Meso-Cluster Typology of Production Complex of Rural Municipalities of the Krasnodar Region

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Abstract. The article reveals advantages of the cluster approach at the regional level; the analysis of features of the functioning of the fruit and berry subcomplex of the region, represented by 37 rural districts, was performed; prospects for further expansion of this sector of agricultural production by clustering them were identified. The clustering method made it possible to determine identification signs of the development of micro-clusters and to extract potential territories that acted as integrators of growth within the fruit cluster. Based on the analysis carried out, a meso-cluster typology of fruit-producing areas of the Krasnodar Region was carried out, taking into account dominant factors in the concentration of fruit production and the analysis of directions for final product sale.

1. Introduction
When building clusters, first of all, it is necessary to focus on territorial and sectoral isolation, which means the creation of a cluster in a specific constituent entity of the Russian Federation within a specific industry.

In any industry, for the formation of a cluster, it is necessary to determine “points of growth”, taking into account the fact that in each specific constituent entity of the Russian Federation all branches of agricultural production cannot be competitive.

For the further progressive development of agricultural production, the creation of clusters is advisable in rural areas, which in the future will lead to the attraction of investments and the effective use of territorial potential [9–13].

With the help of clusters, it becomes possible to engage the unemployed part of the population, improve the demographic situation, reduce the cost of production by increasing the volume of agricultural products, reduce the “gap” between the city and the countryside, introduce innovative agricultural technologies, etc. [14, 15].

The above confirms the need to identify regional agro-zones of intensive development in order to create agro-clusters in the Kuban.
2. Material and methods

The study used abstract-logical, formalized, general scientific methods, methods of analogy, methods of comparative, cause-and-effect and cluster analysis, methods of theoretical and empirical knowledge, as well as systemic and integrated approaches.

The information and empirical basis for testing the hypothesis was the personal observations and developments of the authors, data from the Federal State Statistics Service and Krasnodarstat, official Internet sites.

3. Results and discussion

The economic complex of the Krasnodar Region is represented by 37 districts and has an agro-industrial focus.

Gardening is one of the priority industries for the Krasnodar Region. The natural conditions of the region make it possible to produce and provide the population with environmentally pure horticultural products as much as possible. [1].

The total area of fruit and berry plantations on the territory of the Krasnodar Region is shown in dynamics in table 1.

| Table 1. The area of fruit and berry plantations in farms of all categories, ha [16, 17]. |
|-----------------|-----|-----|-----|-----|-----|-------------------|
| Indicators      | 2015| 2016| 2017| 2018| 2019| Change 2019/2015 |
| Abinskoy district | 2736 | 2756 | 2797 | 3098 | 3182 | 446              |
| Absheron district   | 1059 | 1029 | 973  | 974  | 967  | -92              |
| Beloglnsky district | 823  | 779  | 747  | 824  | 843  | 20               |
| Belorechensky district | 23   | 779  | 747  | 824  | 843  | 820              |
| Bryukhovetsky region | 226  | 150  | 188  | 246  | 232  | 6                |
| Vyselkovskoy district | 1196 | 1141 | 1051 | 1050 | 990  | -206             |
| Gulkhevichskoy district | 949  | 1018 | 1040 | 1017 | 1056 | 107              |
| Dinskoy district | 3136 | 3101 | 3051 | 3149 | 3193 | 57               |
| Yeisk district    | 1963 | 1935 | 2045 | 2091 | 2101 | 138              |
| Kavkazskoy district | 882  | 926  | 852  | 819  | 1073 | 191              |
| Kalininsk district | 260  | 256  | 256  | 251  | 248  | -12              |
| Kanevskoy district | 1250 | 1310 | 1345 | 1076 | 1088 | -162             |
| Korenovskoy district | 163  | 155  | 155  | 195  | 165  | 2                |
| Krasnoarmeyskoy district | 1374 | 1366 | 1384 | 1365 | 1401 | 27               |
| Krylovskoy district | 461  | 604  | 937  | 871  | 747  | 286              |
| Krymskoy district | 1162 | 1306 | 1479 | 1646 | 1555 | 393              |
| Kurgansky district | 310  | 318  | 312  | 325  | 310  | 0                |
| Kushchevskoy district | 156  | 147  | 446  | 414  | 426  | 270              |
| Labinsky district | 340  | 261  | 322  | 452  | 461  | 121              |
| Leningradskoy district | 954  | 1112 | 1139 | 1192 | 1177 | 223              |
| Mostovskoy district | 170  | 364  | 158  | 158  | 153  | -17              |
| Novokubansky district | 183  | 197  | 222  | 372  | 401  | 218              |
| Novopokrovskoy district | 517  | 311  | 466  | 436  | 1057 | 540              |
| Otradensky district | 130  | 123  | 122  | 122  | 118  | -12              |
| Pablovskoy district | 660  | 593  | 534  | 546  | 567  | -93              |
| Primorskoy-Akhtarsky district | 146  | 154  | 167  | 193  | 191  | 45               |
| Seversky district | 646  | 691  | 634  | 667  | 655  | 9                |
| Slavyansky district | 3072 | 3033 | 2963 | 3101 | 3232 | 160              |
| Starominskoy district | 168  | 162  | 196  | 240  | 238  | 70               |
| Tbilisiskoy district | 97   | 117  | 94   | 119  | 129  | 32               |
| Temryuksky district | 606  | 766  | 744  | 738  | 890  | 284              |
In 2015, 275.3 million rubles were allocated from the budgets of different levels for the development of horticulture in the region, and in 2019 state support was increased by 2.8 times and amounted to 758.1 million rubles. About 800 million rubles were allocated to support horticulture in 2020. Support was provided to peasant farms that have been working for at least 12 months for the establishment of intensive gardens with certified planting material with the installation of trellises and drip irrigation systems; to agricultural producers for the establishment of perennial plantations (including nursery-gardens) and care for them.

