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INNOVATIVE DEVELOPMENT OF FISHING INDUSTRY

THE FORMATION OF A RISK MANAGEMENT SYSTEM FOR PROJECTS IN THE FIELD OF AQUACULTURE INNOVATIVE DEVELOPMENT IN THE KALININGRAD REGION: A CASE STUDY

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This article sets out to develop the concept and the principal scheme of the formation of a risk management system for innovative economic development projects in the field of aquaculture. The research carried out by the authors helps identify the main problems and characteristics of risk management projects for the development of aquaculture in present-day Russia. The authors outline the status and features of aquaculture development projects in the North-western federal district and the Kaliningrad region. The article formulates and justifies the concept of "risk management projects in innovative development of aquaculture in the region" focusing on the classification of aquaculture risks in relation to innovative development projects, which expands the conceptual framework of risk management in view of the specific risks relating to economic development projects in the field of aquaculture. The authors characterize modern methods and approaches to risk management projects and organizations in the context of their application in the framework of aquaculture development projects and offer mechanisms for risk management of aquaculture development projects, which make it possible to include risk management activity in the general context of activities of parent project organizations. The authors develop the concept and principal scheme of the formation of risk management system for innovative development projects in aquaculture.

***Key words*:** management, projects, risks, innovations, aquaculture, development of the region

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Experts noted that aquaculture development projects are subject to significant risks. This is primarily due to the fact that it is an issue of the process of creating li-

ving aquatic organisms controlled by human and artificial intelligence. Both commercial breeding and artificial reproduction of aquatic bioresources, being significantly different in many ways and each having its own production specificity, almost equally require a systematic approach to risk management, at the stage of project design and implementation (i. e. throughout the entire process of aquaculture development project management). It should be kept in mind that in the process of development of the individual functional areas of project management, which include project risk management (RM), it is important to remember that innovation is especially fraught with risk, as its successful outcome can almost never be guaranteed. In general, project risk management is a section of project management (PM), which includes a set of processes related to the identification, analysis and development of appropriate responses to project risks. PM of risks is regarded as an opportunity to influence the project and its elements of unanticipated events, which may cause certain damage and hinder the achievement of project objectives [1]. Experts note that the more localized an innovative project is, the higher the innovation risk becomes [5]. These characteristics indicate a high degree of risk of innovative aquaculture projects. The following aspects indicate the utmost importance of risk management systems in the preparation and implementation of aquaculture projects. Today, internationally applied management science has significant potential in the development and implementation of integrated risk management systems. Over the years, the leading aquaculture countries, such as China, India and other countries of the Asia-Pacific region, as well as Norway, Chile, the U. S., Spain, have by trial and error developed their own unique mechanisms for managing a wide range of risks in aquaculture. Specialists in these countries have been using a variety of methods for the assessment and prevention of risk events in the aquaculture industry over the past decades; among them are linear programming, cost-benefit analysis (CBA), multi-criteria decision analysis (MCDA) and others. This experience and methodological apparatus is well documented[1].

However, in current Russia's transition economy conditions, with little experience of implementing large-scale projects on aquaculture and very different conditions of their organization and financing, internationally accepted methodology can be used only partly. Its adaptation and modification to the present state of aquaculture development in Russia presents a separate major scientific and practical problem. Finding a solution to the problem will only be possible provided the Russian Federation has a sufficient amount of efficient aquaculture facilities; only on this condition an extended analysis of specific problems and characteristics of risk assessment and management can be done. Russian regions have their own specificities in aquaculture development. So, in the Far East and North Russia, further development of artificial reproduction of fish is given more importance, while the North West cab specialize both in artificial reproduction and commercial fishing, as there

[1] *Food and Agriculture Organization of the United Nations*, available at: http://www.fao.org/

is a significant number of consumers in the vicinity of water bodies in the region that nowadays face a lack of fresh and frozen fish of different species. Head of the Federal Agency for Fishery of the Russian Federation A. A. Krayniy adduces the following: "Special attention should be paid to the state of aquaculture in the North-western Federal District (NWFD). Because of the climatic conditions of the region, industrial aquaculture has become widespread, i. e. the cultivation of valuable fish species (especially trout and whitefish) in the limited habitat (cage line, pools). The volume of aquaculture production here amounted to 20.7 thousand tons in 2009. Unfortunately, due to the heat wave in 2010, the production of fish remained almost at the same level, reaching 20.8 thousand tons. In Karelia there are 45 fish farms, which in 2010 produced 11 thousand tons of fish. 4.6 thousand tons of fish was raised in the enterprises of the Leningrad Region (38 companies) in the same year, while in the Murmansk Region 5.2 thousand tons of fishery products were produced in 10 aquaculture farms" [2, p. 5].

