

# Development of the Crimean Agriculture



Mir Abdul Kayum Jallal, Diana Burkaltseva, Elena Vorobyova, Nataliya Apatova, Oleg Blazhevich, Aleksandr Betskov, Hizri Kilyashkanov, Svetlana Shcheglova, Inna Mosina

**Abstract:** This article analyzes the Crimean agriculture to determine the factors for increasing the investment attractiveness of the agricultural region. It will allow building a food policy and determining its investment component, as well as identify the main development problems and develop proposals for measures to increase the level of rural development farms. The aim of the study is to assess the state of the agro-industrial complex of the Crimea, its investment component in building food policy.

To achieve this goal, the following tasks solved.

- The economic characteristics of the agricultural sectors of the Crimea given;
- Crop production and animal husbandry analyzed;
- The activities of agricultural organizations analyzed;
- The indicators characterizing the degree of development of agriculture of the Crimea were assessment;
- The problems and prospects for the development of agriculture of the Crimea during the formation of food policy identified.

The methods of analysis, synthesis, and graphic method used in this work.

**Conclusion/Results.**

Crimean agriculture has tremendous potential, but it is necessary to solve several problems for its development when building food policies. These problems are associated, firstly, with the extensive development of agriculture; secondly, with irrational use of water resources; thirdly, with outdated technologies and techniques; fourthly, poor transport logistics; fifthly, with a high cost of production. To overcome these problems and the successful functioning of agriculture and industrial complex (AIC) in the Crimea, it is necessary to perform the following actions: attract investors; change the structure of agriculture; to develop livestock; to build factories for the processing of agricultural products and to convert agricultural manufacturing. Changes in the structure should be due to large differences in the agricultural potential of each individual region of the Crimea, therefore it is required to develop those areas of agriculture that correspond to the climatic,

economic, cultural and historical conditions of each region. The effective use of subsidies and grant-in aid, competent investment management and the intensive formation of the latest enterprises will enable the region to become quickly one of the most successful in the Russian agricultural sector.

**Keywords:** agriculture and industrial complex (AIC), crop production, livestock, investments, activities of agricultural organizations, efficiency, financial and investment indicators, food policy.

## I. INTRODUCTION

The development of agriculture and industrial complex as the most important component of the Russian economy in building food policies is largely determined by the level of investment activity. Today, investment activity in the agriculture and industrial complex of the Crimea characterized by instability, inconsistency of the legislative framework, and the absence of a mechanism for managing the investment market.

The relevance of this work lies in the need to analyze the agriculture of the Crimea, its investment component in order to identify the main problems of development and propose measures to increase the level of development of agriculture, as well as to identify factors that affect the investment attractiveness of the agricultural region when building food policy.

The aim of this work is to assess the state of the agriculture and industrial complex of the Crimea and its investment component.

## II. PROPOSED METHODOLOGY

### A. Economic characteristics of the Republic of Crimea agriculture

The agriculture and industrial complex (AIC) and its basic industry, agriculture, are the leading system-forming spheres of the Crimea economy, which form the agro-food market, food and economic security, and the labor potential of rural territories [1-3].

The agricultural sector of the Crimean economy is one of the main and most developed sectors of the economy. More than half of the peninsula is an agricultural land. There are four main agricultural zones in the Crimean peninsula: the zone of the North Crimean canal, the zone of the southern coast of the Crimea, foothill areas, and the west coast. Agricultural enterprises of the Crimea specialize in the cultivation of grain, technical and fodder, vegetable, fruit and berry crops and grapes in the crop production sector. Livestock farming specializes in raising pigs and poultry, cattle, and producing eggs and meat.

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## Development of the Crimean Agriculture

The food industry is engaged in the processing of grain, milk and meat, fish, primary and secondary winemaking [4, 5].

Statistical data describes the current state of agriculture in the region and the key indicator is gross regional product (GRP).

The volume GRP in millions of rubles for the Republic of Crimea is in the Figure 1.

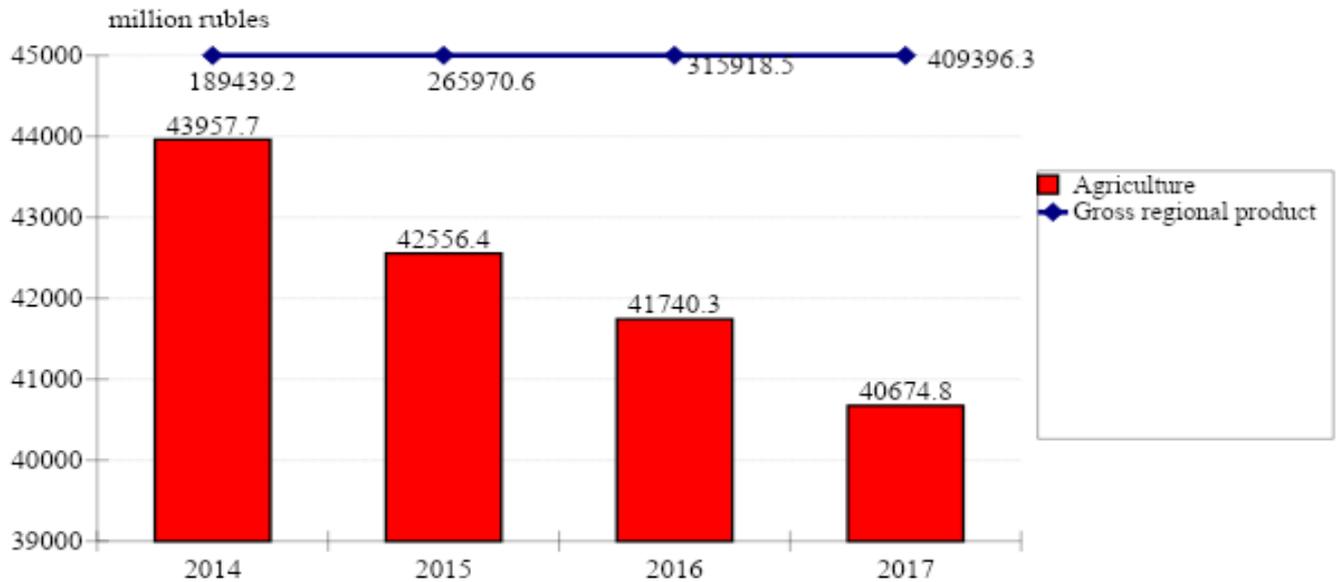


Fig. 1. The volume of gross regional product of the Republic of Crimea [6]

Analyzing this figure, we can conclude that the gross regional product of the Republic of Crimea for all types of economic activity was constantly increasing and at the end of 2017 amounted to 409396, 267 million rubles. At the same time, the volume of gross regional agricultural product has the opposite dynamics. During 2014-2017, this indicator was constantly decreasing and in 2017 amounted to 40674.8 million rubles. The decrease in GRP in agriculture indicates a decrease in the level of sales in this industry and is a

negative factor in the economic development of the region.

The next important indicator for the characterization of agriculture in the region is the volume of agricultural production. It is one of the main indicators, since it characterizes the activities of agricultural enterprises. The volume of sales of products depends on its size, which means the degree of satisfaction of the population's needs for food, and industry for raw materials. Dynamics of agricultural production is in Figure 2.

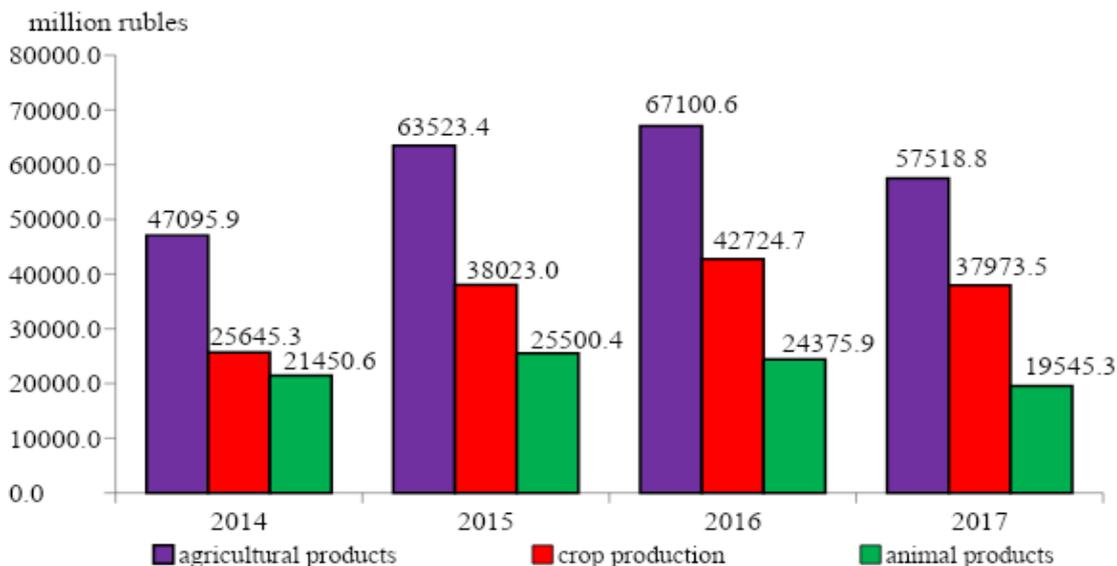


Fig. 2. Dynamics of agricultural production in 2014-2017 [6]

We can see that agricultural production has different dynamics. From 2014 to 2016, the volume of production increased, and in 2017 decreased compared to 2016 by 9581.8 million rubles, amounting to 57518.8 million rubles at the end of 2017, the volume of production in 2017 was lower than the same indicator in 2015 and 2016.

Agricultural products include crop and livestock products.

The production of crop products has a similar dynamics as the production of all agricultural products. After the growth of this indicator during 2014-2016, in 2017 compared with 2016, there was a decrease in the volume of crop production by 4751.2 million rubles. In 2017, the volume of crop production amounted to 37,973.5 million rubles.

Livestock production has a different dynamics. In 2015, compared with 2014, this indicator increased, and in 2016 compared to 2015 it decreased and continues to decline. Consequently, at the end of 2017, the smallest volume of livestock production for the analyzed period was amounting to 19545.3 million rubles.

Crop production prevails in the structure of agricultural production, which occupies an average of 61%. This is because crop production is of primary importance in agriculture, as it largely ensures the production and trading activities of other enterprises in all areas of the agricultural sector, including livestock. The share of crop production in

the overall structure of agricultural production constantly increased from 54.453% in 2014 to 66.019% in 2017.

The share of livestock production averaged 39% of the total production in the industry, but the share of livestock production was constantly decreasing from 45.547% in 2014 to 33.981% in 2017.

