Analysis of the seed fruit production efficiency in the Krasnodar region and ways to improve it

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Abstract. The article examines the economic state and features of the fruit growing industry in the Krasnodar Territory, the main trends in its development in agricultural organizations, the area and yield of intensive orchards, problems associated with the sale of products and the dynamics of average prices. The assessment of the state support to the industry is given. The dependence of the cost of 1 centner of pome fruits on the level of yield has been studied. The analysis of the dependence of the profitability of production and sale of fruits on the size of fruit-bearing orchards on farms and productivity is carried out. The optimal size of the areas for orchards in specialized organizations to ensure a high level of profitability of production has been identified, the “critical” level of yield of pome crops has been determined. The methodological aspects of determining the “break-even point” in fruit growing are considered. An improved model of the critical sales volume is proposed, taking into account the production specifics of the industry. Recommendations are given to improve the efficiency of production and sale of pome fruits.

Currently, 57 agricultural organizations are engaged in gardening in the Krasnodar Territory, including 12 of them highly specialized and receiving the main income from fruit growing. More than 75% of all areas under fruit and berry plantations in the region are pome crops, mainly apple trees. Stone fruit crops give an unstable harvest due to frosts during their flowering period, which have recently been observed quite often.

The profitability of the industry is subject to great risks and depends on both manageable and uncontrollable natural factors. If wheat grain is a valuable export product, its production is fully mechanized and almost always highly profitable, then the fruits are not sold for export, they are in demand on the domestic market. Gardening requires a lot of material and labor costs. The level of qualifications of specialists working in the industry, the timely implementation of agrotechnical measures directly affect the level of yield.

Until 2014, the fruit growing of the region was in conditions of high competition from subsidized and therefore cheap imported products, which led to a significant reduction in the area under gardens. However, the rise in the exchange rate and the ban on the import of agricultural products from Europe improved the economic situation of the industry. The areas under seed orchards in the Krasnodar Territory are gradually growing due to the increase in the number of small enterprises with the area under the garden up to 50 hectares.
Table 1. Production of pome fruits in agricultural organizations of the Krasnodar Territory.

| Index | On average for 2013-2015 | 2016 | 2017 | 2018 | 2019 | 2019 in% to the average for 2013-2015 |
|-------|-------------------------|------|------|------|------|--------------------------------------|
| The total area under fruit plantations, thousand ha | 22.5 | 21.0 | 23.5 | 23.8 | 24.6 | 109.3 |
| including: - seed gardens (total) | 17.2 | 16.3 | 18.0 | 18.4 | 19.2 | 111.6 |
| - at a fertile age | 11.5 | 12.8 | 13.1 | 13.2 | 13.1 | 113.9 |
| Gross harvest of pome fruits, thousand tons | 227.0 | 299.5 | 286.7 | 330.7 | 418.8 | 184.5 |
| Average yield pome orchards at a fruiting age, c / ha | 197.5 | 264.2 | 250.5 | 280.9 | 300.2 | 152.0 |

The gross harvest of pome fruits in the Krasnodar Territory has grown in recent years to 418.8 thousand tons. There is a significant increase in the yield of orchards. If 6 years ago the average yield was 197.5 centners per hectare, then by 2019 its average level reached 300 centners / ha. In specialized farms, the yield of pome fruits reaches 600 c / ha and above. Yield growth is due to the development of intensive gardening (table 2).

Table 2. Dynamics of intensive horticulture development in the Krasnodar Territory.

| Index | 2010 | 2013 | 2015 | 2016 | 2017 | 2018 | 2019 | 2019 in% (times) to 2010 |
|-------|------|------|------|------|------|------|------|-------------------------|
| Area under intensive gardens, ha in% to the total area under seed orchards | 1903 | 3609 | 6648 | 7863 | 8018 | 9647 | 10926 | 5.7 p. 164.4 |
| including at a fruiting age | 10.9 | 18.5 | 39.8 | 48.3 | 48.9 | 56.1 | 56.9 | x x |
| Gross harvest of pome fruits, thousand tons | 849 | 1878 | 3763 | 4948 | 5024 | 6067 | 6446 | 7.6 p. 171.3 |
| Productivity, c / ha | 21.8 | 51.49 | 135.2 | 188.6 | 136.6 | 193.2 | 209.2 | 9.6 p. 154.7 |
| | 169.9 | 274.2 | 359.4 | 350.6 | 271.8 | 318.4 | 324.6 | 191.1 90.3 |

Substantial government support and compensation for the costs of planting and maintaining intensive gardens contributed to the emergence of new small horticultural farms, made it possible to use modern agricultural technologies and ensure a high level of production in a relatively small area [1].

The area under intensive orchards in the Krasnodar Territory has grown 5.7 times compared to 2010 and amounts to 10.9 thousand hectares in 2019, or 56.9% of the total area under seed orchards. The
average yield of pome fruits in intensive orchards is 324.6 c / ha. However, most of the orchards have just entered the fruiting age and the yield will gradually increase.

