

DEVELOPMENT OF THE CEREAL SECTOR IN THE REPUBLIC OF MORDOVIA

Vasily Ivanovich Kargin¹, Regina Alexandrovna Zaharkina²,
Mikhail Mikhailovich Geraskin³

Abstract: *Cereal farming is a strategic and simultaneously multi-purposeful, multi-functional, and system-forming sector of the agro-industrial complex of the Republic of Mordovia. The analysis we have made shows that the change of the area under cereal crops has a cyclic character. In order to optimize the cereal farming and ensure the food safety, it is necessary to perform works on renewing the production of cereals on the abandoned agricultural lands, particularly, for increasing sowing by 100-150 thous. ha. During the researched period acute fluctuations of gross yield were observed. The variation coefficient reached 41.4%. The change of the gross yield is described as a nonlinear equation with two yield downs: during the war and at the post-war period, and during the years of technological destruction of farming.*

Keywords: *the Republic of Mordovia, gross collection of cereals, cereal crops, soil and climate conditions, farming, soils, cultivation technology, fertilizers.*

1. INTRODUCTION

The cereal farming has always been important for Russia. It determines not only the fates of peasants but also the state as a whole. Every Russian period was based on the modernization component of the cereal sector development. The cereal sector in Russia developed under extremely hard conditions: the Great Patriotic War (1941-1945), collectivization, de-collectivization, natural and technogenic (Chernobyl) catastrophes. The cereal sector had a great impact on forming the industry and social area of Russia. It happened at the collectivization period when heavy industry was created, and in the 1960-70s when the oil production and oil processing industries were formed at the expense of cereals export.

The cereal farming is a strategic and simultaneously multi-purposeful, multi-functional, and system-forming sector of the agro-industrial complex of the Republic

¹ Ogarev Mordovia State University 68 Bolshevik Street, Saransk, 430005, Russia

² Saransk Nooperative Institute (branch) of the Russian University of Cooperation 17 Transport Street, Saransk, 430027, Russia

³ State University of Land Use Planning 15 Kazakov Street, Moscow, 105064, Russia

of Mordovia (Altukhov, A.I., 2005, Zakharkina, R.A. et al. 2007, Polushkina, T.M. and Sedova K.S., 2014).

The dynamics of gross yield undergoes great changes due to the weather conditions (Kargin, I. F. et al., 2001; Nemtsev, S. N. and Sharipova, R. B., 2012), soils quality (Geraskin, M. M., 2008; Nosonov, A. M. et al., 2011; Cherniaev, A. A. and Zavorotin, E. F., 2013), cultivation technology (Kargin, I.F. et al., 1997), fertilizers (Geraskin, M. M. et al., 2014; Eryashev, A. P. et al., 2015; Potapova, N. V. et al., 2013), and impact of forest belts (Kargin, I. F., 1991; Kargin, V. I. and Zaharkina, R. A., 2016).

Applying of fertilizers requires great financial expenses and accounting of ecological state of every field. That is why it is reasonable to determine fertilizers doses taking into account peculiarities of every sort and area, and meteorological conditions. Taking into account regional peculiarities of soil and climate conditions, and due to using new sorts, the urgency of economic estimation of mineral fertilizers and biological products doses in the technology of cereal crops cultivation increases.

It is necessary to emphasize that the innovational development of the cereal sector is related to risks that may weaken it considerably. These include macro-economic, agricultural and ecological, social, trading and economic, and political risks (Ushachev, I., 2009; Polushkina, T. M. et al., 2015; Chernyaev, A. A. et al., 2001).

2. METHODOLOGY

The informational background of the research is based on the materials of the Federal State Statistics Service of the Russian Federation, the territorial body of the Federal State Statistics Service in the Republic of Mordovia, the Ministry of Agriculture and Food Products, annual reports of enterprises, and methodological developments of research institutes.

The researches were conducted by using monographic, statistical and economic, calculating and constructing, economic and mathematical, abstract logical methods, and system, factorial, and functional analysis.

