Statistical research of labor resources of agriculture in the USA (according to the 2012 Census of agriculture)

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Abstract

The article is devoted to the research of experience of the United States - one of the countries with a federal system, highly developed economy and agriculture - on conducting, design and presentation of the results of agricultural censuses in terms of workforce analysis capabilities. The key role of ensuring agricultural workforce as one of the main factors of efficiency of agricultural production was revealed based on economic and statistical and econometric analysis. It is closely associated with other indicators of the intensity of production, its concentration and specialization.

Key words: agriculture, the United States, labor, agricultural census, summary and grouping data, Farm Typology, statistical analysis, production function.

National agricultural censuses, including the 2016 Russia census of agriculture, are directed in accordance with the World Census of Agriculture (WCA) program of FAO's 2010 round of the United Nations [4], to the fundamental structural characteristics of agriculture, improving the current agricultural statistics software capacity planning and design of agricultural policy, as well as to monitor the implementation of five of the eight Millennium development Goals (MDGs) for the period from 2000 to 2015, the Millennium development Goals (UN General Assembly resolution 55/2 of 18 September 2000). The monitoring and analysis of poverty and food security can be carried out according to the agricultural census for solving one of the key MDGs – "Eradicate extreme poverty and hunger", which is divided in the UN agenda for sustainable development for the period up to 2030 into two goals (from 17 formulated):

1. Widespread eradication of poverty in all its forms;

2. The elimination of hunger and ensuring food security and better nutrition and the promotion of sustainable agricultural development "(UN General Assembly Resolution 70/1 of 25 September 2015).

The objectives of the 2016 Russia census of agriculture broadly in line with the World Agricultural Census 2010, they will also be used to monitor, control and

making forecasts, according to the Food Security Doctrine (approved by Presidential Decree of January 30, 2010 № 120) and the State Program development of agriculture and regulation of agricultural products, raw materials and food for 2013-2020 (Russian Federation Government Resolution dated July 14, 2012 № 717).

In the process of providing planning and development of Agrarian Policy of the World Agricultural Census program sets such an important area as the "study of the (peasant) farms types" [4, c. 18]. This work is being done in the US, the EU and other developed economies, the Russian agricultural economists such as A.P. Zinchenko V.Ya. Uzun, V.A. Saraykin and others, have repeatedly raised the issue of the need to include in the census the results of production and sales, as well as improving reports of its results to provide comprehensive analysis capabilities [1-3, 5, 7.8].

The problem of food security and poverty eradication, which is particularly acute in rural areas, should be resolved at the present stage of development of science and technology by improving the efficiency of agricultural production and rural incomes. With the solution these problems is related preserving the rural way of life and the development of rural areas, which are also the important geopolitical objectives in our country. The study of agriculture labor resources as a factor for its effectiveness and the preservation of the rural way of life – one of the most important tasks of the World Agricultural Census and the 2016 Russia census of agriculture, for the development of ways to improve the statistical analysis the program and system groups from the United States last conducted an agricultural census in 2012 has been examined.

The US Census system of figures allows us to study not only the presence, composition, availability of human resources in the whole country, the regions, constituencies, and their differentiation by type and analytical groups (by the size of land, revenue, specialization, and other attributes) farms [5, p. 6], as well as indicators of wage employees and farmers' income, labor productivity, etc., in contrast to the 2006 and 2016 Russia census of agriculture.

To study the effect of manpower availability – indicator of intensity level associated with a specialization, as a factor of the efficiency of agricultural production at the regional level the method of statistical grouping and the method of correlation and regression analysis can be used. Based on the interim analytical grouping built by the authors on the number of full-time equivalent agricultural workers census data per 1,000 acres, three major groups of states were identified (Table. 1, Fig. 1).