The pace and effectiveness of agricultural development is affected by the number of labor resources involved in this industry. The dynamics of the average annual number of workers in agriculture in the Crimea has the following form (Fig. 3).

We see that the largest number of employees was in 2016 (21.6 thousand people) and compared to 2015, it increased by 22.034%. In 2017, compared with 2016, the number of employees decreased by 8.796%, amounting to 19.7 thousand people at the end of 2017.

The average annual number of employees is an absolute indicator. It is important to understand that the specific nature of the labor resources utilization in agriculture has the characters of high seasonality, caused by the discrepancy between the production period and the working period. This is especially true for crop production. Seasonality leads to a sharp increase in labor demand during the period of sowing, plant caring, harvesting and processing of agricultural raw materials, and to an equally dramatic decrease in winter period. Livestock production has more even labor costs throughout the year.

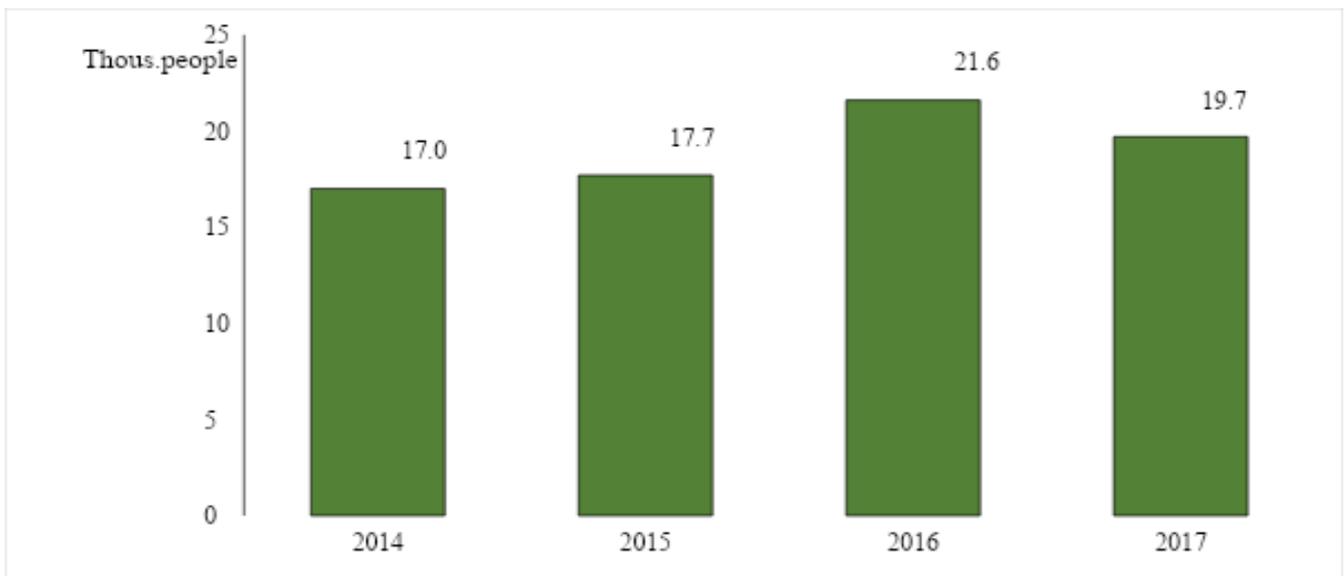


Fig. 3. Dynamics of the average annual number of workers in agriculture in the Republic of Crimea for 2014-2017 [6]

Let us analyze the volume of investments in agriculture of the Crimea. The efficiency of resource use, the production efficiency of agricultural enterprises, as well as socio-economic development of rural areas depend on the level of investment.

According to Figure 4, the volume of investment in agriculture of the Republic of Crimea has different dynamics. Between 2014 and 2016, investment growth observed, and in 2017, compared with 2016, the volume of investments decreased. Consequently, the largest volume of investments in fixed assets of agriculture during the

analyzed period was recorded in 2016 and amounted to 1407099 thousand rubles. The total volume of investments in fixed assets in the Crimea annually increases on average by 2 times, while the share of investments in agriculture in their total volume is constantly decreasing and at the end of 2017 amounted to 1.2%. This suggests that the Crimean agriculture is not a priority for investment, but, on the contrary, their level is low, and as a result, there is an insufficient level of development of this industry in the region.

## Development of the Crimean Agriculture

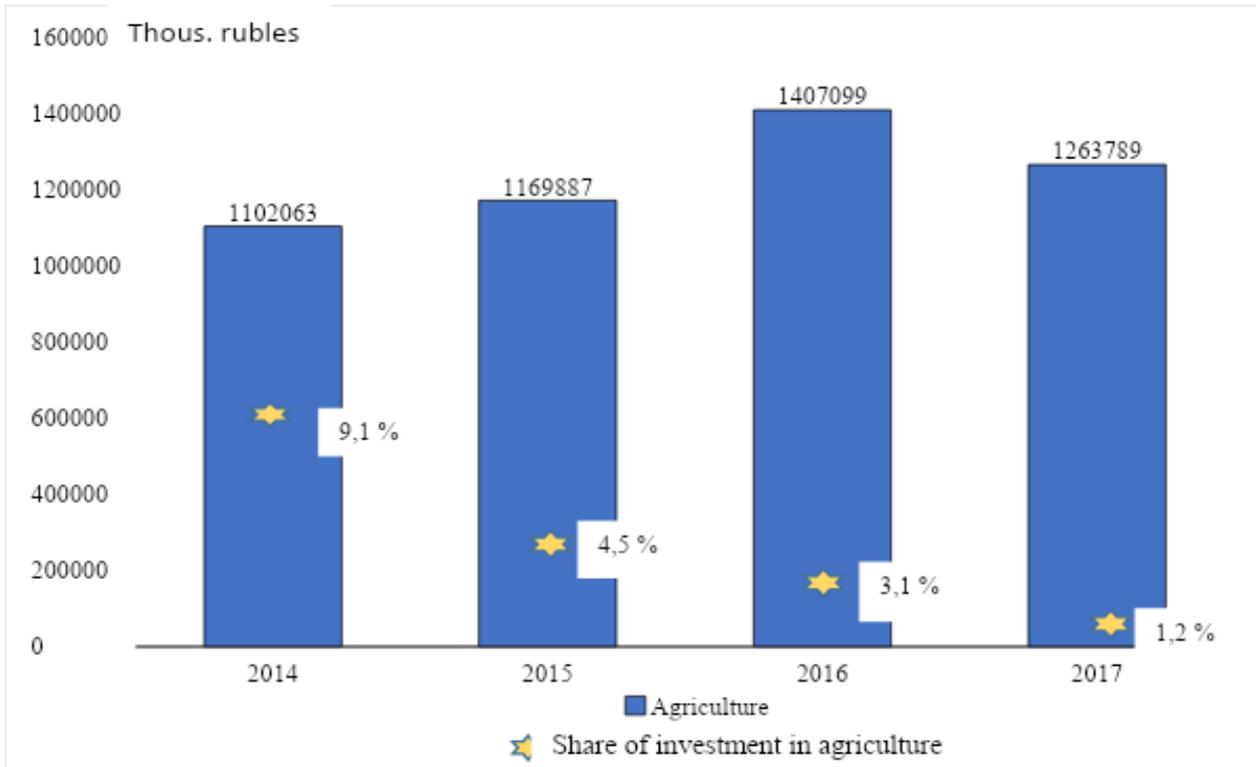


Fig. 4. Dynamics of the volume of investments in agriculture of the Republic of Crimea [7]

### B. Crop Analysis

A comprehensive analysis of the agriculture of the Republic of Crimea should begin with an analysis of crop production.

The first indicator chosen to analyze the crop industry is the rate of change in crop production. The standard for this indicator is 1.05.

The data shown in Figure 5 indicate that the rate of change in crop production exceeded the normative indicator in 2015 and 2016.

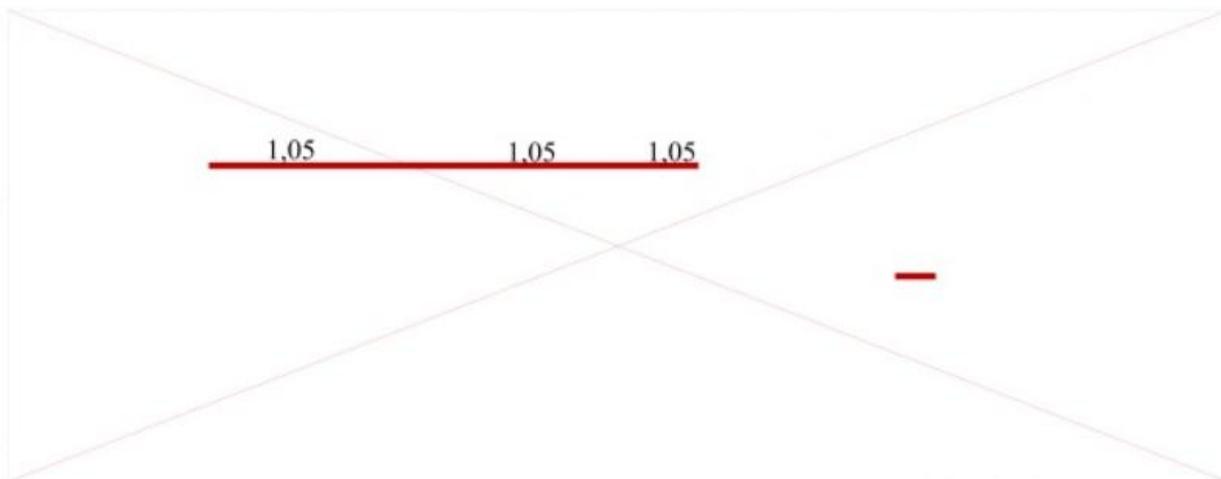


Fig. 5. The rate of change in crop production [7]

The crop production increased by 48.26% in 2015 comparing to 2014, the increase happened in production by 12.37% in 2016 comparing to 2015. Despite the decline in growth of crop production in 2016 comparing to 2015, its value exceeded the standard during these periods. There was a decrease in crop production by 11.12% in 2017 comparing to 2016. This suggests that the smallest value of this indicator was in 2017, which is below the standard respectively. It can be concluded that crop production output is constantly decreasing, which becomes a negative factor for the industry.

The next indicator is the rate of change in sales of crop production in physical terms. According to the results of the analysis presented in Figure 6, it discovered that the growth rate of crop production sales decreases annually in the Crimea as a whole. The product sales had increased by 11.82% in 2015 comparing to 2014, which exceeds the standard equal to 10%. This indicator decreased by more than twice and amounted to 4.3% in 2017 comparing to 2016.