3. RESULTS

3.1. Cyclic Development of Cultivated Area

Since the end of the XVIII century till the middle of the XIX century the area of farm files on the territory of Mordovia increased by 13% and made up 1,226 thous. ha (Kargin, I. F. and Nemtsev, N. S., 2004). In 100 years it had been 1,271.7 thous. ha (Dodonov, I.A., 1969), and then in 20 years it made up 1,250.6 thous. ha (Shchetinina, A.S., 1988). The cyclic development of the cereal sector in the 90s of the XX century caused a decrease in the areas of farm fields and an increase in the neglected fields. As a whole for the period under consideration about 26% of the farm fields were turned into lea tillage and neglected areas.

The analysis we have made shows that the change of the area under cereal crops has a cyclic nature. In 1941-1945 there was a decrease in areas under cereal crops. It is related to social and economic conditions of the war period. However, since 1971 to 1980 the areas under cereal crops gradually increased. During the next decade it was possible to observe an implacable decrease in these areas that was related to political and social and economic conditions. Since 2001 to 2005 the areas increased. It was related to economic revival of the sector (Table 1).

Table 1
Cultivates Areas of Cereal Crops of the Republic of Mordovia

Years	Indicators						Trend of areas under cereal crops
	Average thous. ha	Min. thous. ha	Max. thous. ha	Drawback of the average	Level of fluctuation	Variation index, %	
1941–1945	777.2	641.0	885.2	40.8	91.2	11.7	$Y = 911.3 - 44.7 X$
1971–1975	748.0	710.8	773.2	13.1	29.2	3.9	$Y = 699.6 + 16.1 X$
1976–1980	769.8	760.1	780.8	3.3	7.4	1.0	$Y = 766.2 + 1.2 X$
1981–1985	689.0	677.0	699.0	5.0	11.1	1.6	$Y = 705.8 - 5.6 X$
1986–1990	668.8	644.2	688.2	7.5	16.7	2.5	$Y = 659.0 + 21.6 X - 5 X^2$
1991–1995	581.7	546.6	611.7	13.6	30.5	5.2	$Y = 634.1 - 17.5 X$
1996–2000	491.2	430.4	520.9	16.5	37.8	7.5	$Y = 555.6 - 21.5 X$
2001–2005	410.4	398.3	428.1	5.9	13.2	3.2	$Y = 369.9 + 36.9 X - 6.4 X^2$
2006–2010	428.6	417.0	442.0	5.3	10.6	2.5	$Y = 452.1 - 30.8 X + 7.1 X^2$
Average	637.0	398.0	905.0	21.7	148.9	23.4	$Y = 884.2 - 10.3 X$

The trend of the cultivated areas for 1941–2010s is represented by the equation: $Y = 884.2 - 10.3 X$.

It shows that for the research years the areas under cereal crops decreased more than twice. The variation index is 23.4%.

It is also necessary to note that since 1990s all regions of the Republic of Mordovia have demonstrated a stable tendency to decrease cereal crops sowing (Table 2).

Wheat and barley dominated in the formed structure of cereal crops sowing. The ratio of the most deficit types of cereal considerably decreased in the structure of the gross yield of cereal crops. The share of the food group increased, and the share of the forage group decreased. The situation within the food group is not univocal. The areas under large crops and winter rye have been stably decreasing, and those under wheat – expanding. This is not always reasonable. The share of leguminous crops that are the most important source of feeding protein and efficient improver of the soil fertility decreased most of all and continues decreasing in the structure of sowings.

The decrease is related both to objective and subjective factors. Undoubtedly, during the pre-war and war years a high share of cereals in the structure of sowing did not make it possible to implement modern technologies. Cereals were sowed according to unsatisfactory background – cereal crops. In case of a lack of crop-protection agents,

Table 2
Gross Production of Cereal Crops in the Republic of Mordovia, thous. ha
(Weighted after Enhancement)

<i>Years</i>	<i>Winter wheat</i>	<i>Winter rye</i>	<i>Spring wheat</i>	<i>Barley</i>	<i>Oats</i>	<i>Panic</i>	<i>Buck-wheat</i>	<i>Grain legumes</i>
1971-1975	112.0	136.6	239.6	198.6	113.2	10.4	9.2	88.4
1976-1980	146.1	130.9	130.1	354.1	131.0	1.7	3.4	50.6
1986-1990	72.1	208.4	87.5	323.2	96.1	5.9	4.8	35.8
1991-1995	97.5	170.8	82.0	369.1	54.3	5.1	2.1	13.5
1996-2000	125.5	126.0	99.4	195.7	45.9	6.5	2.5	5.7
2001-2005	162.8	92.0	148.0	310.6	32.1	3.2	1.2	21.0
2006-2010	365.6	65.8	74.2	376.1	21.2	0.8	0.2	20.0

fertilizers, agricultural equipment, this factor had an extremely negative character for the development of the cereal sector. The yield remained low, sowings were blocked, and soils exhausted. A lot of grains were used for seeds, and the yield was often lower than the sowed seeds. Unprofessional approach to managing the cereal sector caused the worsening of the quality of life of the majority of the Russian population.