Table 1

The grouping of US states by number of full-time equivalent agricultural workers per unit of land area, 2012 year

Indicator	The groups of states			Average
	I	II	III	
Number of states	14	28	8	50
Per 1 farm:				
size of farm land, acres	846	252	239	434
market value of agricultural products sold, government paymentsand total income from farm-related sources, gross before taxes and expenses, thousand dollars	196	184	343	200
number of full-time equivalent workers, people	1,0	1,1	3,6	1,3
Per 1000 acres, thousand dollars:				
market value of agricultural products sold, government payment sand total income from farm-related sources, gross before taxes and expenses	231	729	1436	461
including government payments	5	15	6	9
gross value added	54	224	583	137
net cash farm income of operation	43	178	268	101
total farm production expenses	189	550	1168	360
including fertilizer, lime, and soil conditioners	14	56	65	31
estimated market value of capital assets, including land and buildings	1494	4375	6696	2747
number of full-time equivalent workers, people	1,2	4,4	15,2	2,9
Capital productivity, dollars	0,15	0,17	0,21	0,17
The average annual salary of hired farm labor, working 150 days or more, thousand dollars	19,7	18,3	25,5	20,0
The share of market value of agricultural products sold, %:				
livestock, poultry, and their products – total	55,7	45,6	27,4	46,2
Including milk from cows	5,2	9,7	14,4	9,0
cattle and calves	42,3	10,1	7,3	19,4
crops, including nursery and greenhouse crops – total	44,3	54,4	72,6	53,8
Including grains, oilseeds, dry beans, and dry peas	33,8	39,8	4,0	33,2
vegetables, melons, potatoes, and sweet potatoes	1,8	3,0	15,0	4,3
fruits, tree nuts, and berries	0,4	2,4	37,4	6,6
The share of irrigated land in harvested cropland, %	19,2	10,8	80,2	16,5

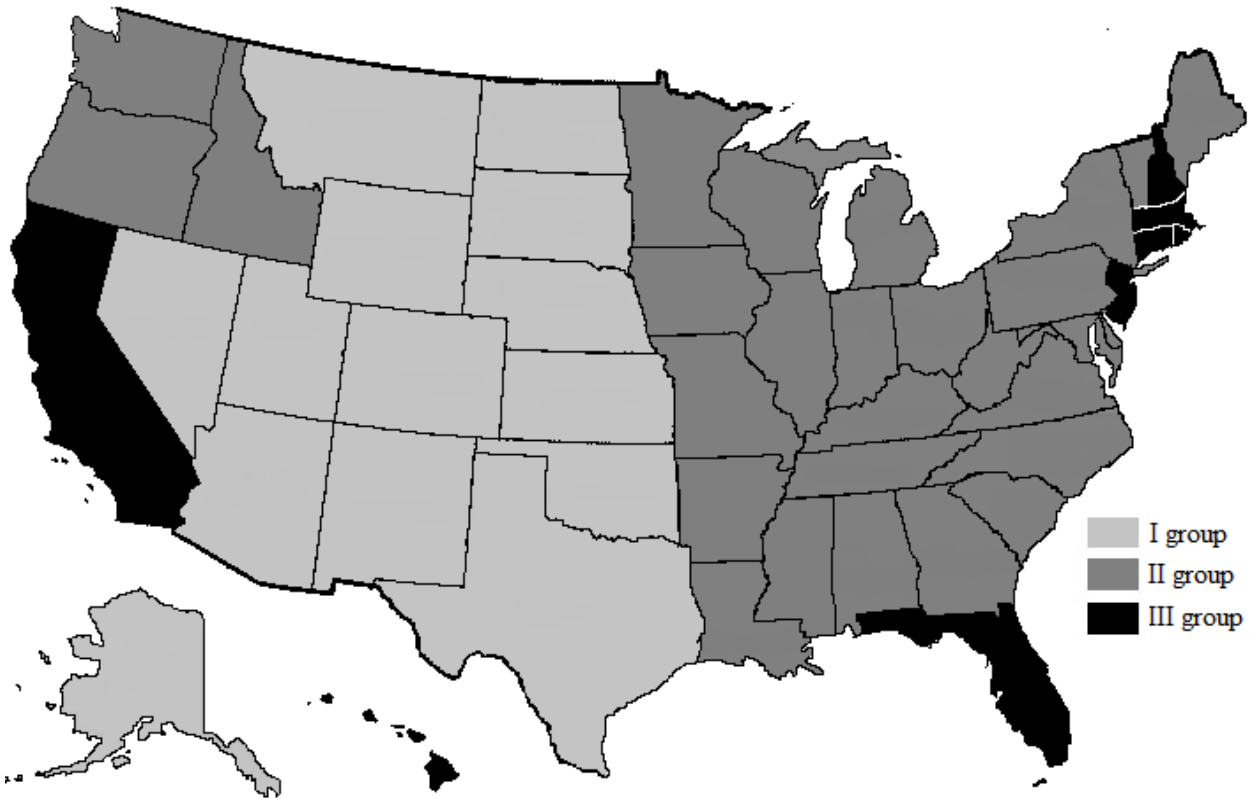

Fig. 1. Cartogram by the number of full-time employees in agriculture per unit of land area in the United States, 2012