Despite the existing prerequisites for aquaculture development, the Kaliningrad region is one of the outsiders in the NWFD in fish production volume. There are a number of reasons for this situation. The geographical position of the region predetermined the development of lagoon coastal, and ocean fishing there. In the late 70's — early 80's Kaliningrad vessels used to catch up to 1 million tons of sea and ocean fish annually. In Soviet times, all artificial fish reproduction enterprises in the Baltic Sea region were built in the Baltic republics and the Leningrad region. Most of them were salmon breeding farms. After the demise of the Soviet Union, most of them are now located outside Russia. In Russia, there are only three fish hatcheries, all situated in the Leningrad region. In the Kaliningrad region only carp livestock breeding was done by several state and collective farms in the pond areas that remained after the WWII. Only in the 70's and 80's of the last century the region began to work on the formation of the material and technical base of aquaculture as a part of commercial breeding and artificial reproduction of aquatic biological resources. Nine aquaculture enterprises were built, later some of them were closed; the majority of the remaining ones require modernization. In 2009, an experimental hatchery for artificial reproduction of whitefish was built in the Kaliningrad region. The company operates a modern, high-tech recirculation system. In a short term perspective, the federal programme "Raising the efficiency and development of resource potential of the fishing industry for the period 2014—2020" presupposes the construction of a fish-breeding complex for the reproduction of freshwater and marine aquatic species (preservation and reproduction of aquatic biological resources) in the Kaliningrad Region. The fish-breeding enterprise will specialize in adaptation and breeding technologies o various freshwater and species of southern Baltic.

The development of aquaculture in the NWFD is one of the priorities because it is an environmentally clean business and a promising source of fish

products that may substitute the imported ones, which are sometimes poor in quality. In this respect, the experience of fish breeding enterprises in Norway, the world leader in fish breeding technology for growing salmon, trout, and cod is quite important. In Norway the state provides enterprises with seeding, which is then grown in the state-owned and private fish nurseries. The state provides support to fish farms in order to fight disease and introduce preventive measures; it partially compensates the cost of fish feed and funds research related to the development and improvement of fish breeding technology and selection.

Today, the Federal Fisheries Agency is working towards the development of risk insurance in aquaculture, aimed at the reduction of revenue loss due to adverse conditions of various kinds. It is also planned to create innovation fish farming centres in Russian regions. The main functions of these centres will include research and development, preparation of information materials and information campaigns, creation of a database of fish breeding, biological studies and biotechnologies, the development of a registry of aquaculture areas in water bodies for the fishery, as well as the development of aquaculture in general. The organization of such innovation centres will be carried out in cooperation with the regional authorities of the Russian Federation, and will take into account specific features of each region. The centres will coordinate reproduction and commercial breeding of aquatic species; they will do complex processing of fish, as well as offer new technological solutions and do quality control. It is planned to create a network of innovation centres within a pilot project to be implemented on the basis of the Federal State Unitary Enterprise "The All-Russia Research Institute of Freshwater Fish Farming (VNIIPRX) (St. Petersburg) [2].

Having considered the present stage of aquaculture development projects in Russia and NWFD, the authors elaborated a concept and principal scheme of forming a risk management system of innovation projects in aquaculture, which makes it possible to include project risk management activities in the overall context of the parent organization of the project. The authors give the definition of "risk management of innovative aquaculture development projects" and present a detailed classification of risks in aquaculture, expanding the conceptual apparatus of risk management focusing on specific risks of the projects of the above-mentioned type.

