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# Investment Attractiveness of the Area for Marine Farming and Marine Aquaculture Target Species

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## Abstract

Based on the designed system of indicators to evaluate the investment attractiveness of the area for marine farming and the target species for marine aquaculture using expert assessment and ABC methods, the research identifies the most significant, fundamental factors that create the investment attractiveness of the marine aquaculture component of the regional fishery complex. It is proved that the investment attractiveness of the area for marine farming and the amount of financial investments in marine aquaculture objects, first of all, depend on the formation of the appropriate organizational and institutional support, namely reducing the degree of business overregulation (simplifying the conditions for allocation of fishery grounds, the procedure for obtaining permission to grow target marine aquaculture species and certification systems for fishery and farming grounds) and ensuring the effectiveness of the mechanism for control and supervision of the illegal harvesting of marine aquaculture species

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## 1. Introduction

The fishery complex and marine aquaculture as its important component traditionally act as important elements of the food facility and play a significant role in solving the problem of balanced nutrition of the population.

However, at present, the available national marine aquaculture resources are not much used. The state and effectiveness of the functioning of the regional fisheries complex lags significantly behind the advanced fisheries

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and does not meet the requirements of the modern society, which is due to the significant dependence of the fish market on imports of products made of living aquatic resources against the background of the crisis state of domestic fishery enterprises and marine aquaculture farms, as well as insufficient control of the shadow sector of fisheries, imperfection of the state support and control enforcement system in this area, a high degree of tax burden on aquaculture farms and overregulation of the farming by Aleksakhina and Tregulova (2016). All of the above factors determine the reluctance of investors to plow money in the development of both the fishing industry as a whole and marine aquaculture in particular by Yarkina and Logunova (2019).

Moreover, the lack of a unified system for assessing the investment attractiveness of a region (separate area) in the field of marine aquaculture development with specific criteria indicators, in conditions of extreme limited financial resources allocated by the state and instability of the external environment, exacerbates the critical situation even more.

## 2. Materials and Methods

In order to identify the most important factors affecting investment decisions in the field of marine aquaculture, we have developed a system for the integrated assessment of the investment attractiveness of the area for marine farming and proposed marine aquaculture target species, with 10 main blocks (5 indicators in every block). Every block would reflect one of the areas of investment attractiveness (Fig. 1).