On the other hand, a sharp decrease in the areas under cereal crops at the end of the previous century caused a decrease in the cereals production and occurrence of abandoned lands. The correlation of separate groups of cereal crops changed simultaneously. Cereal crops and leguminous crops sharply decreased in the structure of sowings.

Cyclic changes of the climate and peculiarities of the market environment caused sharp change of the winter and spring crops structure (Table 3).

Table 3
Areas under Winter and Spring Crops

<i>Years</i>	<i>Crops</i>	<i>Average thous. ha</i>	<i>Min. thous. ha</i>	<i>Max. thous. ha</i>	<i>Drawback of the average</i>	<i>Level of fluctuation</i>	<i>Variation index, %</i>
1971-1975	Winter crops	219.8	61.5	330.8	47.3	105.8	48.1
	Spring wheat	184.2	112.4	264.6	27.1	60.7	32.9
	Barley	126.2	49.7	196.6	26.4	59.1	46.9
1976-1980	Winter crops	212.6	96.1	308.7	39.3	87.9	41.3
	Spring wheat	108.0	93.7	126.3	5.4	12.0	11.1
	Barley	244.4	171.8	299.8	22.1	49.5	20.2
1986-1990	Winter crops	226.5	177.8	260.1	16.0	35.8	15.8
	Spring wheat	63.4	36.8	95.4	11.4	25.4	40.1
	Barley	183.7	155.6	217.2	10.1	22.6	12.3
1991-1995	Winter crops	187.9	121.9	279.4	34.6	77.3	41.2
	Spring wheat	64.0	52.6	81.4	5.4	12.0	18.8
	Barley	161.6	130.3	184.4	9.2	20.5	12.7

Cyclically repeated unfavorable conditions of wintering (1973, 1977, 1979, 1991, 1994, and 1995) caused a decrease in the areas under these crops and an increase in sowing barley that acts as an actuarial crop.

In order to optimize the cereal farming and provide food safety, it is necessary to perform works on renewing cereal production at abandoned agricultural farms, particularly increasing sowing by 100-150 thous. ha.

3.2. Cyclic Development of Cereal Crops Yield

In the Republic of Mordovia there is a process of removing the territorial specialization of the cereal production formed earlier. The de-specialization (as combined with other negative factors) leads to worsening of placing and a decrease in the level of focus on production of specific deficit types of cereals in zones with the most favorable natural

Table 4
Level of Cereal Crops Yield in the Republic of Mordovia, t/ha

Years	Winter wheat	Winter rye	Spring wheat	Barley	Oats	Panic	Buck-wheat	Grain legumes
1971-1975	1.32	1.01	1.30	1.57	1.17	0.93	0.44	0.98
1976-1980	1.73	1.02	1.20	1.44	1.12	0.18	0.19	0.82
1986-1990	1.90	1.10	1.38	1.75	1.10	0.68	0.27	0.89
1991-1995	1.69	1.30	1.28	1.69	1.03	0.62	0.23	0.74
1996-2000	1.81	1.34	1.20	1.21	1.04	0.69	0.41	1.01
2001-2005	2.28	1.98	1.72	1.94	1.25	0.72	0.33	1.40
2006-2010	2.36	1.75	1.75	2.28	1.66	1.14	0.33	1.49

Table 5
Cereal Crops Yield (Weighted after Enhancement,
in Farms of All Categories, Tons from 1 Hectare of the Harvested Acreage)