Given the logic of the present study and taking into account the "Strategy for the Development of Aquaculture in Russia up to 2020"[2], the authors found it necessary to define a number of basic concepts. Risks of innovative development projects in aquaculture are defined as a series of adverse effects related mainly to diseases of cultivated species, a rise in the cost of combined feed, deterioration of the aquatic breeding environment due to man-made pollution, stricter global standards and regulations for food production

[2] See: *Strategy for aquaculture development in Russia up to 2020,* available at: http://www.mcx.ru/documents/document/show/12208.77.htm

and sale, as well as other technological and organizational factors associated with innovative aquaculture development. Project risk management of innovative development of aquaculture is defined as a series of processes related to the identification, analysis and development of appropriate response to the risks associated with technical, technological modernization and reconstruction of innovative aquaculture in the region [3].

Given the state of aquaculture in our country today, the authors have developed a universal conceptual systematic approach to the formation of a risk management system related to breeding valuable aquaculture species. The approach proposes a number of advanced risk management techniques being parts of the integrated Enterprise Risk Management (ERM). The experience of big companies implementing large-scale projects with a high degree of risk, shows that ERM (the so-called integrated approach to risk management) nowadays is one of the most effective concepts of risk management.

It should be noted that the concept of ERM has no generally accepted methodology; no application programme package has been elaborated yet. The ERM principles should be adapted to specific activities implemented by an enterprise or a project. The main difference between the ERM and the traditional risk management concept is that the latter is characterized by the identification of separate types of risks. In this case, risk monitoring is done periodically, with unreported uncertainty remaining in the periods between monitoring. ERM, on the contrary, allows us to solve the problem of the dispersed approach, which, according to some experts, is not suitable for risk management of highly interrelated risks [4].

The conceptual approach to risk management related to aquaculture development projects, proposed by the authors, involves the implementation of the following project activities by risk managers and the parent organization:

1. The risk manager shall distinguish three basic risk levels of the parent organization of the project: the strategic, operational and financial ones.

2. Project risks shall be identified; their structuring and analysis using the "risk tree" shall be done.

3. Project risks shall be assessed and the measures to respond to these risks shall be identified.

4. The risk manager and the project management shall assign each of the aquaculture project risks to the appropriate risk level of the parent organization of the project (strategic, operational or financial).

5. The risk manager shall consider all risks of the parent organization in the aggregate under the concept of ERM. Risk hedging.

The instrument for implementing the systematic approach described above is the authors' model of risk management for aquaculture projects aimed at building a valuable fish breeding enterprise (Fig. 1). The description of each of these specific actions of risk management aquaculture development projects, as well as the results obtained by the authors is presented below:

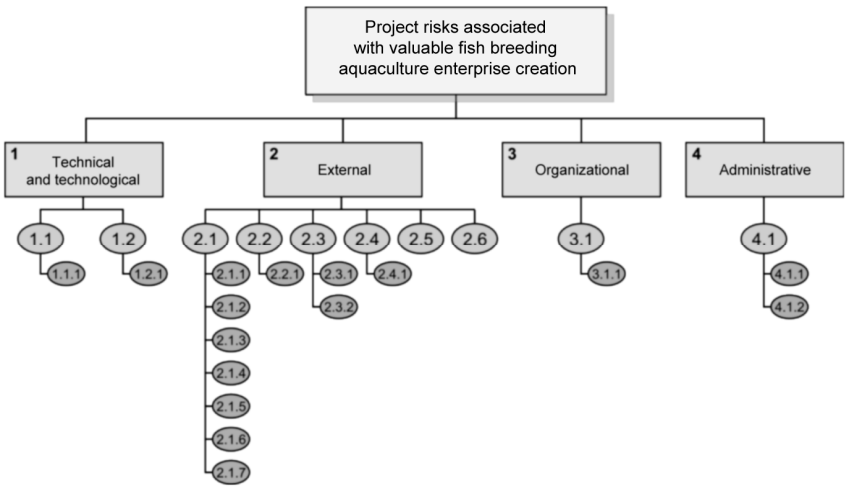

Fig. 1. "Tree of risks" of the project for valuable fish breeding
Note: developed by the authors on the basis of the "project risks tree"

1. The risk manager is to distinguish three basic risk levels of the parent organization of the project: strategic, operational and financial ones. In the process of the project implementation, a comprehensive review and risk management at these levels is expected to take place. For that purpose, risks are analysed in the aggregate (similar to portfolio management). In this way the overall risk minimization is achieved and the probability of successful fulfilment of the main tasks of the project triangle "cost, time and quality" increases.

