

Results

To test the proposed methodology for assessing the impact of institutional forms on food security, Statistica 12 software product and the "Data Analysis" module of Microsoft office Excel 2010 were used.

The final regression equations by institutional forms and food product groups are presented in Tables 6-8.

Table 6. Results of correlation-regression analysis to assess the dependence of annual production of food groups by institutional forms of "agricultural organizations" type

Type of food group	Regression equation		Determination coefficient (R^2)	
	Siberian Federal District	Kemerovo Region-Kuzbass	Siberian Federal District	Kemerovo Region-Kuzbass
Z_1 Winter and spring wheat	$y = -743.58x + 66694$	$y = 11.787x^2 - 350.78x + 4992.3$	0.1093	0.4933
Z_2 Field and protected ground vegetables	$y = -8.6579x + 2195.7$	$y = -1.9615x^2 + 26.332x + 434.15$	0.053	0.3347
Z_3 Potato	$y = 185.33x + 1715.6$	$y = 445.12x^{0.2989}$	0.8848	0.6899
Z_4 Milk production	$y = -0.7884x^2 + 6.451x + 2208.8$	$y = 0.3108x^2 - 6.6375x + 192.9$	0.2383	0.5163
Z_5 Cattle and poultry production on slaughter at slaughter weight	$y = 21.22x + 392.98$	$y = -0.1221x^2 + 6.0049x + 19.74$	0.9795	0.9862

As can be seen from the presented dependencies, food security in bread and bakery products, as well as in meat and meat products, depends to a large extent on the production of the institution by agricultural organizations with a probability of more than 95%.

Table 7. Results of correlation-regression analysis to assess the dependence of annual production of food groups by institutional forms of "peasant farms" type

Type of food group	Regression equation		Determination coefficient (R^2)	
	Siberian Federal District	Kemerovo Region-Kuzbass	Siberian Federal District	Kemerovo Region-Kuzbass
Z_1 Winter and spring wheat	$y = 897.2x + 23332$	$y = -94.005x + 3642.1$	0.3449	0.227
Z_2 Field and protected ground vegetables	$y = 4.242x^2 - 32.936x + 598.93$	$y = 0.452x^2 - 3.4758x + 28.781$	0.8086	0.6028

Z₃ Potato	$y = 175.29x + 407.04$	$y = -0.3563x^2 + 34.068x + 135.05$	0.9346	0.6971
Z₄ Milk production	$y = 127.06e^{0.0626x}$	$y = -0.0381x^2 + 0.4766x + 26.493$	0.9417	0.0524
Z₅ Cattle and poultry production on slaughter at slaughter weight	$y = 0.0504x^2 + 1.4076x + 23.431$	$y = -0.0088x^2 + 0.1x + 1.9156$	0.9804	0.4512

As follows from the presented dependencies, food safety in cattle and poultry production on slaughter in slaughter weight (i.e. meat and meat products) with the probability of 98.04% for the Siberian Federal District and 45.12% for the Kemerovo Region depends on the production of the peasant farm type. On milk production, on the basis of the received models, also high dependence of manufacture of dairy production on the considered institute-form in federal district (more than 94%), is received, similarly on potato production - more than 93% on SFD and more than 69% on the Kemerovo Region - Kuzbass accordingly on data for 2005-2019 analytical years.

Table 8. Results of correlation-regression analysis to assess the dependence of annual production of food groups by institutional forms of " personal subsidiary economy" type

Type of food group	Regression equation		Determination coefficient (R^2)	
	Siberian Federal District	Kemerovo Region-Kuzbass	Siberian Federal District	Kemerovo Region-Kuzbass
Z₁ Winter and spring wheat	$y = 685.99e^{-0.026x}$	$y = 11.172x^{0.8296}$	0.3543	0.7403
Z₂ Field and protected ground vegetables	$y = -20.812x^2 + 358.89x + 11779$	$y = -6.1279x^2 + 142.96x + 1014.1$	0.3755	0.9183
Z₃ Potato	$y = -34.08x^2 + 506.38x + 45980$	$y = -14.998x^2 + 303.19x + 4025.6$	0.0462	0.4999
Z₄ Milk production	$y = 3281.6e^{-0.009x}$	$y = -1.1871x + 215.65$	0.6706	0.4367
Z₅ Cattle and poultry production on slaughter at slaughter weight	$y = -2.642x^2 + 47.63x + 302.66$	$y = -0.5339x + 28.598$	0.9156	0.8416

Food safety depends on the production of the institute-mold of the LPH type for potatoes with the probability of 91% in SFD and 67% in Kemerovo Oblast. Rather high values of the determination coefficient for vegetables (R^2) are 74.4% and 72.2%, respectively.

The research algorithm implies the determination of the degree of influence of institutional forms, in this case agricultural organizations, peasant farms and individual entrepreneurs, as well as personal subsidiary economy, on the total production by food groups and eventually indicates the

source of self-sufficiency of territories and, as a consequence, its level. For this purpose, regression analysis has been used, which allows to determine the dependence, weight coefficients by established parameters. The final regression model to assess the degree of impact of institutional forms on food supply and, as a result, food security is interpreted as a function of an independent variable and parameters with the added random variable, i.e. the aggregate of values of the final model and random value. The construction of a hypothesis, which allows to determine the nature of the distribution according to the obtained model, is based on the performance of the corresponding statistical test (analysis of residuals) with the calculation of the determination coefficient (R^2), indicating that the model corresponds to the data (Table 9).