	1990	1995	2000	2005	2006	2007	2008	2009	2010
The Russian Federation	2.0	1.3	1.6	1.9	1.9	2.0	2.4	2.3	1.8
Privolzhsky Federal District	1.7	1.1	1.3	1.5	1.6	1.8	2.0	1.9	1.0
Republic of Bashkortostan	1.8	1.3	1.3	1.9	2.4	2.5	2.6	2.3	0.9
Mari El Republic	2.0	1.3	1.1	1.3	1.1	1.0	1.4	1.8	1.1
Republic of Mordovia	1.8	1.2	1.6	1.9	2.2	2.2	2.7	2.9	1.6
Republic of Tatarstan	1.9	2.1	2.9	2.7	2.7	3.0	3.4	3.2	1.0
Udmurt Republic	1.5	1.1	1.1	1.2	1.4	1.3	1.5	1.7	1.1
Chuvash Republic	2.4	1.5	1.8	1.9	1.9	1.9	2.2	2.3	1.1
Kirovskaya Region	1.5	1.2	1.2	1.4	1.3	1.3	1.5	1.9	1.6
Nizhegorodskaya Region	1.8	1.3	1.6	1.9	2.0	2.0	2.2	2.5	1.4
Orenburgskaya Region	1.5	0.6	1.0	0.7	0.8	1.2	1.3	1.2	0.6
Penzenskaya Region	1.6	0.8	1.1	1.4	1.6	1.6	1.9	2.0	1.2
Permskaya Region	1.3	1.1	0.9	1.1	1.2	1.1	1.3	1.5	1.3
Samarskaya Region	2.0	1.0	1.3	1.0	1.2	1.4	1.6	1.7	1.1
Saratovskaya Region	1.6	0.6	1.1	1.4	1.5	1.5	1.6	1.4	8.4
Ulyanovskaya Region	2.1	1.0	1.5	1.5	1.6	2.0	2.0	2.0	8.9

and economic conditions, as well as reduction of their production and worsening of the cereals quality. Stability of the cereal farming both in the Republic of Mordovia and the Privolzhsky Federal District (PFD) remained unsatisfactory (Tables 4, 5).

Volumes and specific structure of cereals production was formed because of constant changes in the cultivated areas and the level of cereal crops yield (as influenced by numerous factors of internal and external nature). Herewith, unlike the pre-reform period, the development of the cereal farming was influenced by economic factors related above all to the hasty transfer of the market relations.

3.3. Dynamics of Gross Yield

For the researched period acute fluctuations of gross yield were observed. The variation index achieved 41.4% (Table 6). Changes of gross yield are related to the resourceful provision of farming and climate peculiarities according to years. In case of low resourceful provision, the variation index was 38.2-54.4%, and the level of gross yield was 321.8-453.7 thous. t on average for five years. Subject to sufficient resourceful provision of farming, the variation index was 30.9-42.1%. However, herewith, the average annual gross yield was 898.4-924.5 thous. t. (for five years).

During the constant growth of gross yield (1971-1985), the error of the drawback of the average and standard fluctuation harshly grew, and the variation index changed from 18.7 to 32.9. In the 1986-1990s the conditions of high farming culture caused a decrease in the drawback of the average and variation index. It proves the stability of the cereals farming.