Thanks to state support, new gardens are being laid in the region, where plants of highly productive varieties are grown. So, in 2018, a new regional program Malyy Sad (Small Garden) was launched, developed as a mechanism for involving small forms of farming in the effective use of agricultural land. Under this program, grants totaling 137.2 million rubles were by received 46 peasant (farmer) households, which made it possible to lay 149.2 hectares of new gardens. 60 million rubles have been allocated for the implementation of this program in 2020 from the regional budget.

In 2015–2019, in the region, the area of perennial plantings increased by 14.1%, taking into account the uprooting of retired plantations.

Nursery-gardening is also actively developing in the Krasnodar Region. Now there are 20 fruit nursery-gardens in the region. If in 2015 3 million fruit seedlings were received, then in 2019 – 6.2 million, that is, production has more than doubled.

In the Kuban, work is also underway on the reconstruction and construction of fruit storage facilities. In 2015, the volume of one-time storage was 135 thousand tons, today it is 223 thousand tons, which is 65.2% more than in 2015. The largest fruit storage facilities are located in the Krymsky, Abinsky and Novopokrovsky districts. In 2019, the region began construction of one of the largest fruit storage facilities in the South of Russia with a storage capacity of up to 54 thousand tons.

In 2019, fruit and berry production increased by 29.253 thousand tons, which is due to the frequency of fruiting and climatic conditions of the growing seasons (table 2).

### Table 2. Gross harvest of fruits and berries in farms of all categories, thousand tons [16, 17].

| Indicators          | 2017  | 2018  | 2019  | Changes (+, -) | Changes (+, -) |
|---------------------|-------|-------|-------|----------------|----------------|
|                     |       |       |       | 2019/2017      | 2019/2018      |
| Abinsky district    | 1782  | 1969  | 1472  | -310           | -497           |
| Apsheron district   | 104   | 107   | 115   | 11             | 8              |
| Beloglinsky district| 41    | 43    | 47    | 6              | 4              |
| Borechensky district| 162   | 189   | 203   | 41             | 14             |
| Bryukhovetsky district| 157  | 159   | 140   | -17            | -19            |
| Vyselkovsky district| 35    | 37    | 40    | 5              | 3              |
| Gulkevichsky district| 159  | 167   | 177   | 18             | 10             |
| Dinskoy district    | 229   | 240   | 278   | 49             | 38             |
| District               | Yeisk                    | 354 | 387 | 971 | 617 | 584 |
|-----------------------|--------------------------|-----|-----|-----|-----|-----|
| Kavkazsky district    | 325                      | 333 | 358 | 33  | 25  |
| Kalininsky district   | 1137                     | 1221| 2910| 1773| 1689|
| Kanevskoy district    | 122                      | 129 | 139 | 17  | 10  |
| Korenovsky district   | 94                       | 103 | 126 | 32  | 23  |
| Krasnoarmeysky district| 297                     | 318 | 344 | 47  | 26  |
| Krylovsky district    | 92                       | 97  | 104 | 12  | 7   |
| Krymsky district      | 3926                     | 4239| 6102| 2176| 1863|
| Kurganinsky district  | 83                       | 88  | 94  | 11  | 6   |
| Kushchevsky district  | 128                      | 139 | 149 | 21  | 10  |
| Labinsky district     | 71                       | 73  | 79  | 8   | 6   |
| Leningradsky district | 138                      | 144 | 155 | 17  | 11  |
| Mostovsky district    | 76                       | 81  | 87  | 11  | 6   |
| Novokubansky district | 149                      | 159 | 757 | 608 | 598 |
| Novopokrovsky district| 38                       | 40  | 62  | 24  | 22  |
| Otradensky district   | 33                       | 34  | 37  | 4   | 3   |
| Pavlovsky district    | 101                      | 110 | 118 | 17  | 8   |
| Primorsko-Akhtarsky district | 88   | 97  | 104 | 16  | 7   |
| Seversky district     | 376                      | 390 | 422 | 46  | 32  |
| Slavyansky district   | 215                      | 220 | 236 | 21  | 16  |
| Starominsky district  | 77                       | 79  | 85  | 8   | 6   |
| Tbilisi district      | 71                       | 73  | 108 | 37  | 35  |
| Temryuksky district   | 145424                   | 160822| 169584| 24160| 8762|
| Timashevsky district  | 398                      | 415 | 445 | 47  | 30  |
| Tikhoretsky district  | 130                      | 155 | 167 | 37  | 12  |
| Tuapse district       | 344                      | 358 | 386 | 42  | 28  |
| Uspensky district     | 30                       | 32  | 35  | 5   | 3   |
| Ust-Labinsky district | 169                      | 174 | 187 | 18  | 13  |
| Shcherbinovsky district| 98                       | 106 | 114 | 16  | 8   |
| Total:                | 157253                   | 173527| 186937| 29253| 13410|