Table 9. Summary data for the assessment of the impact of institutional forms on annual production of food groups

Institute-Form	Degree of impact, %		Determination coefficient (R^2)	
	Siberian Federal District	Kemerovo Region-Kuzbass	Siberian Federal District	Kemerovo Region-Kuzbass
Z_1				
Winter and spring wheat				
Agricultural organizations	71.4	54.7	99.63	99.24
Peasant farms and individual entrepreneurs	30.9	48.2	98.74	99.19
Personal subsidiary economy	0.9	1.2	83.16	84.77
Z_2				
Field and protected ground vegetables				
Agricultural organizations	14.1	24.71	99.61	99.01
Peasant farms and individual entrepreneurs	3.9	1.41	89.42	83.71
Personal subsidiary economy	81.97	75.02	99.76	99.03
Z_3				
Potato				
Agricultural organizations	5.7	11.1	96.51	99.01
Peasant farms and individual entrepreneurs	2.8	5.1	92.04	95.14
Personal subsidiary economy	92.21	83.02	99.67	99.63
Z_4				
Milk production				
Agricultural organizations	41.01	42.16	99.74	98.88
Peasant farms and individual entrepreneurs	3.41	7.04	98.22	98.04
Personal subsidiary economy	56.8	52.14	99.83	98.97
Z_5				
Cattle and poultry production on slaughter at slaughter weight				
Agricultural organizations	53.8	70.4	99.62	99.41
Peasant farms and individual entrepreneurs	3.7	2.9	97.51	97.22
Personal subsidiary economy	46.7	26.8	99.63	99.01

The final data obtained as a result of the application of the methodology for assessing the impact of institutional forms on food security of the entities that form it indicate the presence of similar values.

Discussion

According to the data for the estimated year 2019, it was determined that the degree of impact of the activities of institutional forms in the production of food groups:

- Z_1 "winter and spring wheat" is more represented by the institutional form "agricultural organizations" with the distribution of participation of 71.4% for the Siberian Federal District and 54.7% for the Kemerovo Region - Kuzbass;- Z_2 "vegetables of open and protected ground" depends on the activity of LPH with the contribution of 81,97% for Siberian Federal District and 75.02% for Kemerovo Region - Kuzbass;

- Z_3 "potatoes" as a cultivated crop is represented by the institute form of the " personal subsidiary economy " species with the distribution of participation 92.21% for Siberian Federal District and 83,02% for the Kemerovo region - Kuzbass;

- Z_4 "milk production" practically with equal participation is represented by the institute-form "agricultural organizations" and " personal subsidiary economy " with predominance of the latter at the ratio of 41.01% and 56.8% for Siberian Federal District against 42.16% and 52.14% for Kemerovo Region - Kuzbass respectively;- Z_5 "production of cattle and poultry on slaughter (in slaughter weight)" with distribution of participation 53.8% for Siberian Federal District and 70.4% for Kemerovo Region - Kuzbass.

The institute-form of the species "personal subsidiary economy", as a type of small forms of management, confirms the essential importance in providing the population with food, in particular, on vegetables of open and protected soil and potatoes, the degree of influence more than three times higher than other species.

Conclusion

The proposed methodology for assessing the impact of institutional forms on food security allows for taking into account the contribution of each type of institution based on the construction of regression models, as well as to identify the dependence of food self-sufficiency and security on the type of institutional form based on the definition of correlation dependence.

References

- Batukova, L., Bagdasaryan, N., Belyakova, G., Vladimirova, O., Belyakov, S. (2019). The model of innovation development metasystem. *Quality - Access to Success*, 20(172), 18-24.
- Bondareva, G.S., Bondarev, N.S. (2019). Food supply for the population of Siberian regions: theory and methodology. Ministry of Agriculture of Russian Federation; FSBEI of Higher Education Kuzbass State Agricultural Academy. Retrieved from: <http://ksai.ru/upload/files/2020/01/23/%D0%91%D0%BE%D0%BD%D0%B4%D0%B0%D1%80%D0%B5%D0%B2/mobile/index.html> (Accessed on February 14, 2020)
- Don, J., Rodriguez, S., Saka-Helmhout, A., Makhija, M. (2017). International business responses to institutional voids. *Journal of International Business Studies*, 48, 293-307.
- Federal State Statistics Service: Rosstat. Official website of the Federal State Statistics Service: Rosstat. Retrieved from: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/ (Accessed on March 8, 2020)
- Kostyaev, A.I., Kostusenko, I.I. (2012). Ensuring of Russian food security: regional aspect. *Economics of agricultural and processing enterprises*, 5, 4-7.
- Nelson, G., Bogard, J., Lividini, K., et al. (2018). Income growth and climate change effects on global nutrition security to mid-century. *Nature Sustainability*, 1, 773-781.
- Ozcakmak, S. (2017). A model of hazard and risk analysis for bread production and the awareness of food safety. *Quality Assurance And Safety Of Crops & Foods*, 11(8), 719-724.
- Peng, W., Berry, E. (2018). *The Concept of Food Security*. DOI: 10.1016/B978-0-08-100596-5.22314-7.
- Pershukevich, P.M. (2019). Food self-sufficiency of Siberian population: algorithm and methodology of estimation. *AIC: Economics, management*, 4, 4-13.
- Thorburn, P.J., Boote, K.J., Nendel, C. et al. (2018). Recent advances in crop modelling to support sustainable agricultural production and food security under global change. *European Journal Of Agronomy*, 100(SI), 1-3.
- van Meijl, H., Shutes, L., Valin, H., Stehfest, E., van Dijk, M., Kuiper, M., Tabeau, A., van Zeist, W.-J., Hasegawa, T., Havlik, P. (2020). Modelling alternative futures of global food security: Insights from FOODSECURE. *Global Food Security*, 25.

Wang, Y., van Vliet, J., Pu, L. et al. (2019). Modeling different urban change trajectories and their trade-offs with food production in Jiangsu Province, China. *Computers Environment and Urban Systems*, 77, 101355.