Table 6
Gross Yield of Cereals in the Republic of Mordovia, thous. t

Years	Gross yield, thous. t,	In %	Variation index, %	Regression equation	r
1913	623,5	100	–	–	–
1940	630,6	101.1	–	–	–
1941–1945	<u>195.0–593.1</u> 338.1+68.05	54.2	45.0	Y = 596.72 – 86.18 X	0.90
1946–1950	<u>125.3–580.0</u> 321.8+78.24	51.6	54.4	Y = 157.64 + 340.59 X – 49.31 X ²	0.66
1951–1955	<u>291.5–722.3</u> 453.7+77.50	72.8	38.2	Y = 165.63+96.01 X	0.88
1956–1960	<u>419.3–621.5</u> 523.1+33.45	83.9	14.3	Y = 427.94 + 74.63 X – 11.71 X ²	0.31
1961–1965	<u>524.4–719.1</u> 630.1+33.45	101.1	13.9	Y = 651.78 – 52.93 X + 12.49 X ²	0.48
1966–1970	<u>609.9–975.6</u> 861.4+33.45	138.0	18.7	Y = 588.59+90.95 X	0.89
1971–1975	<u>694.3–1,312.8</u> 898.4+124.28	144.1	30.9	Y = 44.2 + 685.88 X – 109.4 X ²	0.75
1976–1980	<u>672.6–1,181.5</u> 947.9+87.77	152.0	20.7	Y = 1233.2 – 98.47 X	0.73
1981–1985	<u>544.5–1,239.1</u> 935.5+137.48	150.0	32.9	Y = 199.99 +573.78 X – 89.62 X ²	0.58
1986–1990	<u>895.3–1,261.2</u> 1,037.4+70.15	164.4	15.1	Y = 784.74 +209.92 X – 34.28 X ²	0.41
1991–1995	<u>474.9–1,197.7</u> 896.0+123.78	143.7	30.9	Y = 290.76 +652.49 X – 122.93 X ²	0.96
1996–2000	<u>440.6–890.6</u> 645.9+79.6	103.6	27.6	Y = 857.74 – 70.6 X	0.63
2001–2005	<u>631.1–937.9</u> 774.1+49.49	124.2	14.3	Y = 882.44 – 36.1 X	0.52
2006–2010	<u>292.1–1,308.4</u> 924.5+1,74.2	148.3	42.1	Y = 158.4 +799.38 X – 148.36 X ²	0.80
1941–2010	<u>125.3–1,308.4</u> 725.7+35.6	116.4	41.4	Y = 165.46 + 30.12 X – 0.31 X ²	0.68

For the researched period the change of the gross yield is described by a nonlinear equation with two downs of the yield: during the war years and at the post-war period, and during the years of the technological destruction of farming. According to separate five-year plans, cycles of decreases and increases in the yield are observed. They are related to abrupt worsening of climate indicators.

During the first decade of the XXI century in some regions of the Privolzhsky Federal District the cereal farming was developed extremely nonlinearly (Table 7, 8). Subject to sufficient resourceful provision, Tatarstan considerably surpassed, and Mordovia achieved the level of the 1986–1990s. At the same time, the Samarskaya and Ulyanovsk Regions considerably decreased their cereals productions.

Table 7
Cultivated Areas under Cereal Crops and their Structure in the Republic of Mordovia, thous. ha

Years	Winter wheat	Winter rye	Spring wheat	Barley	Oats	Panic	Buck-wheat	Grain legumes
1971-1975	84.7	135.1	184.2	126.2	96.2	11.1	20.6	89.9
1976-1980	84.4	128.2	108.0	244.4	116.8	9.3	17.7	61.0
1981-1985	56.1	172.6	94.6	173.9	97.3	9.3	19.2	58.6
1986-1990	37.9	188.6	63.4	183.7	86.9	8.6	17.3	40.0
1991-1995	57.4	130.5	64.0	252.0	52.3	8.2	8.9	18.1
1996-2000	69.0	93.5	82.8	161.6	43.8	9.3	6.0	5.6
2001-2005	71.1	46.3	86.0	160.0	25.6	4.4	3.6	15.0
2006-2010	154.7	37.4	42.4	164.5	12.7	0.7	0.6	13.4

Table 8
Dynamics of Volumes of Cereal Production in Households of All Categories (Gross Yield of Cereal Weighted after Enhancement, thous. tons)

	1990	1995	2000	2005	2006	2007	2008
The Russian Federation, mln.t	116.7	63.4	65.5	77.8	78.2	81.5	108.2
Privolzhsky Federal District	33,776.6	16,137.8	19,403.1	19,194.5	20,882.3	22,322.7	27,151.5
Republic of Bashkortostan	4,727.6	2,990.7	2,520.7	2,884.0	3,883.3	4,069.4	4,533.0
Mari El Republic	625.1	344.3	236.4	249.1	210.1	176.9	249.7
Republic of Mordovia	978.9	474.9	620.5	767.7	945.7	908.9	1,167.9
Republic of Tatarstan	3,660.5	2,939.1	3,287.9	4,129.5	4,164.5	4,745.2	5,742.5
Udmurt Republic	1,112.1	736.0	596.1	569.7	567.2	556.4	646.1
Chuvash Republic	946.9	483.8	508.8	397.5	418.6	362.4	522.8
Kirovskaya Region	1,680.2	896.9	781.2	663.5	566.6	419.5	607.0
Nizhegorodskaya Region	1,741.8	942.8	1,003.2	1,011.3	1,165.9	1,042.5	1,299.3
Orenburgskaya Region	5,581.5	1,497.9	3,141.8	1,812.9	2,019.3	3,155.0	3,717.8
Penzenskaya Region	1,841.2	873.3	820.3	994.9	1,107.9	932.1	1,422.3
Permskaya Region	1,129.4	735.7	563.6	465.5	443.8	398.4	436.4
Samarskaya Region	3,025.8	1,264.6	1,529.3	1,101.8	1,251.5	1,402.1	1,824.4
Saratovskaya Region	4,783.2	1,239.1	2,865.3	3,491.4	3,411.3	3,315.9	3,853.5
Ulyanovskaya Region	1,942.3	718.8	928.1	655.8	726.6	765.9	1,128.7