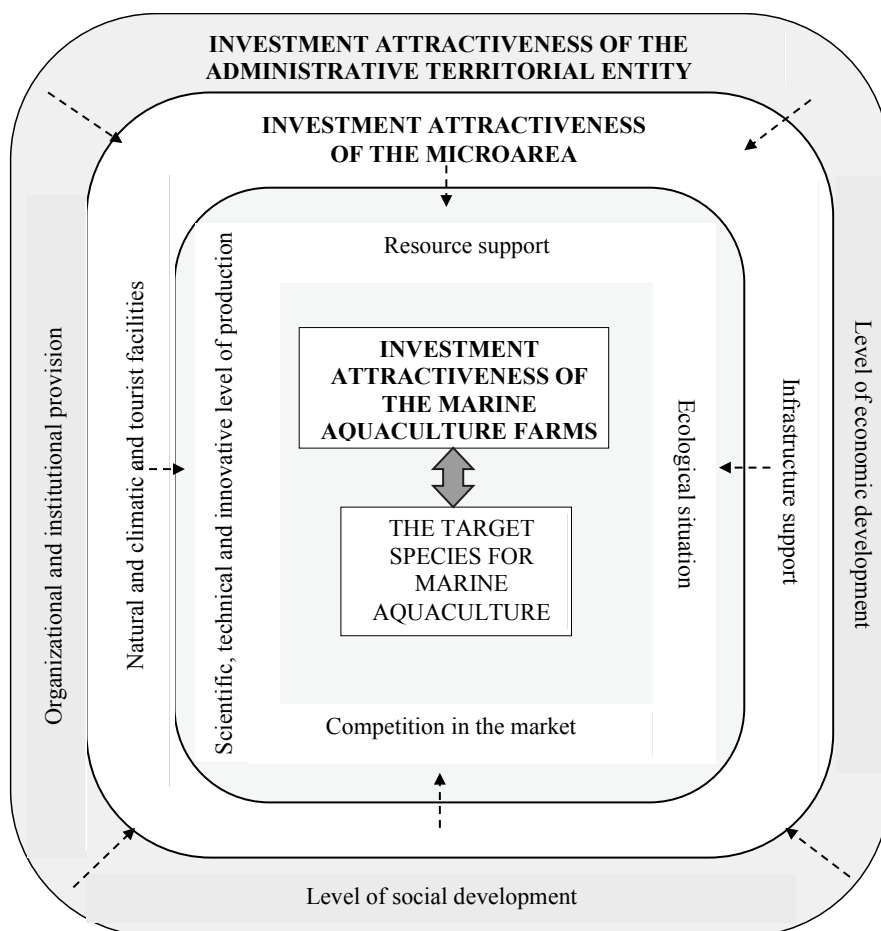


Fig. 1. Correlation of criteria for investment attractiveness of a business in the sphere of marine aquaculture.

Thus, the investment attractiveness of the territorial-administrative entity was represented by the following traditional indicators:

- organizational and institutional support (the existing regulatory framework governing activities in the field of freshwater and marine aquaculture; the degree of tax burden on aquaculture farms; the level of federal support; the effectiveness of the mechanism for controlling and supervising the illegal harvesting of marine aquaculture products; regulatory policy reflecting the degree of business regulation, conditions for the allocation of fishery grounds, including the duration of the procedure for registering the right to use a water area for fish farming, etc.);
- level of economic development (investment in fixed assets per capita; level of entrepreneurial activity (number of small and medium-sized enterprises per 10 thousand people; per capita cash income of the population; dynamics of prices for fish products, which allows to determine the most promising types of production and consumption of marine aquaculture products; the dynamics of the average annual turnover of organizations with the main activity "Fishing and fish farming", reflecting the financial well-being (ill-being) of the fishing industry as a whole);
- level of social development (unemployment rate; level of education, represented by the number of people with higher education, per 1000 people; medical and demographic indicators of population health; structure of consumption of basic food products (specific weight of consumption of products from aquatic living resources); crime rate (including the level of offenses and crimes in the field of catch of aquatic living resources), which is a significant factor in the refusal (desire) to run business in a certain area.

When assessing the investment attractiveness of a micro-region (area for creating a marine aquaculture farm), we recommend the following criteria to be used:

- natural and climatic and tourist facilities (geographical characteristics (access to sea areas, coastline); biotic characteristics (density of fries, feed supply factors, intra-specific relationships of aquatic organisms, fish predators, etc.); hydrogeological characteristics (quantitative and qualitative characteristics of water bodies as environment for the existence of biologically diverse flora and fauna), which determine the species composition of target species for commercial farming of aquatic living resources; climatic characteristics (temperature, frequency of occurrence and duration of storm situations, duration and thickness of ice formation, etc.); the presence of objects of tourist interest (natural wealth, cultural and historical sights), which determine the change in the volume of seafood consumption depending on the time of year, weekends and holidays, the level of development of gastronomic tourism);
- infrastructure support (market infrastructure favoring the effective functioning of parties involved in the development of marine aquaculture; transport infrastructure (communication lines, logistics centers, transport communications, etc.), providing the timely and high-quality delivery of raw stuff, materials, semi-finished products and finished products to the destination; production infrastructure (technical structures, warehouses, engineering networks, etc.), as an integral element of the production process from aquatic living resources; scientific and educational infrastructure, including research and educational centers, Small Innovative Enterprises (SIE), business incubators, involved in scientific research and introducing scientific developments in the field of marine aquaculture; information infrastructure (information centers, data and knowledge banks, communication systems, hardware and software tools and technologies for collecting, storing, processing and transmitting information, etc.).