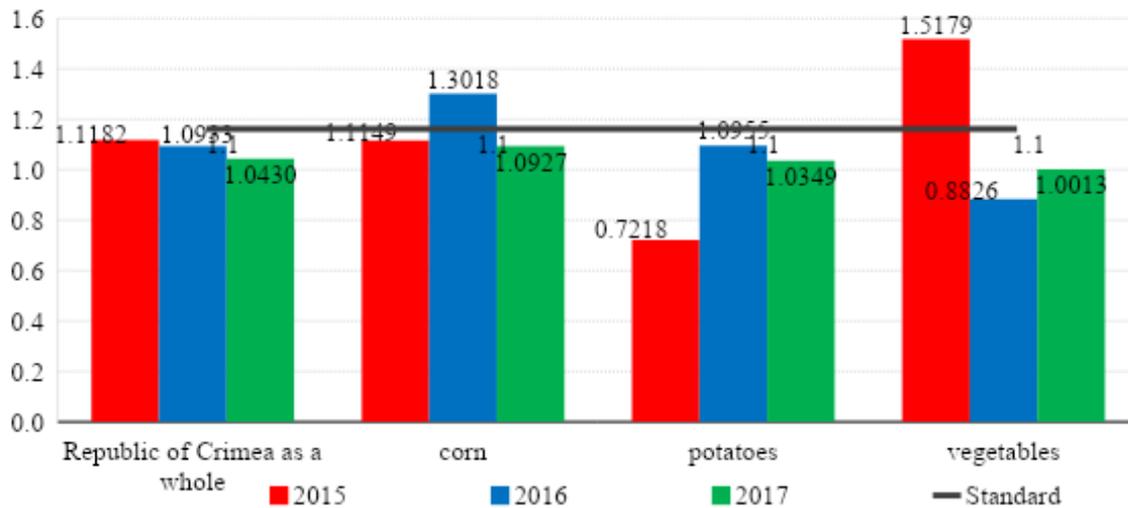


Fig. 6. The rate of change in the sale of crop products in kind [7]

The rate of change in grain sales has different dynamics. In 2015, compared with 2014, the volume of grain sold increased by 11.49%, in 2016 compared to 2015, this increase was 30.18%, in 2017 compared to 2016, respectively 9.27%, which is below the normative value.

The rate of change in the volume of potatoes sold also has different dynamics. In 2015, compared with 2014, the volume of potatoes sold decreased by 28.72%. In 2016, compared with 2015, there was an increase of 9.55%, in

2017 compared with 2016, the growth decreased to 3.49%. The rate of change of potatoes sold did not exceed the standard indicator of 1.1 for the entire analyzed period

The growth rate of vegetables in 2015 compared to 2014 was 51.79%. In 2016, compared with 2015, the volume of vegetables sold decreased by 11.74%. In 2017, compared to 2016, the growth rate increased and amounted to 1.0013.

The analysis of the dynamics of sown areas yielded the following results (Figure 7).



Fig. 7. The rate of change of sown areas for crops [8]

The rate of change in cultivated areas in the Crimea has different dynamics. In 2015, compared with 2014, the sown area decreased by 11.64%, in 2016, compared with 2015, an increase of 12.06% was observed, in 2017 compared to 2016, the sown area again decreased areas by 2.92%.

A significant increase in sown area for industrial crops occurred in 2016 and amounted to 49.16%.

Sown areas are the basis for the formation of crop yields.

Crop yield is a comprehensive indicator that determines the volume of crop production and characterizes the level of use of agricultural land. Productivity calculated by dividing the gross yield by the sown area.

The yield indicator and its dynamics present in table 1.

## Development of the Crimean Agriculture

**Table 1. Crop yield (cwt /ha) [7]**

Republic of Crimea	2015 r.	2016 r.	2017 r.	Absolute change		Relative change	
				2016-2015	2017-2016	(2016-2015)/2015	(2017-2016)/2016
				Wheat	27	27,4	30,4
Rye	32,4	28,6	26,2	-3,8	-2,4	-11,728%	-8,392%
Barley	45,2	48,2	42,3	3	-5,9	6,637%	-12,241%
Oats	14,6	19,3	18,3	4,7	-1	32,192%	-5,181%
Corn for grain	48,1	30,7	20,3	-17,4	-10,4	-36,175%	-33,876%
Legumes	17,5	22,3	20,1	4,8	-2,2	27,429%	-9,865%
Sunflower seed	13,2	13,1	10,2	-0,1	-2,9	-0,758%	-22,137%
Potatoes	171,9	170	151,4	-1,9	-18,6	-1,105%	-10,941%
Vegetables	246,8	246,6	248,8	-0,2	2,2	-0,081%	0,892%

During the analyzed period, the yield of only one agricultural crop increased - wheat. From 2015 to 2017, wheat productivity increased by 3.4 cwt from one ha; in 2015-2017, the yield of corn and potatoes was constantly decreasing.

Analyzing the table, we can conclude about the low level

of use of agricultural land.

One of the factors affecting crop yields is fertilizer application in the soil.

The amount of organic fertilizers applied per one ha of sown area is in table 2.

**Table 2. The application of organic fertilizers for crops dropping [8]**

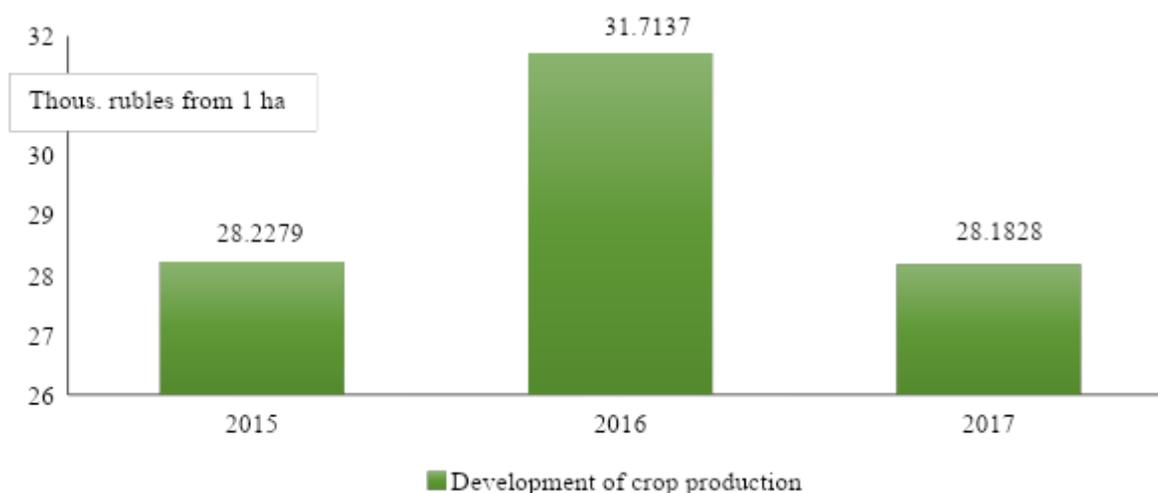
	2015	2016	2017	Absolute variation	
				2016-2015	2017-2016
Organic fertilizers applied					
Total thousand, t	123,1	242,3	261,8	119,2	19,5
Per 1 ha of sowing, t	0,4	0,8	0,8	0,4	0
Ration of fertilized area by organic fertilizers throughout the entire sown area, %	3,7	5,7	5,3	2	-0,4

Analyzing the table, we can conclude that the amount of organic fertilizers added annually increases. In 2016, compared with 2015, there was an increase of 119.2 thousand tons, in 2017 compared with 2016 - by 19.5 thousand tons. The number of fertilizers per hectare of sowing in 2015 amounted to 0.4 tons, in 2016 and in 2017 it is 0.8 tons.

The specific gravity of the area fertilized with organic

fertilizers over the entire sown area has different dynamics. In 2016, compared with 2015, this indicator increased by 2% and amounted to 5.7%. In 2017, compared with 2016, the specific gravity decreased by 0.4% and amounted to 5.3%.

Analysis of crop production yielded the following results (Figure 8).



**Fig. 8. Production of crop products from 1 ha, thousand rubles [8]**

The largest volume of crop production during the analyzed period was observed in 2016 (37.7137 thousand rubles per one ha). In 2017, compared with 2016, the volume of output decreased by 3.5309 thousand rubles from 1 hectare and amounted to 28.1828 thousand rubles from

one hectare in 2017 the smallest output of crop production was recorded. Based on a comprehensive analysis of crop production in the Republic of Crimea, we made the following conclusions.

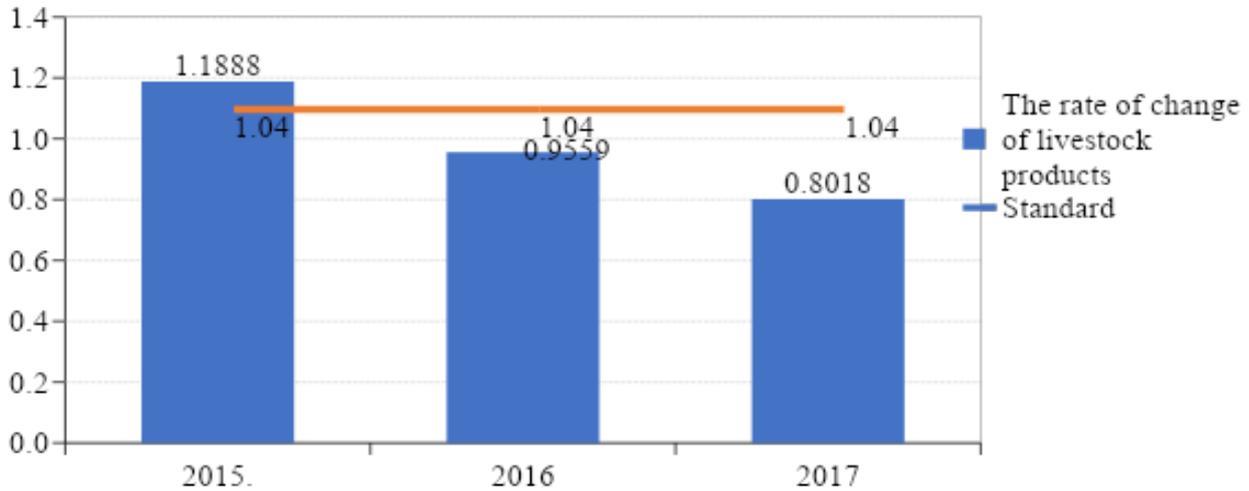
Crop production is the predominant sector in the agriculture of the republic; its products occupy on average about 60% of the structure of all agricultural products. Many factors influence the crop production volume; they are the size of cultivated areas, crop yields, the application of organic fertilizers in the soil, etc. An analysis of these indicators showed that they are unstable and insufficient for the effective development of the industry. This is also due to the low level of investment in agriculture of the Republic of

Crimea.