The most effective production of products in large, specialized fruit growing farms (table 3). However, the studies carried out show that in 2017, small, specialized organizations with an area of fruiting seed orchards on average 40 hectares had a sufficiently high profitability of production at the level of 43.2% due to the low cost of 1 centner with a low by the standards of the edge of the yield of seed fruits 120 centners / ha. By 2019, the number of small fruit-growing organizations increased to 20, young intensive orchards do not yet yield high yields, which is reflected in the cost and profitability of products. The highest level of cost price is observed in organizations with gardens up to 50 hectares and over 300 hectares.

Table 3. Dependence of the profitability of products sold on the size of areas under an apple tree at a fruiting age, 2019.

| Groups of enterprises by area of gardens, ha | Number of enterprises in the group | Average area of gardens, ha | Average yield, c / ha | Full cost 1 centner of products sold, rub. | Average price of 1 centner, rub. | Profitability (unprofitable-) products sold,% |
|---------------------------------------------|-----------------------------------|-----------------------------|----------------------|-----------------------------------------------|-------------------------------|---------------------------------------------|
| Up to 50                                    | 20                                | 27                          | 104                  | 2573                                          | 2529                          | -1.7                                        |
| 50 – 100                                    | 10                                | 75                          | 180                  | 2019                                          | 2170                          | 7.5                                         |
| 100 – 150                                   | 6                                 | 120                         | 225                  | 1982                                          | 2081                          | 5.0                                         |
| 150 – 200                                   | 5                                 | 190                         | 240                  | 1592                                          | 1925                          | 20.9                                        |
| 200 – 250                                   | 2                                 | 225                         | 280                  | 1784                                          | 1998                          | 12.0                                        |
| 250–300                                     | 4                                 | 280                         | 300                  | 1995                                          | 2123                          | 6.4                                         |
| over 300                                    | 10                                | 700                         | 480                  | 2384                                          | 3284                          | 37.7                                        |
| Total and average                           | 57                                | 202                         | 300                  | 2180                                          | 2687                          | 23.3                                        |

The lowest costs are observed in organizations with an area of 150-200 ha. As the area of the gardens grows, the administrative and commercial expenses increase. Small and large farms sell their products at the highest prices. Small batches of fruits are in demand and are quickly sold on the regional market, and large specialized farms have their own storages, they can rhythmically supply products to large retail chains and do not experience difficulties with implementation [2].

![Dependence of the production cost of 1 centner of pome fruits on the level of yield, thousand rubles.](image-url)

**Figure 1.** Dependence of the production cost of 1 centner of pome fruits on the level of yield, thousand rubles.
The productivity of orchards (output per hectare) has the greatest impact on the level of production costs. With a yield of up to 50 c / ha, the highest level of the cost of 1 c of fruits is observed and the loss ratio of sales is 49.3% (table 4).

Intensive gardens require more maintenance than conventional gardens. The low level of average selling prices in this category of farms also negatively affects the financial result. The critical sales volume or “break-even point” is often considered as the main indicator of the risk of production activities, which is determined by the formula:

\[ X_{\text{critical}} = \frac{A}{z-b}, \]  

where \( X_{\text{critical}} \) – sales volume in kind (units); 
\( A \) – fixed costs of the organization; 
\( z \) – the average selling price; 
\( b \) – variable costs per 1 unit of production [3].

It is assumed that the value of variable costs per 1 unit of production does not change with an increase in the volume of production. But in agriculture, the situation is somewhat different. The yield and the volume of products produced in horticulture are unstable indicators, depending on natural and climatic conditions, biological, technological and many other factors. The total fixed costs (A) and the average selling price (z) in fruit growing are indicators that can be easily calculated and planned, but variable costs (such as fertilizing, treating gardens with protective equipment, pruning, irrigation, etc.) are possible determine only per 1 hectare of gardens. The size of variable costs per 1 centner of production depends on the yield, or rather, the yield of marketable products from 1 hectare. In addition to the costs of maintaining the garden, fruit-growing organizations bear the costs of harvesting and storing products in refrigerators and in warehouses. These types of expenses make up a significant share of the cost of fruit and are determined per 1 centner. Therefore, the refined break-even point formula takes the form:

\[ X_{\text{critical}} = \frac{A}{z-b-y-c} \]

where \( A \) - the total amount of fixed costs in fruit growing; 
\( z \) - average selling price of 1 centner of fruit; 
\( b \) - variable costs of maintaining 1 hectare of gardens; 
\( y \) - the yield of marketable products from 1 ha (yield); 
\( c \) - the cost of cleaning and storage of 1 centner of products.