As criteria characterizing the investment attractiveness of the marine aquaculture farms, the following ones are recommended:

- resource support (financial resources; represented by internal, external and borrowed funds; human resources consisting of specialists in the field of freshwater and marine aquaculture and related industries, as well as their knowledge, competencies, entrepreneurial abilities; material and technical resources providing conditions for fishery activities in the field of marine aquaculture and representing a combination of fixed and current assets of

farms; commercial resources, which include established relationships with buyers, suppliers and partners, distribution networks, brands and advertising technologies; spatial resources (water environment, territory, form etc.) that determine the environment and boundaries of the area within which fisheries activities are carried out);

- competition in the market of aquatic living resources (the number of marine aquaculture farms producing similar products, determining the level and intensity of competition in the industry; the cost of products from competitors, including those producing substitute products; market capacity, conditions for new producers to enter the market, product quality parameters);
- scientific, technical and innovative level of production of marine aquaculture facilities (condition and power of the experimental base; level of mechanization and automation of production; technical level of equipment; level of progressivity of the technology used; share of new types of marine aquaculture in the total volume of commercial harvesting);
- ecological situation (seawater quality; level of anthropogenic (man-induced) impact on the environment of the functioning of the marine aquaculture farm; risk of product losses due to morbidity; frequency of ship calls / passages per day to / from the water area; geochemical characteristics of bottom sediments) by Logunova et al., (2019), Gentry et al., (2020);
- the target species for marine aquaculture, which is of particular importance to the investor and is often the crucial criterion for the investment attractiveness of the marine aquaculture farms (nutritional and biological value of the marine aquaculture target species; costs per ruble of the commercial output; ratio of the sale price of the product to the average cost of the marine aquaculture product; capital intensity of creating a marine aquaculture farm; compliance of the sanitary and bacterial characteristics of the final product with the requirements of quality standards) by Chernyi, (2018).

It should be noted that, despite the undoubted importance of all the criteria presented, there are factors that have the greatest influence on the choice of an investment object and the investment attractiveness of the area for siting a marine aquaculture farm. In this connection, based on the expert assessment and ABC methods, we have undertaken a ranking of the criteria under consideration, which allows us to select the most significant and fundamental factors of investment attractiveness of the marine aquaculture business from this set by Wang et.al., (2019).

### 3. Results

To make an expert assessment, twenty highly qualified specialists in the field of aquaculture were invited, representing a combination of four groups of 5 specialists in each group by Alleway et al. (2019):

- Group 1: top managers of marine aquaculture farms (management representatives);
- Group 2: researchers engaged in research in the field of commercial farming of aquatic organisms;
- Group 3: potential investors;
- Group 4: representatives of authorities (regional, municipal).

The expert assessment was carried out at several stages based on a survey of specialists as per the extent of significance of every of the proposed criteria by assigning them a ranking number.

The questionnaire had the ten most significant indicators of investment attractiveness of marine aquaculture objects. At the same time, the indicator, to which the expert gave the highest score, was assigned a rank of 10. If the expert recognized several criteria as equivalent, then they were assigned equal ranks, which were subsequently converted to standardized ones.

Within the framework of every of the proposed indicators of investment attractiveness, five main criteria were also indicated that informally disclosed each of the indicated indicators, which should be ranked on a scale from 1 to 5, where 1 - “does not have a significant impact”, 5 - “has a greater impact on the implementation of priorities”

The results of the expert assessment are presented in Tables 1 and 2 and in Fig. 2.