**C. Livestock Analysis**

Livestock production is one of the priority areas for the development of the agricultural sector in the Crimea. It accounts for about 40% of agricultural output on average.

An analysis of the rate of change in livestock production is in Figure 9.

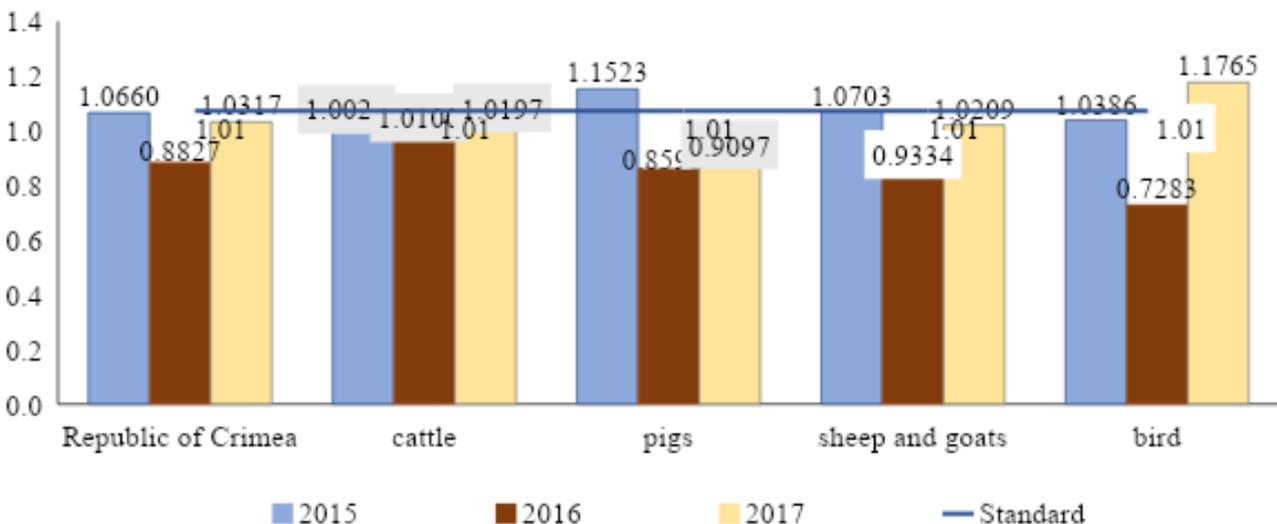


**Fig. 9. The rate of change in livestock production output [7]**

The figure shows the negative trend in the rate of change in livestock production output. Livestock production output had increased by 18.88% in 2015 comparing to 2014. In 2016 comparing to 2015 this indicator decreased by 4.41%, the volume of livestock production output decreased by

19.82% in 2017 comparing to 2016. The decline in growth indicates a decrease in the development effectiveness of this branch of agriculture.

The dynamics of the growth rate of livestock in the Republic of Crimea is in Figure 10.



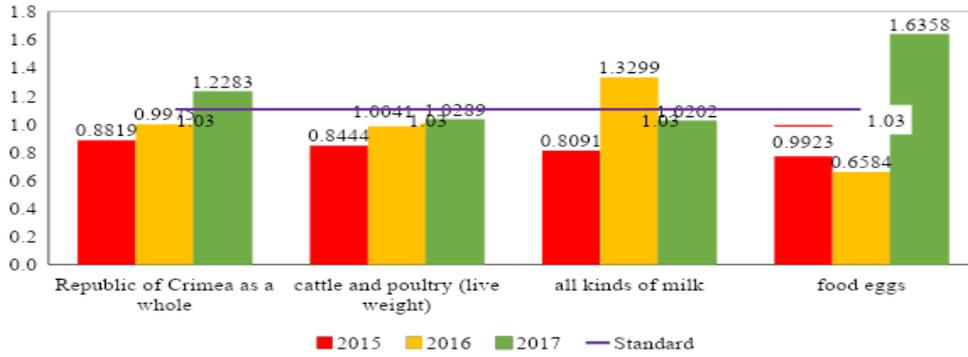
**Fig. 10. The rate of change in livestock and poultry [7]**

The growth occurred in general and types of farm animals in the Crimea in 2015 compared with 2014. Only the number of cattle increased by 1% in 2016 compared to 2015. The number of pigs and poultry decreased significantly during this period. The reason of decrease in the number of pigs is associated with the emergence in 2016 in the territory of Crimea of African swine fever, which led to the death and elimination of a significant number of animals. The reason for the decrease in the number of birds

is the transition of one of the largest enterprises of the Republic to a new production technology. The number of cattle increased in 2017 compared to 2016 by 1.97%, sheep and goats by 2.09%, poultry by 17.65%; the number of pigs decreased by 9.03%. In 2017, only the growth rate of the number of birds exceeded the standard of 1.03.

## Development of the Crimean Agriculture

The analysis of the dynamics of sales of livestock products in kind gave the following results (Figure 11).



**Fig. 11. The rate of change in the sale of livestock products in kind. [7]**

The volume of sales is increasing annually as a whole in the Crimea. The positive dynamics of growth rates evidences this process. If we analyze by types of products, then the volume of livestock and poultry sold in live weight in 2016 compared to 2015 increased by 0.41%, in 2017 compared to 2016 this increase amounted to 2.89%. Despite the increase in the growth rate for this type of product, it does not reach the standard value of 1.03 (or 3%).

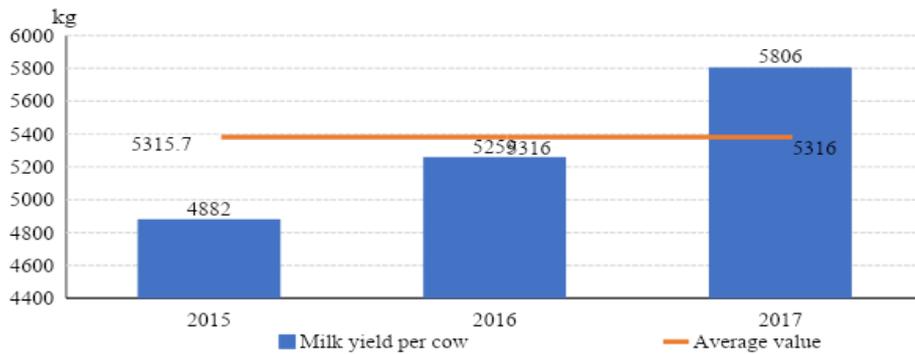
The volume of milk sales increased by 32.99% exceeding the standard value in 2016 compared to 2015; this indicator decreased and the growth amounted to 2.02% in 2017

compared with 2016

Sales of food eggs decreased by 34.16% in 2016 compared to 2015. This indicator increased and the growth rate amounted to 63.58% in 2017.

Despite the decline in some animal species, livestock and poultry productivity is increasing in the region.

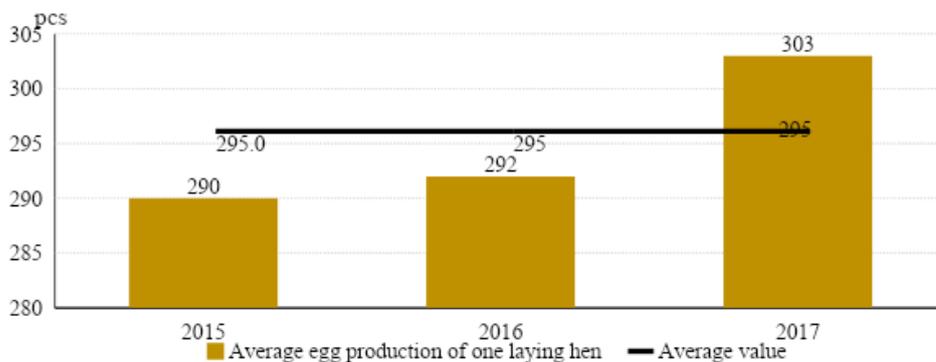
Figure 12 shows that the average annual milk yield per one cow in the period from 2015 to 2016 tends to increase, from 4882 kg in 2015, this indicator increased to 5806 kg in 2017.



**Fig. 12. Milk yield per one cow, kg [8]**

A similar dynamics has such an indicator as the average egg production of one laying hen

(Figure 13). This indicator increased from 290 eggs in 2015 to 303 eggs in 2017.



**Fig. 13. The average egg production of one laying hen, pcs. [8]**

The average wool cut from one sheep has a different dynamics. In 2016, compared with 2015, this indicator decreased by 2 kg, in 2017 increased by 1 kg and amounted to 3 kg compared to 2016 (Figure 14).

The main factor affecting the level of animal productivity is the level of feeding, which also reflected in the live

weight of the livestock. The level of development of feed production is not high enough at the present stage and the provision of animals with coarse and succulent feeds does not meet the needs of animals and remains at the lowest level.

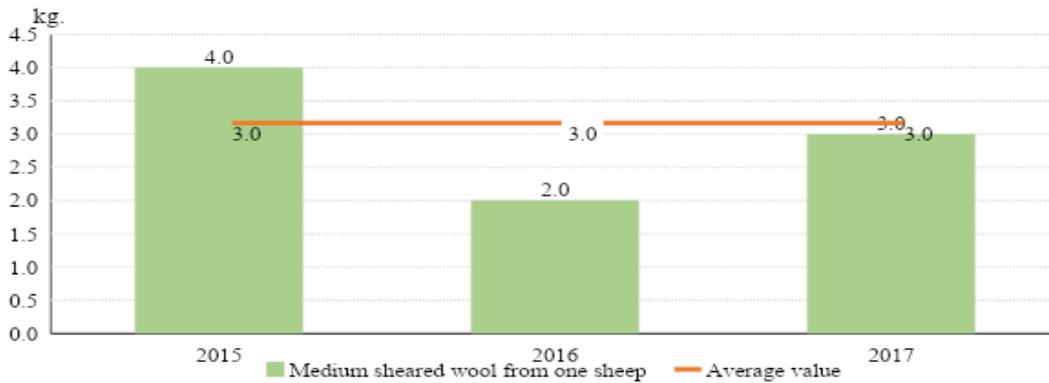


Fig. 14. The average cut of wool with one sheep, kg. [8]

**D. Analysis of the agricultural organizations activity**

The first indicator considered in this block is the rate of change in the GRP of agriculture, which shows the changes

the volume of goods and services production in the agricultural sector over the analyzed period (Figure 15).