The number of full-time equivalent agricultural employees in order to ensure comparability defined in the US as well as in Russia, according to sample surveys. In the US, the equivalent of full-time employees are considered to be 2000 hours worked per year: 50 weeks at 40 hours a week [11, p.11]. The system of agricultural census indicators provides information about the number of farm owners and workers differentiated by the number of days worked, which makes some assumptions to recalculate the full-time employment. It was estimated by the authors that there was 1.3 full-time employees per one farm on average that corresponded to the figure obtained according to a special survey Economic Research Service (ERS) in 2011 – 1.4 [11, p.11].

States differentiated by the availability of human resources of agriculture to a degree: in the third group the number of full-time employees per unit area is much higher than in the first, and more than three times higher than in the second. These differences, as can be seen from Fig. 1, have a natural-historical conditioning and is

closely linked to other indicators of intensity - the level of costs and the cost of the basic means of production, as well as the specialization.

The states of the third group perform an intensive crops irrigation (fruit-growing, viticulture and vegetable-growing) and dairy cattle, the first and the second groups specialize in the production of cereal crops and legumes, sunflower and corn for grain, as to the stock-breeding the states of the first group specialize in growing cattle, the second group – in poultry (16.2% in the revenue structure) and pigs (8.3%). The states of the third group differ by larger concentrated production, which provides a higher level and efficiency of agricultural production in conjunction with the higher level of production intensity.

The level of state subsidies per unit area in the second group of states is three times higher than in the first and 2.5 times higher than in the third, that bear evidence to the differentiated state policy and support the rural way of life.

The effects of manpower availability as a significant feature of the US modern high-tech agricultural production, on the level of its effectiveness can be studied using means of correlation and regression analysis. The correlation coefficient between the variable L – the number of full-time employees per 1,000 acres and Q – revenue from the sale of agricultural products and from other activities (Thousand dollars, per 1000 acres of land area also), equal to 0.6 that indicates the presence of middle closeness of the connection. Complete regression coefficient in the model Simple Linear Regression (authentic, as well as the correlation coefficient, at the level of critical significance 0.01%) leads to the conclusion that if the manpower availability increase by 1 per 1,000 acres, the level of revenue will increase by 43.4 thousand dollars per the same area unit.

Paired regression overstates the true impact of the factor on the result, but the construction of multiple regression models is complicated by the strong collinearity of the factors, that has been shown by the grouping. Using the production Cobb-Douglas function: $Q = AK^{\alpha}L^{\beta}$ (K – market value of the basic means of production (thousand dollars per 1,000 acres, Q and L defined above), and bringing it to a linear form $\ln \hat{Q} = A + \alpha \ln K + \beta \ln L$ does not ensure elimination of the problem of

collinearity between the factors, the correlation coefficient between the logarithm of which is equal to 0.876. Researchers often neglected requirement of lack of collinearity in multiple regression models in the evaluation of their parameters by least squares, for example, in [5] a number of production functions was built, for agriculture as a whole, as well as separately for crops and livestock. In multiple regression models the coefficient by the factor arable land is either statistically insignificant or revealed the negative impact of arable land on the sales revenue, or the coefficient is significant, but its value is so small that the author comes to the conclusion that there is the redundancy of land in the agricultural organizations [5, p.107]. This may be an indication of collinearity of factor variables, which leads to unreliable estimates of the parameters of the regression equations, and obtaining the indicators of communication that are difficult to interpretable from the economic point of view. In the case of multicollinearity factors the multiple model parameters can not be interpreted as net regression coefficients.

To exclude factors collinear the regression model of dependence of productivity on its capital can be constructed: $\frac{Q}{L} = 0{,}294 \cdot \left(\frac{K}{L}\right)^{0{,}903}$.

The coefficient of elasticity is statistically significant (with a critical level of significance of 0.1%), and shows that an increase of the capital-labor ratio in agriculture by 1% increase its capacity by 0.9%. The marginal rate of substitution of manpower for capital, defined on the basis of the model indicates that a decrease the number of full-time employees by 1 person. 1000 acres, value of fixed assets is necessary to increase by 73.3 thousand dollars per 1,000 acres on average. Fig. 2 shows the isoquant, defined by the equation: $K = \left(\frac{Q}{A}\right)^{\frac{1}{\alpha}} \cdot L^{1-\frac{1}{\alpha}}$ for the median states by groups, they show a correlation of factors at a constant level of production. The higher is the revenue per acre in 1000, the higher is the line location.