Table 1. Expert-scoring assessment of the criteria for investment attractiveness of the area for marine aquaculture farming and the marine aquaculture target species proposed for farming.

| Criteria                                                                                    | Symbol legend of the criterion | Average ranks in groups of experts |        |         |         | Groupwise rank |
|---------------------------------------------------------------------------------------------|--------------------------------|------------------------------------|--------|---------|---------|----------------|
|                                                                                             |                                | Group 1                            | Group2 | Group 3 | Group 4 |                |
| I. Organizational and institutional support                                                 | $r_i^1$                        | 8.8                                | 8.8    | 9.0     | 9.4     | 9.0            |
| II. Competition at the market of aquatic living resources                                   | $r_i^2$                        | 3.8                                | 7.2    | 6.8     | 6.6     | 6.1            |
| III. Resource allocation                                                                    | $r_i^3$                        | 8.2                                | 7.6    | 8.8     | 8.6     | 8.3            |
| IV. Natural and climatic and tourist facilities                                             | $r_i^4$                        | 9.4                                | 9.0    | 8.4     | 8.4     | 8.8            |
| V. Environmental situation                                                                  | $r_i^5$                        | 8.0                                | 8.2    | 6.8     | 8.2     | 7.8            |
| VI. Infrastructure support                                                                  | $r_i^6$                        | 4.8                                | 5.8    | 4.6     | 6.4     | 5.4            |
| VII. The level of economic development                                                      | $r_i^7$                        | 7.0                                | 8.4    | 6.0     | 5.4     | 6.7            |
| VIII. The level of social development                                                       | $r_i^8$                        | 2.8                                | 4.8    | 4.0     | 6.8     | 4.4            |
| IX. Scientific, technical and innovative level of production of marine aquaculture products | $r_i^9$                        | 5.0                                | 5.4    | 4.8     | 4.8     | 5.0            |
| X. The target species for marine aquaculture                                                | $r_i^{10}$                     | 8.0                                | 8.4    | 8.8     | 8.8     | 8.5            |

Thus, according to experts, the most significant indicators for the investor are as follows: organizational and institutional support, characterizing the investment attractiveness of the administrative-territorial entity and receiving the highest possible score, climatic and tourist facilities of the territory for creating a marine aquaculture farm, as well as the target species for marine aquaculture. Experts paid considerable attention to the resource support of the marine aquaculture farm, the environmental situation in the water area intended for growing aquatic organisms, and the level of economic development of the territory.

At the same time, despite the fact that the level of social development of a certain area is inextricably linked with the quality characteristics of the end consumer of products made of aquatic organisms, all specialists, with the exception of representatives of the authorities, gave this criterion the last position by Zhilenkov and Chernyi (2019).

An assessment of the degree of agreement of experts' opinions regarding the significance of the criteria for investment attractiveness of the area for creating a marine aquaculture farm and the potential for growing marine aquaculture target species showed a sufficient level of coordination among specialists (the group-wide coefficient of concordance was 0.67).

The opinions of expert groups - managers of marine aquaculture farms ( $W = 0.81$ ) and representatives of government ( $W = 0.80$ ) - were the most consistent; potential investors expressed less unanimous opinion ( $W = 0.68$ ), which is most likely due to different priorities and opportunities (in particular, initial capital) to run business in marine aquaculture sphere. At the same time, despite some deviations in the answers of experts, the calculated values of the Pearson's chi-squared test, which for all groups of experts exceed tabular (critical) values, confirmed the nonrandom consistency of experts' opinions (Table 3).

Considering the indicators of investment attractiveness in the context of their key components, it should be noted that each of them has its most significant criteria, creating favorable conditions for investing and doing business in the field of marine aquaculture.