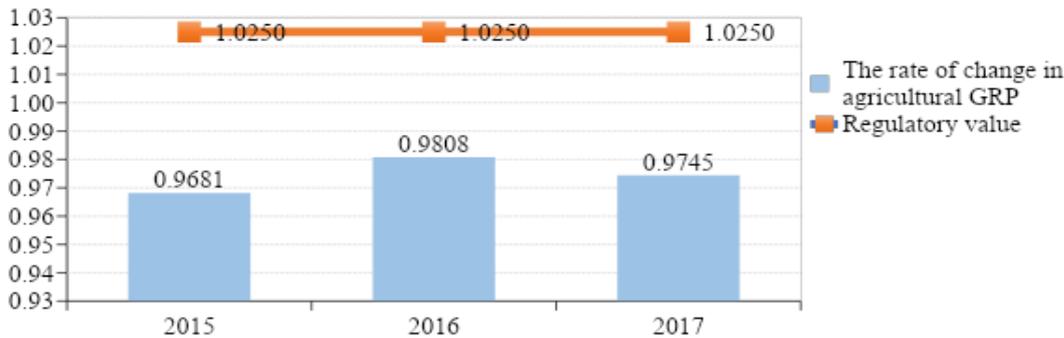


Fig. 15. The rate of change of GRP in agriculture [6]

According the diagrams, we conclude that the GRP in agriculture was constantly decreasing during the analyzed period because the growth rate of GRP in agriculture is less than 1 during 2015-2017. There was a decrease in the volume of GRP production in agriculture by 3.19% in 2015 comparing to 2014, by 1.92% in 2016 comparing to 2015

and by 2.55% in 2017 comparing to 2016; the growth of GRP production in agriculture should be at least 2.5% annually according to the standard value.

The rate of change in agricultural production output we see in Figure 16.

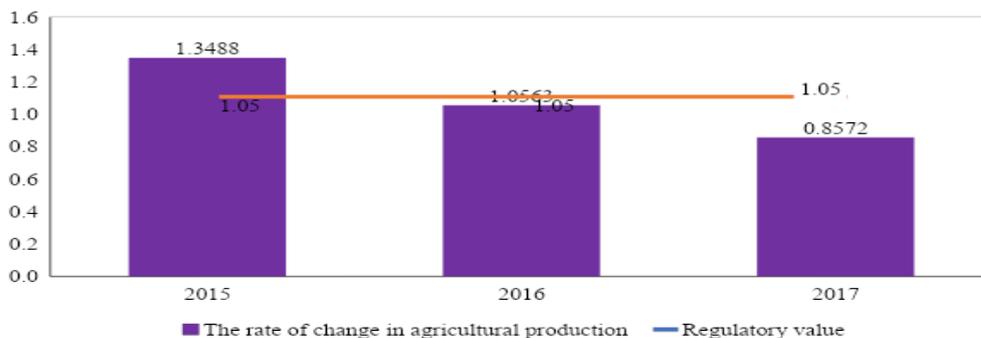


Fig. 16. The rate of change in agricultural production output [7]

## Development of the Crimean Agriculture

This figure shows that there is a trend to a slowdown in growth rates of agricultural production output. Agricultural production output had increased by 34.88% in 2015 comparing to 2014. This trend continued in 2016 comparing to 2015 but the growth rate amounted only to 5.63%. There occurred a decrease in agricultural production output by

14.28% in 2017 comparing to 2016. This trend shows deterioration in the state of agriculture in the region.

In order to analyze the utilization of land reserves in agriculture, it is necessary to consider the dynamics of changes in the area of agricultural land (Figure 17).

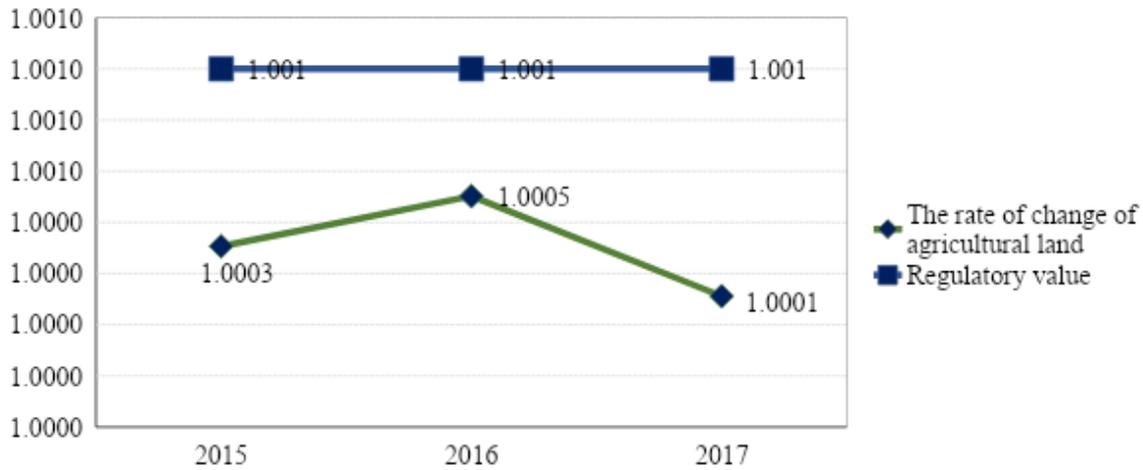


Fig. 17. The rate of changes of agricultural land [8]

After the analyzing of Figure 17, we conclude that the agricultural land in the Crimea increased slightly during the 2015-2017; this increase was 0.03% in 2015 comparing to 2014, it is 0.05% in 2016 comparing to 2015, and 0.001% in 2017 comparing to 2016. There was the highest growth rate in 2016; however, it did not reach the standard value equal to 0.1%. Therefore, the degree of land involvement in

agricultural production has unchanged.

An indicator called capital productivity characterizes the efficiency of the fixed assets utilization in agriculture. Capital productivity shows how much revenue falls on the unit value of fixed assets. Capital productivity of fixed assets in agriculture had the following values during the analyzed period (Figure 18).

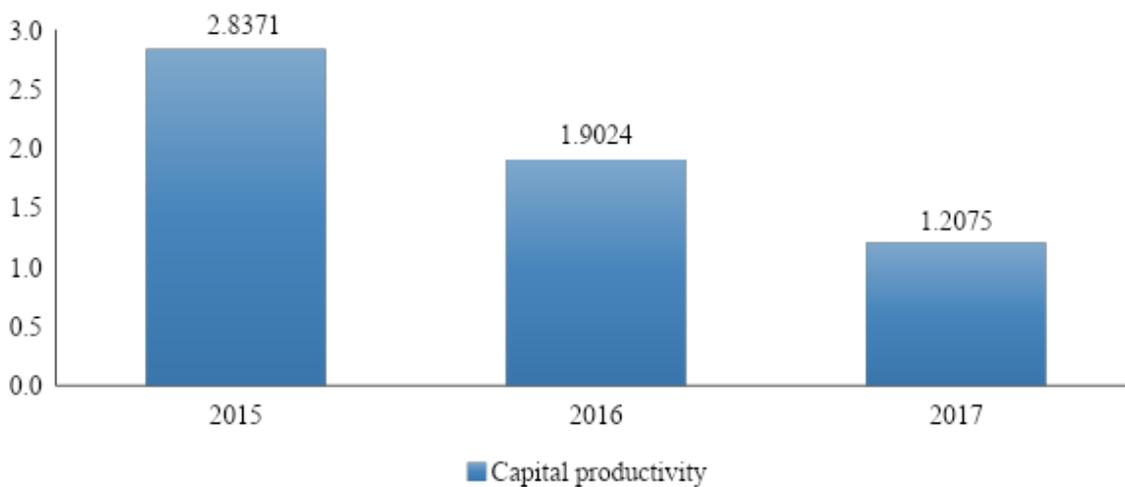


Fig. 18. Capital productivity of fixed assets in agriculture [6]

As the figure shows, the indicator of capital productivity is constantly decreasing in a period of 2015-2017. Therefore, lowest capital productivity was in 2017, and was amounted to 1.2075. This means that 1.2 rubles of agricultural production output accounts per 1 ruble of the fixed assets cost. The decrease in capital productivity by 0.9347 in 2016 comparing to 2015 shows the growth rate of fixed assets exceeded the growth rate of agricultural production output. The decline in capital productivity in 2017 comparing to 2016 is due to the growth of fixed assets

and simultaneous decrease in agricultural production output in 2017.

The indicators depreciation rate and the renewal rate characterize the state of fixed assets, as well as their dynamics.

The rate of fixed assets renewal is the ratio of the value of newly introduced funds to the average annual value of all fixed assets in the industry.

The coefficient of fixed assets depreciation shows the ratio of worn fixed assets in their total volume.

In table 3 there are the coefficients of depreciation and

renewal of basic production assets in agriculture of the Crimea.

**Table 3. The coefficient of renewal and degree of fixed assets depreciation in agriculture of the Crimea [7]**

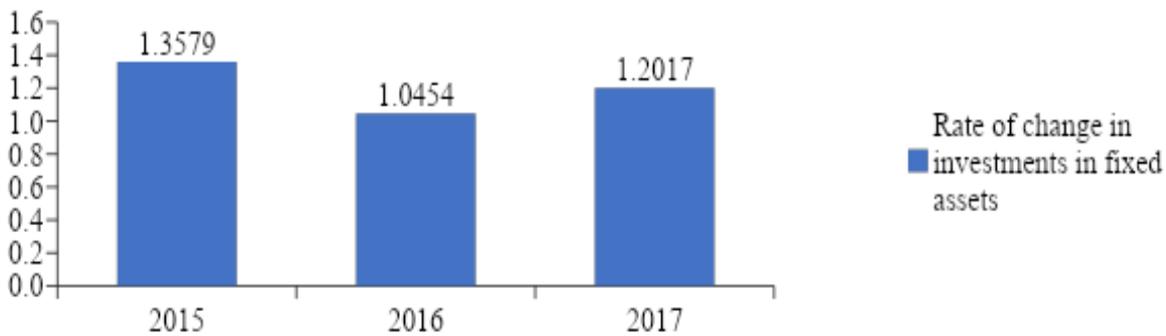
	2015	2016	2017	Absolute renewal	
				2016-2015	2017-2016
Renewal coefficient, %	5,9	10,9	12,3	5	1,4
Depreciation degree, %	60,4	50,3	50,2	-10,1	0,1

According the table, we conclude that the renewal coefficient was constantly increasing during the analyzed period. There was an increase of 5% in 2016 comparing to 2015, the renewal coefficient grew by 1.4% in 2017 comparing to 2016.