4. DISCUSSION

By virtue of the current historical, social and economic, organizational, and a number of other internal conditions, in the Republic of Mordovia, and other regions of the Povolzhsky Federal District, mainly multi-sectoral households (Table 9) rather than specialized ones produce cereals. The role of peasants' and other households is inconsiderable.

The quality of soils is one of the most important natural and climate factors that have an impact on the production of cereals.

Table 9
Structure of Cereal Production in the Povolzhsky Federal District according to
Households Categories (in Percent from Households of All Categories)

	<i>Agricultural organizations</i>							<i>Peasants' (farmers') households</i>						
	1995	2000	2005	2007	2008	2009	2010	1995	2000	2005	2007	2008	2009	2010
	<i>Cereal (weighted after enhancement)</i>													
The Russian Federation, mln. t	94.4	90.7	80.2	78.8	78.1	78.2	77.1	4.7	8.4	18.2	20.2	21.0	20.9	21.9
Privolzhsky Federal District	96.9	92.8	80.7	81.0	80.0	82.0	83.5	2.8	6.9	18.9	18.8	19.7	17.6	16.0
Republic of Bashkortostan	97.9	97.6	86.5	86.2	86.4	85.6	86.4	1.8	2.4	13.5	13.8	13.6	14.4	13.6
Mari El Republic	98.4	97.3	97.6	95.8	94.9	95.5	95.4	1.6	2.5	2.2	4.1	4.8	4.3	4.3
Republic of Mordovia	98.0	95.7	92.3	90.3	89.9	89.2	91.3	1.9	4.3	7.7	9.4	9.6	10.2	7.7
Republic of Tatarstan	99.5	97.8	86.6	87.2	85.9	87.3	87.5	0.5	2.2	13.4	12.8	14.1	12.7	12.5
Udmurt Republic	96.0	95.7	92.5	91.7	92.0	91.4	93.0	3.7	4.0	7.4	8.2	7.9	8.5	6.5
Chuvash Republic	95.1	93.9	91.6	88.3	86.0	82.8	81.9	0.7	1.2	5.5	10.8	13.3	16.6	17.1
Kirovskaya Region	96.6	95.9	90.6	93.0	94.6	94.2	96.8	2.1	1.8	8.3	6.7	4.9	5.2	2.7
Nizhegorodskaya Region	97.0	97.8	94.9	94.7	93.5	92.1	92.3	2.9	2.2	5.1	5.2	6.3	7.7	7.2
Orenburgskaya Region	96.3	92.1	84.3	75.7	73.4	77.9	76.1	3.7	7.9	15.4	23.8	26.2	21.4	22.6
Penzenskaya Region	97.1	96.0	86.5	85.7	82.4	81.8	86.2	3.5	6.9	12.3	13.6	14.8	17.1	11.8
Permskaya Region	96.8	96.2	95.9	95.0	95.2	95.4	95.7	2.7	3.6	3.9	4.8	4.5	4.3	3.9
Samarskaya Region	94.0	92.5	79.1	81.7	80.4	84.6	85.5	6.0	7.5	20.9	18.2	19.5	15.3	14.3
Saratovskaya Region	92.3	77.0	50.3	54.8	52.3	54.7	60.3	7.7	22.8	48.7	45.1	47.6	45.2	39.7
Ulyanovskaya Region	97.0	96.1	83.3	84.2	84.6	84.5	87.5	3.0	3.9	16.6	15.7	15.3	15.1	12.3