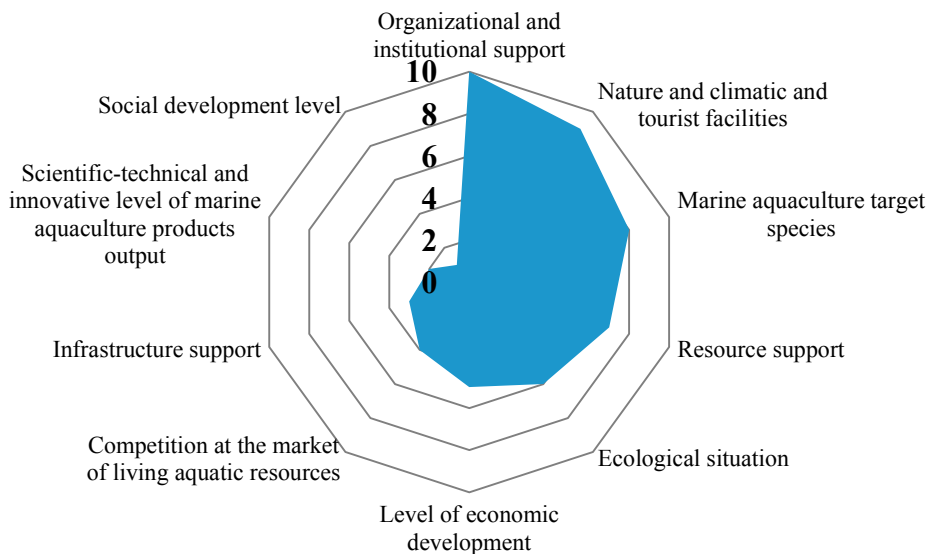


Fig. 2. Test significance for investment attractiveness of the area to develop marine farms and to grow target marine aquaculture according to experts.

Table 2. Quantitative characteristics of the range experts' views.

| Indicators                  | Objects for ranking (criteria) |         |         |         |         |         |         |         |         |            |
|-----------------------------|--------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|------------|
|                             | $r_i^1$                        | $r_i^2$ | $r_i^3$ | $r_i^4$ | $r_i^5$ | $r_i^6$ | $r_i^7$ | $r_i^8$ | $r_i^9$ | $r_i^{10}$ |
| Mean                        | 9                              | 6.1     | 8.3     | 8.8     | 7.8     | 5.4     | 6.7     | 4.4     | 5       | 8.5        |
| Standard error              | 0.218                          | 0.403   | 0.242   | 0.236   | 0.381   | 0.336   | 0.317   | 0.328   | 0.205   | 0.312      |
| Mid-point                   | 9                              | 6       | 8.5     | 9       | 8       | 5       | 6.5     | 4.5     | 5       | 9          |
| Mode                        | 10                             | 8       | 9       | 10      | 9       | 5       | 5       | 4       | 5       | 10         |
| Standard deviation          | 0.973                          | 1.804   | 1.081   | 1.056   | 1.704   | 1.501   | 1.418   | 1.465   | 0.918   | 1.395      |
| Dispersion                  | 0.947                          | 3.253   | 1.168   | 1.116   | 2.905   | 2.253   | 2.011   | 2.147   | 0.842   | 1.947      |
| Leptokurtosis               | -1.125                         | -0.671  | 3.598   | -1.312  | 2.142   | -0.786  | -1.117  | -0.721  | 0.536   | -0.620     |
| Skewness coefficient        | -0.381                         | -0.345  | -1.506  | -0.155  | -1.284  | 0.162   | 0.347   | -0.227  | 0.000   | -0.646     |
| Range of variability        | 3                              | 6       | 5       | 3       | 7       | 5       | 4       | 5       | 4       | 4          |
| Coefficient of variation, % | 2.42                           | 6.61    | 2.91    | 2.68    | 4.89    | 6.21    | 4.73    | 7.45    | 4.10    | 3.67       |

Table 3. Quality characteristics for dimension of agreement of the experts' views.

| Indicators                                                    | Group 1 | Group2 | Group 3 | Group 4 | Group-wide assessment |
|---------------------------------------------------------------|---------|--------|---------|---------|-----------------------|
| Matrix midrank                                                | 27.5    | 27.5   | 27.5    | 27.5    | 110                   |
| Midrank spread                                                | 1465    | 1379   | 1241    | 1391    | 21061                 |
| Kendall's coefficient of concordance                          | 0.81    | 0.68   | 0.77    | 0.80    | 0.67                  |
| Pearson's chi-square test (factual)                           | 36.49   | 30.60  | 34.75   | 35.86   | 119.89                |
| Pearson's chi-square test (tabular, at 1% significance level) | 16.92   | 16.92  | 16.92   | 16.92   | 16.92                 |