The rate of depreciation degree of fixed assets has an inverse trend, that is, it was constantly decreasing. This decrease amounted to 10.1% in 2016 comparing to 2015 and it was 0.1% in 2017 comparing to 2016.

The increase in the renewal coefficient and the decrease in the depreciation degree of fixed production assets are positive for agriculture and indicate an acceleration of fixed assets renewal in the analyzed industry, which also confirms a decrease in the depreciation degree of fixed production assets used in agriculture.

The next considered indicator is the rate of change in investments in fixed assets. It reflects the commissioning of fixed assets based on a capital investment plan.



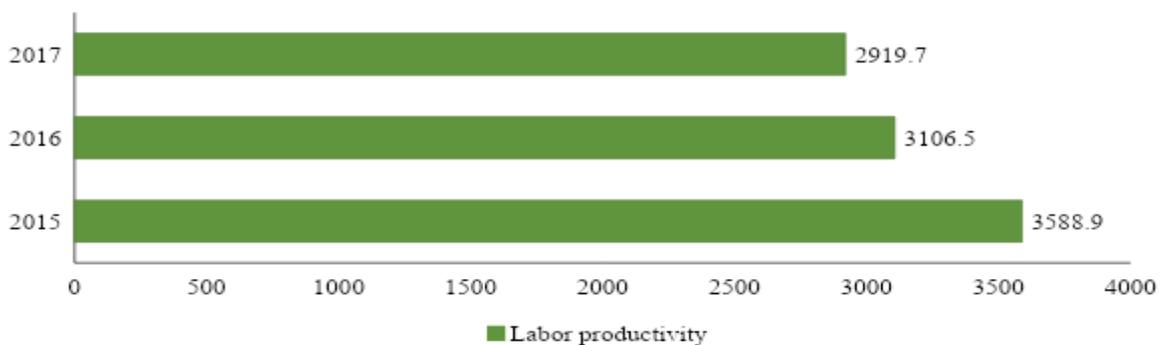
**Fig. 19. The rate of change in investments in fixed assets [6]**

Figure 19 shows the positive trend of investments volume in fixed assets in agriculture, this is evidenced by the growth rate (indicator is more than 1). Investments in fixed assets had increased by 35.79% in 2015 comparing to 2014. The growth rate decreased and investments increased by 4.54% in 2016 comparing to 2015. Investments in fixed assets grew as well by 20.17% in 2017 comparing to 2016.

One of the important indicators in the assessment of agriculture is labor productivity. Agriculture is one of the

branches of the national economy where manual labor is used and the lowest level of production processes mechanization is present. Therefore, the increase in labor productivity is the most urgent problem, which affects the rates of expanded reproduction in agriculture and the full satisfaction of the population needs for its products.

Labor productivity in agriculture of the Crimea is in Figure 20.



**Fig. 20. Labor productivity in agriculture of the Republic of Crimea [6, 8]**

## Development of the Crimean Agriculture

The figure shows that labor productivity in agriculture of the Crimea was declining during 2015-2017. This indicator decreased by 482.4 thousand rubles/person in 2016 comparing to 2015. This explains the fact that the growth rate of the employees' number in agriculture exceeded the growth rate of agricultural production output. Labor productivity decreased by 186.8 thousand rubles/person in

2017 comparing to 2016. This is due to the increase in the number of employees in agriculture and the decline in agricultural production output in 2017.

Now consider the profitability of agricultural production sales. The profitability of sales is the profitability ratio, which shows the ratio of profit in each ruble earned.

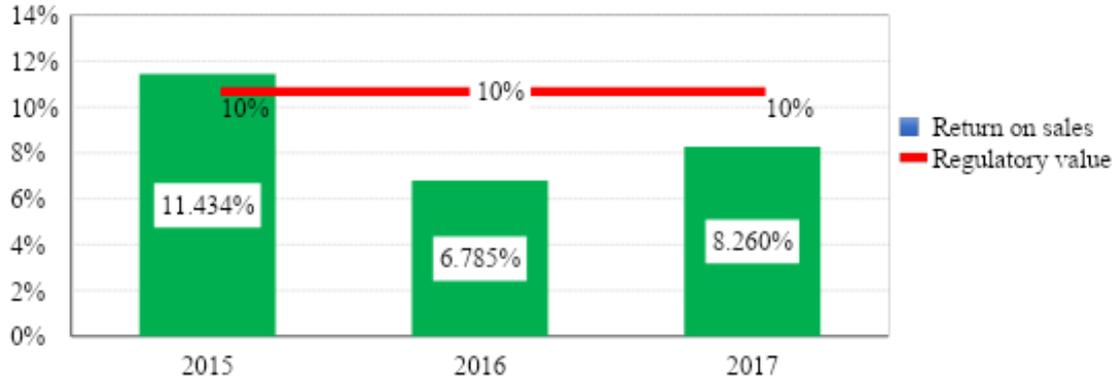


Fig. 21. The profitability of agricultural production sales [7]

The figure shows that the profitability of agricultural production sales in the Crimea has different dynamics. This indicator decreased in 2016 comparing to 2015 and it increased and amounted to 8.260% in 2017 comparing to 2016; the profitability of sales exceeded the set standard was recorded only in 2015. A positive point is the fact that the level of sales profitability in 2017 was higher than the same indicator in 2016.

The results of our analysis show that there is a negative trend by a number of indicators: the output of agricultural products, capital productivity, labor productivity, the area of agricultural land. Investments in the fixed assets of agricultural enterprises have a positive trend, but they are not enough for the efficient operation of enterprises. Moreover, despite the decline in depreciation of fixed assets,

this indicator remains quite high.

### III. RESULT AND DISCUSSION

#### A. Assessment of agriculture development indicators in the Crimea

This section presents the integral indicators, which can set a numerical expression of the direction of the agricultural sector in the Crimea and make a conclusion of its trends. The integral indicator for each industry is calculated on group indicators that are calculated in order to compare the indicators in different units of measurement (rubles, hectares, %) and normalize them to the same format.

The calculations of the integral indicator of the crop production development in the Crimea are in Table 4.

Table 4. The calculations of the integral indicator of the crop production development in the Crimea

Rate of change	2015	2016	2017
Rate of change in crop production output (RCCPO)	1,4120	1,0701	0,8465
Rate of change in crop production sales in physical terms (RCCPSpht)	1,0166	0,9939	0,9481
Rate of change in sown areas for agricultural crop (RCSAAC)	0,8828	1,1195	0,9698
Agricultural crop yield (ACY)	1,0837	1,0753	0,9676
Ratio of area fertilized with organic fertilizers over sown area (RAFOFosa)	1,3243	0,8596	0,9245
Yield of crop production per one ha (YCP)	0,9610	1,0796	0,9594
<b>Integral indicator of the crop production development in agriculture</b>	<b>1,1134</b>	<b>1,0330</b>	<b>0,9360</b>

Let us consider the calculation method for each of these indicators.

1. Rate of change in crop production output. This indicator is the ratio of the rate of crop production output to the standard in each period.

2. Rate of change in crop production sales in physical terms. This indicator calculates on the changes in the mass of main agricultural crops (see Appendix E).

3. Rate of change in sown areas for agricultural crops. The indicator calculates on the changes in the area of crops sown in the analyzed period (see Appendix E).

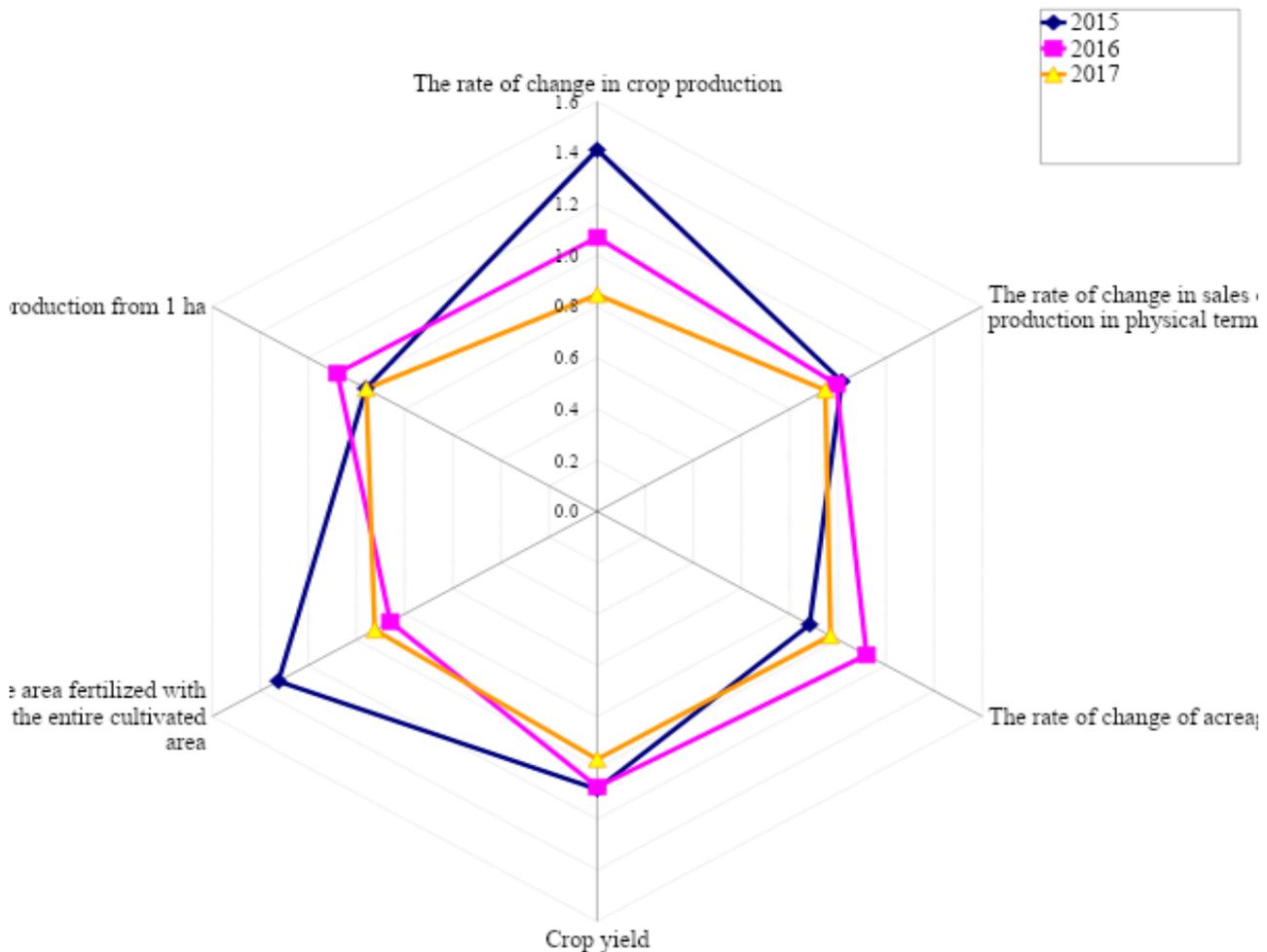
4. Agricultural crop yield. The indicator calculates as

the sum of the ratios of the yields of individual crops to their average value over three years (see Appendix E).