The analysis confirms that the manpower availability is a limiting factor for agricultural production, so the USDA pays great attention to its study. The system of statistics collected and processed by the Ministry with the agricultural census,

allows a differentiated and detailed description of the composition of the labor force, including farm owners, for groups system, one of the most important of which is the typology of farms, developed by Economic Research Service (ERS) [10].

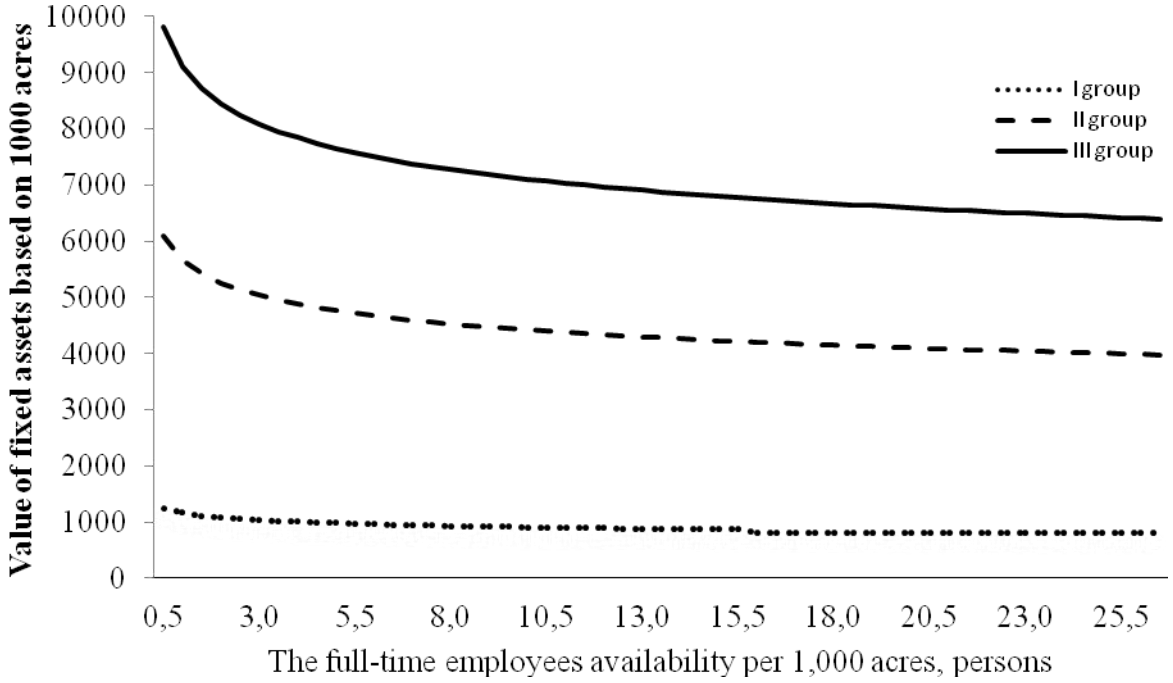

Fig. 2. Isoquants for the state median for groups

All farms on the basis of the typology are divided into two major groups: the family and non-family (the latter occupy 3% of the total number of farms and 15% of total sales), the further analysis assumes the formation of seven groups of family farms taking into account the size of the revenue, the main activity and a lifestyle (Table. 2).

The most effective is a major intensive production with the size of proceeds from the $ 5 million per year based on wage labor (0.3% of the total number of farms, 19% - their contribution to the formation of revenue, 17% – of gross value added in the allocation for this group of farms 2.4% of government subsidies and employment in which 15% of employees). The order of the gross value added of this group per unit area is comparable only with small farms with revenues of 150 to 350 thousand dollars – it is more than 8 times when compared with all the small farms, the difference reaches 24 times.