The yield of fruit and berry crops [2] remains rather low, which is explained by both the horticultural zone and the age of plantations, garden rotation, range, technologies used.

The average yield of fruits and berries in farms of all categories is shown in Table 3.

**Table 3.** Yield of fruits and berries in farms of all categories, cwt / ha [16].

| Indicators             | 2017  | 2018  | 2019  | Changes (+, -) | 2019/2017 | 2019/2018 |
|------------------------|-------|-------|-------|----------------|-----------|-----------|
| Abinsky district       | 179.4 | 181.5 | 214.9 | 35.5           | 33.4      |
| Apsheron district      | 25.9  | 24.8  | 20.0  | -5.9           | -4.8      |
| Beloglinsky district   | 55.3  | 67.6  | 80.4  | 25.1           | 12.8      |
| Belorechensky district | 51.7  | 60.7  | 98.2  | 46.5           | 37.5      |
| Bryukhovetsky district | 171.2 | 168.1 | 88.0  | -83.2          | -80.1     |
| Vyselkovsky district   | 119.5 | 124.4 | 190.5 | 71             | 66.1      |
| Gulkevichsky district  | 110.1 | 108.1 | 107.3 | -2.8           | -0.8      |
| Dinskoy district       | 143.9 | 158.8 | 190.2 | 46.3           | 31.4      |
| Yeisk district         | 70.8  | 71.4  | 69.6  | -1.2           | -1.8      |
| Kavkazsky district     | 57.6  | 64.2  | 98.6  | 41             | 34.4      |
| Kalininsky district    | 112.4 | 117.9 | 182.7 | 70.3           | 64.8      |
| Kanevskoy district     | 188.2 | 194.2 | 239.6 | 51.4           | 45.4      |
| Korenovsky district    | 112.6 | 110.2 | 108.3 | -4.3           | -1.9      |
| Krasnoarmeysky district| 102.9 | 108.0 | 153.5 | 50.6           | 45.5      |
| Krylovskoy district    | 47.8  | 55.4  | 71.9  | 24.1           | 16.5      |
| Krymsky district       | 45.6  | 51.0  | 68.1  | 22.5           | 17.1      |
| Kurganinsky district   | 71.3  | 78.7  | 123.5 | 52.2           | 44.8      |
| Kushchevsky district   | 29.0  | 32.0  | 39.3  | 10.3           | 7.3       |
| Labinsky district      | 54.8  | 60.7  | 71.1  | 16.3           | 10.4      |
| Leningradsky district  | 286.2 | 287.5 | 288.1 | 1.9            | 0.6       |
| Mostovsky district     | 71.9  | 75.1  | 110.9 | 39             | 35.8      |
| Novokubansky district  | 103.6 | 100.7 | 82.1  | -21.5          | -18.6     |
| Novopokrovsky district | 71.2  | 79.4  | 97.5  | 26.3           | 18.1      |
| Otradensky district    | 65.3  | 70.7  | 115.4 | 50.1           | 44.7      |
| Pavlovsky district     | 145.0 | 146.3 | 138.1 | -6.9           | -8.2      |
| Primorsko-Akhtarsky    | 144.7 | 142.6 | 132.8 | -11.9          | -9.8      |
The analysis of the peculiarities of the functioning of the fruit and berry subcomplex showed that at present one of the promising directions of the plant growing subindustry is the stimulation of the development of fruit growing on an industrial scale.