If in 2014 the critical yield level ("break-even point") for small enterprises with an area of gardens up to 100 hectares was within 68-70 c / ha, for large, with a high level of management costs - 140 c / ha, then by 2019 These indicators have grown. For small, specialized organizations, the critical yield level is 115 kg / ha. It can be easily achieved by entering the gardens into full fruiting.

According to table 4, it can be seen that with an increase in yield, the cost of 1 centner of production decreases and profitability increases. Low cost and high profitability of apple production (102.8%) is observed in large, specialized organizations with an average yield of 500 c / ha. Such farms have the opportunity to sell products at higher prices than other manufacturers.

**Table 4.** Dependence of the profitability of apple production on the yield in specialized farms in the Krasnodar region, 2019.

| Groups of farms by | Cost price of 1 centner, rub. | average price | Profitability production, |
|-------------------|-----------------------------|---------------|--------------------------|

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yield of pome fruit, c / ha & Number of farms in the group & Average production, complete c / ha & 1 cent, rub. & % & Profitability (unprofitable sales, %)

| Range     | Number | Average | Production | Complete | Cent | Rub | % | Profitability |
|-----------|--------|---------|------------|----------|------|-----|---|---------------|
| Up to 50  | 3      | 48      | 2967       | 3080     | 1562 | -47.3 | -49.3 |
| 50–100    | 7      | 71      | 2297       | 2330     | 1498 | -34.8 | -35.7 |
| 100–150   | 11     | 120     | 2586       | 2590     | 2637 | 2.0  | 1.8 |
| 150–200   | 7      | 216     | 2028       | 2252     | 2256 | 11.2 | 0.2 |
| 200–250   | 12     | 227     | 1411       | 1751     | 1794 | 27.1 | 2.5 |
| 250–300   | 6      | 285     | 1892       | 1969     | 2109 | 11.5 | 7.1 |
| Over 300  | 11     | 512     | 1618       | 1721     | 3281 | 102.8 | 90.6 |
| Total and average | 57 | 300 | 1672 | 2180 | 2687 | 60.7 | 23.3 |

Large retail chains prefer to conclude contracts with farms capable of organizing the rhythmic supply of large batches of packaged and sorted products to stores for a long period of time [4].

Figure 2 shows that compared to 2013, the average producer price increased insignificantly, but consumer prices increased 1.6 times and 2.6 times higher than producer prices. Maintaining a price balance that would suit both domestic producers and consumers is possible only through the creation of a regional association with the participation of economic entities of the fruit and berry subcomplex, governing bodies of the regional agro-industrial complex and scientific organizations for gardening. The Association could assist gardeners in introducing the latest scientific developments, organizing storage, pre-sale preparation of products and their sale at prices acceptable to all market participants [5].

**Dynamics of average prices for apples in the Krasnodar Territory, RUB / kg**

| Year   | Price from manufacturers for 1 kg | Consumer price for 1 kg |
|--------|----------------------------------|-------------------------|
| 2013   | 22.2                             | 45.4                    |
| 2014   | 23.4                             | 57.2                    |
| 2015   | 33.3                             | 68.3                    |
| 2016   | 33.1                             | 69.0                    |
| 2017   | 32.9                             | 67.9                    |
| 2018   | 33.0                             | 69.6                    |
| 2019   | 27.0                             | 71.6                    |

**Figure 2.** Dynamics of average prices for apples in the Krasnodar Territory, RUB / kg.

To increase the efficiency of fruit growing in the region, it is necessary:
- carry out further renovation of plantations taking into account the use of new intensive technologies;
- to develop the production of domestic planting material adapted to the natural and climatic conditions of the area on the basis of the latest scientific developments;
- unite the efforts of fruit growers by creating an association capable of providing assistance to producers in all areas of their activities;
with the support of government agencies to create industrial production for processing non-standard products;

The retention by the state of restrictions on the import of imported products is an essential condition for increasing the economic efficiency of the fruit growing industry [6].

References
[1] Akimova E P and Oleynik A N 2019 Analysis of the state grants’ impact on the economic sustainability and efficiency of agricultural production IOP Conference Series: Earth and Environmental Science 315 22016
[2] Malykh E and Oleynik A N 2016 Proc. Int. Conf. on Economic Analysis (Krasnodar: KubGAU) pp 143-47
[3] Vasilieva N K and Oleynik A N 2020 Comprehensive Analysis of Economic Activities Part 2: Financial Analysis (Kursk: University book) p 95
[4] Sidorchukova E V and Nefidova M T 2018 Methodological aspects of assessment of business activity of agricultural organization Colloquium-Journal 11-9 (22) 90-94
[5] Ionova D M, Aristova S A, Sidorchukova E V and Vasilyeva N K 2018 State support for sustainable development of rural areas of the Krasnodar Territory Colloquium-Journal 12-5 (23) 19-23
[6] Korovina K G and Polyakov V E 2019 Improving the methodology for analyzing the economic efficiency of agricultural organizations Modern Management Technologies 1(88) 3