5. Ratio of the area fertilized with organic fertilizers over the entire area under crop. It calculates as the ratio of the percentage of the area fertilized with organic fertilizers over the entire sown area to its average value over three years.

6. Yield of crop production per one ha. It calculates the yield of crop production per one hectare in the current year to its average value over three years.

The dynamics of these indicators is in Figure 22.



**Fig. 22. Dynamics of indicators of crop production development in the Republic of Crimea**

Having analyzed the figure 22, we do the following conclusions.

The integral indicator of crop production development calculates on the six indicators listed above has the following dynamics: there is a trend to decrease of this indicator during the analyzed period. It means that its lowest value was in 2017. Basing on this fact the conclusion about the general deterioration of the crop industry in agriculture of the Crimea is.

The main negative impact on the resulting indicator had an indicator of the rate of change in crop production output. The given indicator of this coefficient had a negative trend, it best value was in 2015 and the worst was in 2017.

A significant negative impact on the integral indicator had the indicators of the rate of change in the crop production sales in physical terms and agricultural crop yield. These indicators had a negative trend, and their lowest value has a record in 2017.

The high value of the integral indicator in 2015 (1.1134) is explained by the fact that 4 out of 6 integral indicators were higher than one in this period. A similar situation was in 2016. The integral indicator is equal to 0.9360 in 2017, because there was the low value of all these indicators.

The calculations of the integral indicator of the livestock development in the Republic of Crimea are in table 5.

**Table 5. The calculation of the integral indicator of the livestock development in the Republic of Crimea**

Indicators	2015	2016	2017
Rate of change in livestock production output (RCLPO)	1,1431	0,9191	0,7710
Rate of change in livestock and poultry number (RCLaPN)	1,0554	0,8740	1,0215
Rate of change in livestock production sales in physical terms (RCLPSph)	0,8562	0,9684	1,1925
Milk yield per one cow (MY)	0,9184	0,9893	1,0922
Average egg yield per one laying hen (EY_LH)	0,9831	0,9898	1,0271
Average wool production from one sheep (WP_S)	1,3333	0,6667	1,0000
<b>Integral indicator of livestock development in agriculture</b>	<b>1,0483</b>	<b>0,9012</b>	<b>1,0174</b>

## Development of the Crimean Agriculture

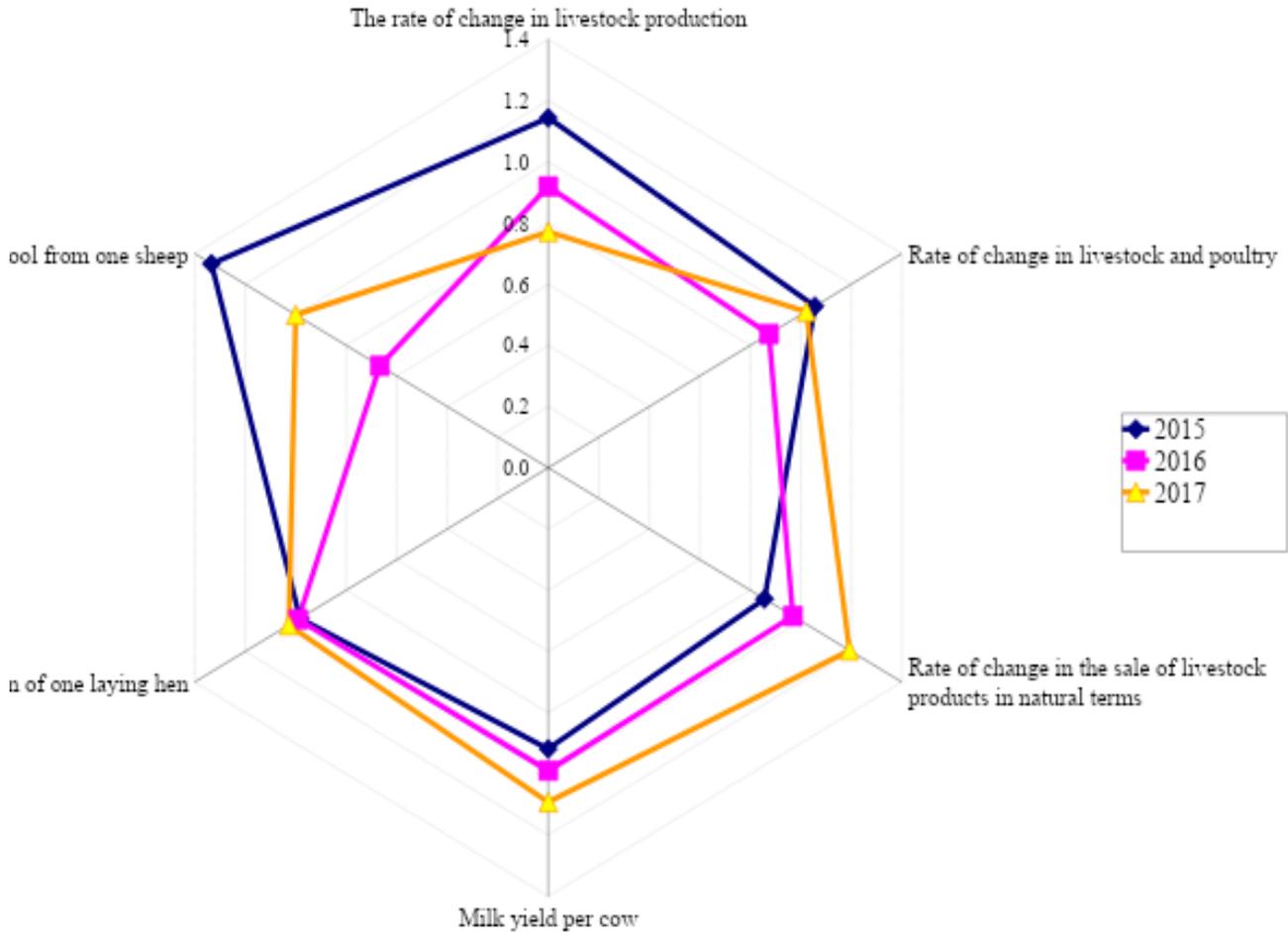
Consider the calculation method for each of these indicators.

1. Rate of change of livestock production output. It calculates as the ratio of the rate of change in livestock production output to the standard.
2. Rate of change in livestock and poultry number. This indicator was calculates the changes in livestock of cattle and poultry (see Appendix 3).
3. Rate of change in livestock production sales in physical terms. The indicator is the sum of ratio of rate of

change in products sales for each animal type to the standard (see Appendix 3).

4. Milk yield per one cow. It calculates the ratio of the mass of milk yield per one cow to its average value over three years.
5. Average egg yield per one laying hen and average wool production from one sheep calculate in the same way as indicator 4.

The dynamics of these indicators is in Figure 23.



**Fig. 23. Livestock production development indicators dynamics in the Crimea.**

The integral indicator was equal to 1.0483 in 2015, this result was affected by the fact that 3 out of 6 given indicators are larger than 1 (rate of change in livestock production output, rate of change in livestock and poultry number, average wool production from one sheep). The integral indicator had a high value in 2015, largely due to the high resulting indicator of the average wool produced from one sheep. The value of this indicator decreased in 2016 comparing to 2015 and amounted to 0.9012. This is due to the low value of all given indicators. The integral indicator increased and amounted to 1.0174 in 2017 comparing to 2016. This growth is due to the fact that 5 of

the 6 indicators in this period were more than 1, except for the rate of change in livestock production output which was 0.7710.

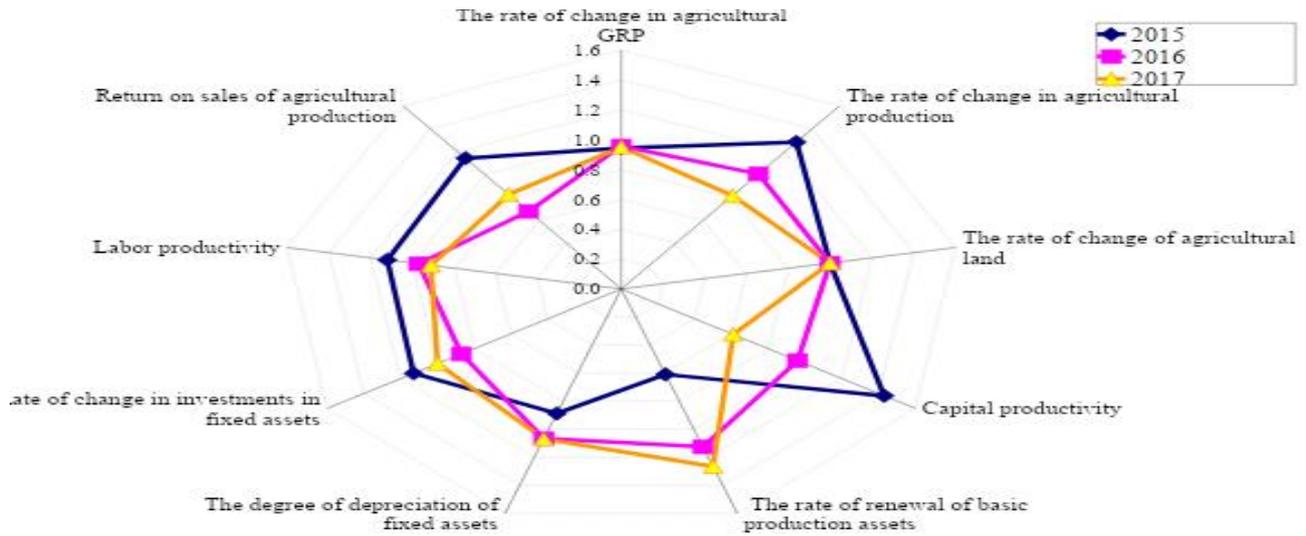
The calculation of the integral indicator of the agricultural organizations activity in the Republic of Crimea is in Table 6.