2. Identification of project risks, their structuring and analysis using the "risk tree." Based on the analysis of several aquaculture projects and expert interviews, the authors investigated and identified the most likely sources of project risks. Certain types of risk groups in aquaculture were analysed using the "risk tree" method, which provides a full and systematic process of identification of project risks [7]. A conceptually enlarged "risk tree" of the aquaculture model project for breeding valuable fish species has been developed by the authors and is presented in Figure 1.

Risks were structured according to four types: first — technical and technological risks, second — external risks, third — organizational risks, and fourth — administrative ones. In order to indicate risks starting from the third level of the “risk tree”, a standard matrix code typical of the "objectives tree" and the project breakdown structure (WBS) is presented in the table below. Generally speaking, the "risk tree" is a hierarchical model similar to the previous ones, with the only difference — its elements are not goals, objectives, or works, but risks of various degrees of importance and character. On the basis of this structure, the authors propose a classification of project risks related to a valuable fish breeding enterprise creation (Table) [6].

Classification of project risks related to the creation of a valuable fish breeding enterprise

Number according to the "risk tree"	*Risks*
1	***Technical and technological risks***
1.1	Performance and reliability
1.1.1	Equipment failures and malfunctions
1.2	Changing the quality of the finished product
1.2.1	Risk of harm to the health of consumers
2	***External risks***
2.1	Natural risks
2.1.1	Floods and flooding
2.1.2	Drought
2.1.3	Change in water salinity
2.1.4	Change in the state of silt
2.1.5	Electricity supply cuts due to wind or other adverse weather conditions
2.1.6	Possibility of fish diseases
2.1.7	The possibility of predators access to the area of cultivation
2.2	Defaulting contractors and suppliers
2.2.1	Delay in feed delivery
2.3	Market conditions
2.3.1	Increase in production costs
2.3.2	Delay in fish sale
2.4	Behaviour of the client (the state)
2.4.1	High dynamics of changes in the fishing industry and agriculture of the Russian Federation
2.5	***Legal Risks***
2.6	Social protests
3	***Organizational risks***
3.1	Organizational complexity
3.1.3	Large number of actors in the project environment and, as a consequence, a conflict of interests
4	***Administrative risks***
4.1	Planning
4.1.1	Plan shortfall due to lack of experience in implementing similar projects
4.1.2	Errors in sales analysis

Let us consider in detail some specific aquaculture risks presented in Table 1. Risks related to an increase in production cost (risk 2.3.1) are mainly connected with a possible increase in the price of seeding (such as glass larvae for eels, which is brought from Europe), as well as an increase in feed price. Legal risks (2.5) may occur due to specific regulations concerning the use of coastal waters for aquaculture (designated areas along the coast). For instance, cases of lease agreement termination with aquaculture enterprises are not infrequent in a number of European countries, which is why these enterprises suffered significant losses. This issue, in our view, requires a separate study with specific reference to the Russian legislation. Adding social

protests to one of the groups of risks is done for a number of reasons. First, they can be triggered by international environmental organizations such as Greenpeace, whose representatives are traditionally hostile to the new types of industrial activity in wilderness areas. And since even the most advanced technologies of aquaculture industry still have a negative impact on the environment, there will always be a reason for these organizations to express their discontent. As the experience of other countries shows, it may come down to an authorized release of fish from cages by environmental activists; even bad odours from fish breeding farms may become a stumbling block. In addition, with the development of aquaculture, the industry starts to compete with other sectors of the economy, such as agriculture, energy, forestry, which also require adjacent water bodies. This can give rise to various conflicts of interest and legal disputes over the use of territories[3].