The results of the analysis of the production complex in the context of rural municipalities in the region under study confirms the presence of a favorable environment in order to expand the considered agricultural sector by clustering them.

Using the clustering method, the signs [3, 4] of the development of micro-clusters are identified and the internal territorial reserves of municipal districts are revealed. In this connection, the meso-cluster typology of the fruit-producing districts of the Krasnodar Region was carried out.

The grouping of municipalities was carried out by the method of a multidimensional statistical procedure – cluster analysis, which involves determining the distances between the compared objects, combining them into relatively homogeneous groups according to a set of various indicators [8].

Cluster analysis was performed using the k-means method, the measure of proximity is Euclidean distance:

$$p(x, y) = \|x - y\| = \sqrt{\sum_{p=1}^{n} (x_p - y_p)^2}$$

where $x, y \in \mathbb{R}^n$

Hierarchical unification of rural areas into clusters of the Krasnodar Region was carried out by the Ward method based on the minimum variances within the clusters (figure 1).
Figure 1. Meso-cluster typology of the spatial and economic distribution of fruit-producing zones.

Table 4. Structure of the selected clusters.

| Municipality                | Cluster | Distance |
|-----------------------------|---------|----------|
| Abinsky district            | 1       | 0.71     |
| Apsheron district           | 2       | 0.62     |
| Beloglinsky district        | 2       | 0.28     |
| Belorechensky district      | 2       | 0.26     |
| Bryukhovetsky district      | 3       | 0.26     |
| Vyselkovskiy district       | 3       | 0.72     |
| Gulkevichsky district       | 2       | 0.15     |
| Dinskoy district            | 1       | 0.85     |
| Yeisk district              | 2       | 0.65     |
| Kavkazsky district          | 2       | 0.10     |
| Kalininsky district         | 3       | 0.54     |
| Kanevskoy district          | 1       | 0.92     |
| Korenovskiy district        | 3       | 0.17     |
| Krasnoarmeysky district     | 2       | 0.49     |
| Krylovskoy district         | 2       | 0.37     |
| Krymsky district            | 2       | 0.34     |
| Kurganinsky district        | 3       | 0.07     |
| Kushchevsky district        | 3       | 0.62     |
| Labinsky district           | 3       | 0.37     |
Leningradsky district 1 0.85
Mostovsky district 3 0.17
Novokubansky district 3 0.28
Novopokrovsky district 2 0.11
Otradensky district 3 0.19
Pavlovsky district 3 0.21
Primorsko-Akhtarsky district 3 0.19
Seversky district 3 0.23
Slavyansky district 1 1.29
Starominsky district 3 0.16
Tbilisi district 3 0.18
Temryuksky district 4 0.00
Timashevsky district 2 0.57
Tikhoretsky district 3 0.13
Tuapse district 2 0.19
Uspensky district 3 0.42
Ust-Labinsky district 3 0.16
Shcherbinovsky district 3 0.38

As a result of the analysis, four clusters were identified, the most attractive of which are the municipalities of the Krasnodar Region that form the first cluster, namely Abinsky, Dinskoy, Kanevskoy, Leningradsky and Slavyansky districts.
Further, we can rank the municipalities of the 2nd and 3rd clusters.
The study of the organizational and economic mechanism of the functioning of the regional fruit-
producing cluster made it possible to form the key directions of the industry’s development, presented in figure 3.

**Figure 3.** Conceptual model of formation and development of infrastructure of fruit cluster at meso-level.
4. Conclusion

Thus, in the proposed cluster model, an attempt was made to overcome the shortcomings and highlight the elements of the attractiveness of the proposed model.

1. The presence of financial, organizational and informational advantages for the enterprises of the cluster [6, 7], which contribute to an increase in the volume of products and a reduction in production costs.

2. Simplification of procedures for control by state authorities over the activities of cluster enterprises.

3. Increasing the level of investment attractiveness and business activity of rural areas [5].

Creation of a group of clusters in the region will solve a number of problems:
- in the revenue side of the budget;
- improving the quality of food and, accordingly, the competitiveness of local producers;
- a decrease in the unemployment rate, which is one of the pressing problems in the countryside;
- development of interconnected agricultural markets, etc.

The creation and effective functioning of the fruit and berry cluster will lead to the fullest use of the possibilities of the territorial markets of fruit and berry products of the municipal districts of the Krasnodar Region.

The main criteria are:
1) the presence of the power resource of districts and localities;
2) rational placement, availability of equipment and technical equipment of interacting branches and productions;
3) common interests of stakeholders;
4) proportionality as a principle of the most efficient development of production capacities;
5) optimal specialization and concentration of production using innovative technologies;
6) efficiency of management structures.

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