At the same time, it should be noted that the criteria to which experts previously assigned low ranks received higher scores when detailed by Bordyug, (2019). For example, the significance of the social development level, put by experts in the last line, took a leading position in the intra-criteria ranking. In particular, such indicators as “dynamics of prices for fish products”, “structure of consumption of basic food products (specific weight of consumption of products from aquatic living resources),” “The level of crime (including the level of offenses and crimes in the sphere of catching the aquatic living resources)” received more than four scores out of five possible.

The experts highly appreciated the importance of the technical level of equipment and the corresponding level of mechanization and automation of production, which characterize the scientific, technical and innovative level of growth of target species, which experts put on the penultimate position.

The lowest ranks were assigned to such criteria as “the availability of tourists' sights”, “market capacity” and “the ratio of the sale price of an object to the average cost of marine aquaculture products”, due to the fact that today these criteria are not strategically significant with the position of an investor who wants to start a business in the field of commercial growth of aquatic organisms.

#### 4. Discussion

Based on the data from experts, in order to ensure the optimal balance between the significance of individual factorial terms for investors and other concerned parties and the costs for farming, we identified the main, auxiliary and insignificant criteria applying the ABC method. These criteria determine the investment attractiveness of the area for creating marine aquaculture farms and marine aquaculture target species proposed for farming, taking into consideration the following restrictions:

A - the main criteria that are of the greatest importance and which are paramount when choosing an object for investment, according to the ranking received 4.15-4.55 (maximum rating) scores;

B - minor factors that are important for cruise operators and serve as supporting elements of the main factors, estimated by experts in the range of 3.75-4.15;

C - insignificant factors that received scores of less than 3.75 (minimum score).

#### 5. Conclusions

The results confirmed the previous conclusions that the investment attractiveness of the area for the establishment of marine aquaculture farms and the amount of financial investments in marine aquaculture facilities, first of all, depend on the formation of the appropriate organizational and institutional support, namely: reducing the degree of business overregulation, including simplification of allocation of fishery grounds, procedures for obtaining permission to grow marine aquaculture target species and certification systems for fishing grounds; as well as legislative acts that determine the procedure for allotment and use of marine water areas and the coast adjacent to them. An important role in creating a favorable investment environment, according to experts, is to ensure the effectiveness of the mechanism for controlling and supervising the illegal catch and harvesting of marine aquaculture target species.

High estimates from specialists during intra-criterion ranking were also obtained according to the characteristics reflecting the availability and content of spatial resources (aquatic environment, territory, form, etc.), in which special attention was paid to the quality of sea water (concentration of petroleum hydrocarbons, dissolved oxygen,

pH values, etc., the concentration of contaminants), as well as the biotic characteristics of the water area that determine the conditions for the reproduction of aquatic organisms, the particularities of growing technology that ensure the integrity of the ecosystem of water bodies in the area; as well as hydrogeological characteristics that determine the quantitative and qualitative characteristics of water bodies as a medium for the existence of biologically diverse flora and fauna.

Moreover, the most significant criteria of investment attractiveness included specific indicators characterizing the type of marine aquaculture target species proposed for growing (nutritional and biological value, sale price, costs per ruble of marketable products, etc.) and related expenses for organizing a marine aquaculture business taking into account the preferred cultivation technology to obtain the maximum possible economic effect.

However, despite the objective necessity of having an appropriate market and scientific-production infrastructure that allows for effective activity in the field of marine aquaculture, the above criteria were put down by experts. Experts noted that infrastructure support, without the presence of basic and pacing factors (organizational, institutional, climatic, resource) that create the basis for the functioning of marine aquaculture farms, is not able to lead to the development of this type of business.

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