Table 2

Characteristics of the labor force on farms types in the US (ERS Farm Typology), 2012 year

Indicator	All farms	Family farms							Non-family farms
		Small family farms - GCFI less than $350,000				Mid-size family farms - GCFI $350,000 to $999,999	Large-scale family farms - GCFI $1,000,000 or more		
		Retirement	Farm occupation	GCFI					
			Off-farm occupation	Low sales - GCFI less than $150,000	Moderate sales - GCFI $150,000 to $349,999		Large - $1,000,000 to $4,999,999	Very large - $5,000,000 or more	
Number of states, thousand	2109	612	812	342	95	12	54	6	70
Per 1000 acres, thousanddollars:									
gross value added	137	20	10	17	107	154	263	816	177
net cash farm income of operation	101	9	-2	3	92	133	216	480	107
Numberper 1 farm people:									
farmers	1,5	1,5	1,5	1,5	1,5	1,6	1,8	2,5	1,9
worked on farm: 165 days or more	0,6	0,9	0,2	0,7	0,9	0,8	0,9	0,8	0,6
hired farm labor	1,3	0,5	0,5	0,8	1,8	3,0	8,5	69,6	5,5
working 150 days or more	0,5	0,1	0,1	0,2	0,6	1,2	3,8	36,7	2,6
unpaid workers	1,0	0,9	1,1	1,1	0,9	0,7	0,5	0,3	0,9
Theshareoffarms, %:									
farms by number of 1 operator	56,0	61,1	53,1	57,3	60,3	56,2	44,0	34,6	43,6
2 operators	37,2	33,8	41,3	36,4	32,6	33,2	36,8	27,7	37,9
farms with hiredlabor	26,9	19,5	17,6	27,2	50,6	66,2	87,5	97,4	44,9
contract labor	10,3	8,4	8,1	10,4	15,9	18,3	26,5	41,3	16,3
with household income from farming: less than 25 percent	70,3	80,1	87,8	58,4	15,2	13,0	10,3	17,2	63,5
with primary occupation - farming	47,8	60,4	-	100,0	100,0	90,5	94,7	90,8	53,5
with place of residence on farm operated	76,9	79,1	75,2	79,2	83,1	81,2	76,4	53,7	52,7
working on present farm 10 years or more	77,8	86,5	69,6	73,4	85,1	89,4	92,5	89,6	75,1
female	13,7	16,5	13,2	18,4	4,2	2,9	2,1	2,4	12,4

One of the most important indicators of the level of intensity – manpower availability, as noted earlier, in the group of farms with revenues of $ 5 million per year by 1-2 orders of magnitude higher than the other and up to 70 employees per one thousand acres of the land area, more than half of them work more than 150 days a year, which is associated with a focus on high-intensity fields of animal husbandry and crop production. The farms of retirees and the farms which are residence, occupied 67% of the total population, concentrated 27% of land, they are employing 70% of unpaid workers and 25% of employees, they account for 25.8% of all state payments at a much lower specific gravity in the revenue - 8%.

Despite the relatively high level of income in US agriculture, the attractiveness of low labor problems in the industry for young people it is also relevant, as well as for Russia: the average age of a farm owner is about 60 years.

To characterize the gender inequality according to MDGs and the UN guidelines the indicator of the proportion of women farm owners – 14% on average, 2-3% can be used in the groups of medium and large farms.

Solution to the problem of the Russian Federation food security issues through the development of highly efficient agricultural production based on the intensification and application of innovative technologies, as shown by the US experience, requires improving the quality of statistical support and monitor the implementation of state programs of the course, the expansion of Russian Ministry of Agriculture to participate in statistical surveys and processing the results. The study of agricultural labor resources in the Russian Federation should be carried out using a system of analytical and typological groups based on census results. Employees of the Department of Statistics and Econometrics Russian Timiryazev State Agrarian University have developed and handed over to the Commission on the WCA 2016 proposals on the need to build not on the census distribution series, and really analytical and combination groups, including the number of employees, with the characteristic of the selected groups of indicators system.

It is necessary to renew the analysis, which was conducted by Federal State Statistics Service until 2008 according to the forms of reporting on financial and

economic situation of producers of agro-industrial complex (from 2009 reporting is accumulated only in the Ministry of Agriculture of Russia). Based on the experience of the Ministry of Agriculture of the United States the Department of Agriculture of the Russian Federation needs to develop a typology of agricultural organizations and peasant farmers, the system of analytical groups according to their annual financial statements and to publish the results, including the regional context, on the official website. It is also possible to combine database and census of agriculture, as well as departmental reports on organizations and farmers.

Such information and analytical support would help to develop a differentiated approach to state regulation and support of agriculture, rural life and rural development.

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