**Table 6. The calculation of the integral indicator of the agricultural organizations activity in the Crimea**

Indicators	2015 r.	2016 r.	2017 r.
Rate of change of GRP in agriculture (RcGRP_A)	0,9445	0,9569	0,9507
Rate of change of agricultural production output (RcPO_A)	1,2846	1,0060	0,8164
Rate of change of agricultural land (RcAL)	0,9993	0,9995	0,9991
Capital productivity (CP)	1,4312	0,9597	0,6091
Coefficient of capital production assets renewal (CrCPA)	0,6092	1,1254	1,2654
Deterioration degree of capital production assets (D_CPA)	0,8880	1,0664	1,0682
Rate of change of investments in fixed assets (RcIFA)	1,1300	0,8700	1,0000
Labor productivity (LP)	1,1198	0,9693	0,9110
Profitability of agricultural production sales (PS_AP)	1,1434	0,6785	0,8260
<b>Integral indicator of the agricultural organization activity</b>	<b>1,0611</b>	<b>0,9591</b>	<b>0,9384</b>

Calculations of these indicators are similar: ratio of the indicator value in the current period to the standard or to the

average value of this indicator for three years. Dynamics of indicators is in Figure 24.



**Fig. 24. Dynamics of indicators of agricultural organizations activity in the Crimea**

The integral indicator of the agricultural organizations activity has tends to decrease during the analyzed period. An indicator of capital productivity had the main negative impact on the resulting indicator. This indicator had a negative trend, the best value was in 2015, and the worst was in 2017.

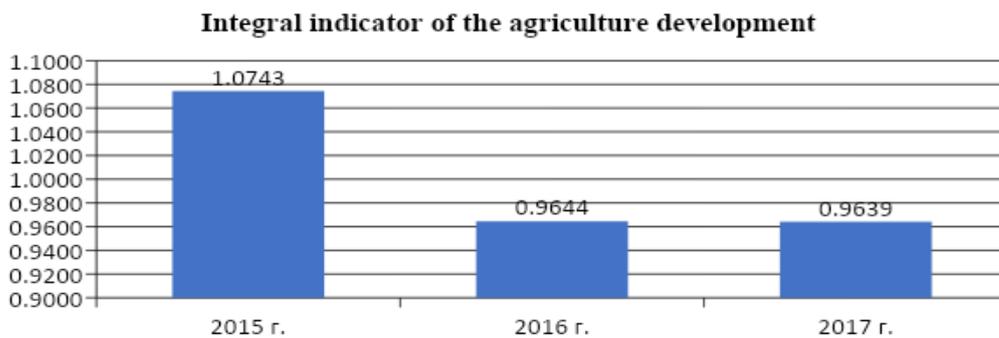
The indicators of the rate of change in agricultural production output and labor productivity affected the integral indicator as well. They had a negative trend their lowest value was in 2017.

The renewal coefficient of capital production assets and

their deterioration degree were constantly increasing during the analyzed period. However, the negative influence the above three indicators exceeded the positive impact of two another indicators.

A complex indicator calculated on three integral indicators of development of crop production, livestock and agricultural organizations activity, Analysis of this complex indicator reflected the trends of the state of agriculture in the Crimea during 2015-2017.

The value of this indicator is in Figure 25.



**Fig. 25. Integral indicator of the agriculture development in the Republic of Crimea**

## Development of the Crimean Agriculture

Figure 25 shows the integral indicator of the agriculture development in the Crimea tends to decrease. Consequently, it is the conclusion that the state of agriculture in the region is deteriorating during the analyzed period was proved by us by the analysis of individual agriculture branches.

### B. Problems and prospects for the agriculture development in the Crimea for forming a food policy

The agriculture and industrial complex of the Crimea and the agriculture as basic industry are the leading strategic sectors of the regional economy, forming the agro-food market, food and economic security and the labor potential of rural areas.

The main task of the industry is ensuring the production of marketable products in quantity, quality and assortment complying with the potential opportunities and needs of the domestic and foreign markets for forming a food policy. In this regard, the agriculture development is of particular importance.

The Crimea guarantees completely the internal need for food wheat, wheat flour, vegetables, pork, eggs, non-alcoholic and confectionery products by means of own production. At the same time, there is a need to increase the production volume of seed oil, cattle meat, poultry, lamb, milk and dairy products, fruits and berries. The leadership and scientists, economists of Crimea should pay attention to these problems of the agricultural sector that arise during the transformation [2].

Agriculture in the Republic of Crimea has a number of problems and shortcomings, the main of which are:

1. The shortage of water resources arising from the blocking of the North-Crimean Canal functioning, which resulted in a significant reduction in the production of some crops, especially fodder ones. And this, in its turn, led to the need to purchase compound feed in the southern regions of Russia and contributed to the increase in prices and volume reduction in livestock production output. In crop production sectors, the reduction of moisture supply entailed negative consequences as well. Crimean agrarians are overcoming water shortages by using groundwater (well drilling) and drip irrigation.

2. Limited foreign economic relations. Financial and economic sanctions by Western countries led to the actual isolation of the Crimea. The limited export-import relations of Crimean enterprises, high prices for supplying of raw materials and goods damaged the economy of Crimea and its business entities. It affected the agriculture development as well. The inflow of foreign investments decreased, the possibility of purchasing highly efficient agricultural equipment was limited. Agricultural enterprises buy raw materials, goods, farm animals, foreign-made equipment through intermediary companies registered in other regions of the Russian Federation. Limited transport communication and the need to work through intermediaries increased the cost of purchased products, raw materials and extension of delivery terms [9].

3. Market infrastructure insufficiently developed (the system of sale and storage of agricultural products).

4. Physical and moral deterioration of equipment. The most of the agricultural equipment used during the Soviet

period. It should also be noted that after entering of the Crimea into the Russian Federation, the number of investors using more modern equipment in their activities from mainland Russia has increased.

5. Low productivity of agricultural production. The use of outdated technology leads to low productivity of agricultural production.

6. High prices for electricity.

7. High self-cost of agricultural products. High electricity prices, problems with logistics lead to a significant increase in self-cost, which push away the buyers from other regions of the Russian Federation.

8. Low competitiveness. All of the above factors lead to the fact that the Crimean agricultural products cannot compete in the markets of other constituent entities of the Russian Federation with local products primarily because of the high prices.

9. Incomplete use of the agricultural potential of the region (a large number of unused areas).

10. Lack of developed livestock production on the peninsula (no large farms for growing livestock and poultry) [8].

11. Disadvantages of legal and regulatory support. Inconsistency in the actions of local governments, public and business, high level of corruption and legal nihilism of the population lead to slowdown of the agricultural industry development and hinder the effective implementation of the developed state programs.

12. Limited financial resources. The regional banking system end their work after the entering of the Crimea to Russia. Large Russian banks are slow to enter the banking system of the peninsula; small banks mainly started their activity, which significantly reduced the possibility of Crimean entrepreneurs in getting affordable loans. Today, this problem solves by a number of government programs that support agricultural enterprises in the Crimea.

13. The low level of innovation implementation and low production efficiency.

14. Lack of qualified personnel [10].

The organizations of AIC must solve the problem of Crimean agriculture and make the activities for forming a food policy:

- a) Engaging the unused agricultural land in crop rotation.
- b) Finding alternative sources of water for irrigating agricultural land.
- c) Transferring the industry to intensive development of horticulture, viticulture and winemaking.
- d) Developing food and processing industry, greenhouse vegetables as well as increasing the capacity of vegetable and fruit storage.
- e) Creating wholesale and distribution centers.
- f) Improving the sector of livestock both in dairy and meat groups.
- g) Developing small farms and agricultural consumer cooperatives.
- h) Increasing the farming standards.

The following measures need to realize when forming food policy and developing agriculture in the Crimea In order to solve the listed problems:

1. Expansion of the base of enterprises processing agricultural products.
2. Priority development of individual branches of the crop production (viticulture, fruit and berries production, vegetables production and processing). To implement this measure it is necessary to create an infrastructure for the storage and processing of vegetables, fruit and berries.
3. Livestock development (primarily poultry). This requires the creating of a large factory for the production of poultry meat and the construction of large farms and proprietorship.
4. Development of essential-oil production.
5. Development of tobacco and sericulture.
6. Production and processing of medicinal plant species.
7. Establishing lavender and roses plantations.

The last three recommendations are very promising and relevant. They will help the Crimea's agriculture to expand its specialization and move the Crimean economy to a new level. To implement these measures, it is necessary to develop industrial-technological complexes (construction of factories, warehouses, improving the sown areas) [11].

8. Creation of regional target programs for the agriculture development, attracting investors from mainland Russia and the near-abroad countries.
9. Reconstruction of perennial plantations. This concerns mostly the gardens and vineyards of the Southern Coast of Crimea and the steppe Crimea.
10. The development of greenhouses [8].

It will be necessary to improve the structure of agricultural production considering its economic expediency for the agriculture development in the Crimea in a future. A reasonable regional strategy for the development of the Crimea suggests investments as well. This will allow not only to revive in the near future, but also to raise to a qualitatively new level such industries as winemaking, fruit, vegetable and essential oil production, which will positively affect the formation of the budget of the Crimea. Moreover, the rise of agriculture will solve one of the most pressing social problems of employment the working-age population in rural areas.

The key objective of the agriculture functioning in modern conditions is identification of priority areas of development considering the current socio-economic and geopolitical conditions, as well as forecasting trends in their future. In addition, the agrarian strategy builds on the terms of coordinating the actions of the legislature, local governments, and municipalities in the region and its economic entities in the long term. The main objective of the current stage is creation of an effective and high-quality base to meet the needs of the region in the main types of food and agricultural raw materials, as well as the formation of a creditworthy and investment-active agricultural producer [11-13].

#### IV. CONCLUSION

The agriculture of Crimea has a huge potential for its development. For the development of agriculture when

forming a food policy, it is necessary to overcome the existing problems in this sector related to the extensive development pattern of the AIC, inefficient use of water resources, outdated technologies and methods, poor transport logistics and high production costs.

To solve the problems and to achieve the successful functioning of the AIC in the Crimea, it is necessary to do:

- attracting the investors;
- change the structure of agriculture in the Crimea, as it itself has significant differences in the agricultural potential of each individual region (development of those agricultural sub-sectors that correspond to the climatic, economic, cultural and historical conditions of the Crimea region);
- developing the livestock production;
- constructing plants for processing agricultural products and have modern equipment for agricultural production.

Effective use of subsidies and grants, competent investment management and intensive formation of new enterprises will enable the region to become quickly one of the most successful regions in the agricultural sphere of Russia.

Further research suggests to developing a methodology for assessing the economic security of the agro-industrial complex.

As part of a research project carried out by teams of research laboratories of educational institutions of higher education "Interaction of social institutions as the basis of Russia's economic security in the context of globalization".

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