The quality of soils was valuated as compared with the average republican indicators. According to it, the first zone makes up 62%. The soil covering is represented mainly by grey forest and derno-podzolic soils. It occupies 428 thous. Ha, including 217 thous. ha of farm field. The second zone makes up 108%. In terms of its soil, it is represented mainly by black soil, and occupies 272.9 thous. ha, including 193.7 thous. ha of farm field. The third zone makes up 93%. It is represented mainly by grey forest soils that occupy 67.5% of the farm field area, and 27% of black soils. The fourth zone makes up 114%. It combines the land use of central regions of the Republic. In terms of the land area, this area is the largest. In total, it is 509.3 thous. ha, including 450.8 thous. ha of farming area with 358.8 thous. ha of farm field. It has more fertile soils – leach black soils of heavy texture. This is only in the east of the Chamzinsky and in the south of the Atiashevsky regions that contain light-grey channery soils. The fifth zone makes up 86%. It is small according to the land area and number of land users. The basic type is grey channery soils that occupy 72% of farm field. Table 10 shows the characteristics of the volumes of selling cereals according to the agricultural zones of the republic.

Various soil and agro-climate conditions of natural zones of the republic considerably stipulate the volumes of sales.

Table 10
Volumes of Selling Grain according to Aero-landscape Zones of the Republic of Mordovia

		<i>Amount of products, thous. t.</i>						
		<i>2004</i>	<i>2005</i>	<i>2006</i>	<i>2007</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>
Republic of Mordovia		276.9	333.7	477.4	469.7	691.6	381.2	525.3
Zone 1	Tengushevskiy	1.6	1.4	1.5	1.9	5.8	3.1	5.0
	Elnikovskiy	4.6	5.0	5.4	4.6	3.8	1.3	2.5
	Temnikovskiy	8.4	6.4	7.5	14.0	15.4	11.4	12.4
Zone 2	Zubovo-Polianskiy	8.4	9.9	6.8	12.7	10.8	2.7	9.0
	Krasnoslobodskiy	17.3	18.2	23.6	21.1	14.8	12.5	16.5
	Atuirievskiy	10.1	8.9	13.4	11.4	11.3	5.1	9.2
	Torbееvskiy	11.5	19.1	17.9	34.0	58.0	36.1	35.7
Zone 3	Kovylkinskiy	9.5	10.9	26.1	25.9	34.8	11.2	25.0
	Insarskiy	17.3	10.0	11.3	8.4	12.3	4.4	9.4
	St.-Shaygovskiy	10.1	14.0	27.1	20.2	29.1	6.1	11.5
	Ruzaevskiy	11.5	21.7	30.3	30.2	31.2	18.3	23.1
Zone 4	B-Ignatovskiy	9.5	11.3	10.7	5.9	13.1	8.1	15.4
	Kadoshkinskiy	17.3	1.4	0.6	6.6	28.0	11.9	12.0
	Romodanovskiy	31.4	42.0	50.3	39.6	67.4	29.4	47.3
	Ichalkovskiy	9.3	17.6	17.9	19.3	24.8	6.8	20.1
Zone 5	Atiashevskiy	28.3	32.7	48.1	619.5	102.4	35.9	69.4
	Ardatovskiy	8.7	8.4	24.6	25.5	40.8	14.0	34.3
	Liambirskiy	12.1	8.4	12.9	7.3	10.2	2.8	6.8
	Kochkurovskiy	10.9	15.2	20.3	17.7	28.8	20.3	12.6
	g.o. Saranks	12.2	11.6	42.2	15.8	47.9	25.5	39.7
Zone 5	Dubenskiy	15.1	7.3	23.3	30.2	24.5	35.8	37.0
	B.-Bereznikovskiy	7.4	8.3	11.5	12.8	18.6	6.1	11.1
	Chamzinskiy	14.8	43.2	43.4	42.0	38.5	71.7	59.9

The second and fourth natural zones where black soils prevail have higher indicators. Comparatively low indicators are found in the first, third, and fifth zones where there are mainly grey forest and derno-podzolic soils.

5. CONCLUSION

The research allows to forecast the dynamics of the production of grains and scales of the grain production as a bio-economic system taking into account agro-ecological regionalization. The obtained data prove that the yield of cereal crops is determined both by soil conditions of separate regions of the Republic, and the size of agricultural enterprises.

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