It is quite clear that the list of typical risks associated with aquaculture projects identified by the authors is not exhaustive. Therefore, when using the methodological approach developed by the authors, to the formation of a risk management system related to the creation of a valuable fish breeding enterprise, a hatchery (or several hatcheries, if it is an aquaculture multiproject) it is necessary to adjust this list to a specific type of production, specific species, aquaculture type (commercial breeding and (or) artificial reproduction), the ownership structure of the company and other factors. The degree of elaboration of the "risk tree" for an aquaculture project of specific type(s) should depend on the size of the project. For large-sale projects of federal importance (the construction of an aquaculture and marine culture centre in Zelenogradsk, Kaliningrad Region[4], the construction of a farm for commercial breeding and artificial reproduction of eel in the Curonian Lagoon[5]), a hierarchical structure containing a maximum number of the most likely risks of such a project is to be developed.

For smaller projects, including projects for creating mini-productions run by private entrepreneurs (such businesses operate with relative success in the Far East); the hierarchical structure of risks can be replaced by a simple list of possible project risks, or a rather simple hierarchy consisting of two or three levels. But in any case, the lowest level of this structure should contain the risks that can be quantified and described in the form of an event, or a set of events that have tangible implications. As in the case of the "objectives tree" and the project breakdown structure (WBS), the “risk tree” can be developed on the basis of different grounds. These can include priority, importance, relevance, requirements for a further analysis, response actions, possible implications etc. [7].

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[3] *Food and Agriculture Organization of the United Nations*, available at: http://www.fao.org/

[4] Federal programme "More effective use and development of the resource potential of the fisheries industry in 2009-2013" [Government Decree of 12.08. 2008 № 606], available at: http://data.rbc.ru/cgi-bin/showb.cgi/220808563.pdf

[5] Government Decree of December 7, 2001 № 866 "On the federal program for the Kaliningrad region for the period up to 2010", available at: http://base.garant.ru/1587100/

3. Risk assessment and response to them. This process consists of three components, and is characterized as an on-going cyclical process (Fig. 2).

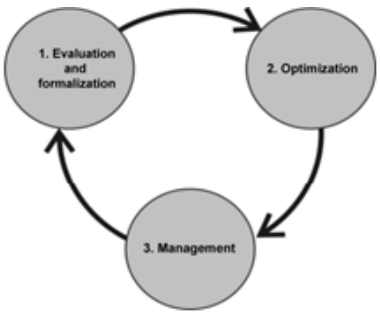

Fig. 2. Structure of the risk assessment process of the project and identification of measures to respond to it

Note. In the process of development of the structure the ERM concept by M.P. McCarthy, T.P. Fiynn was used.

The first component of "evaluation and formalization" of risk assessment involves using qualitative and quantitative indicators, risk ranking according to their importance, modelling and measurement of their impact on the project. The second component "optimization" is to analyse and identify the interconnection between various risks and response of the risk manager to them (as a rule, it is manifested in the avoidance of risk, its acceptance, or, for example, its transmission to an insurance company or risk reduction). The third component "monitoring" is a continuous series of measures for the implementation, tracking and improvement of management processes associated with risks. To assess the identified and structured project risks related to a specific fish breeding enterprise creation, the project risk assessment methods, well described in the Russian and foreign literature can be used. The methods are based on the identification of the probability and consequences of risks. It is advisable to use the evaluation matrix of the estimated probability, the consequences of "decision trees" and the theory of "games with nature" methods [7].

The analysis of the specific character of aquaculture enterprise creation, as well as peer reviews, revealed a range of risk assessment problems associated with the need to differentiate complex problems of decision making within risks, then identify a set of smaller problems that can be dealt with separately, and finally consider all the problems in the aggregate. For example, risk 2.3.1 “Increase in production cost” (see Table 1) should be assessed in the context of the possibility of setting up their own production of fish feed prepared by the wet granulation method using fish processing waste and secondary raw materials from food processing industries. This production can be organized at the same time with the establishment of a fish breeding enterprise. According to experts, the efficiency of fish feed prepared by the wet granulation method is more efficient than the dry feed — wet feeds are more valuable and nutritious for fish and enhance its quality. Also the cost of feed is lower than that of dry parts[6]. Creating this mobile wet granulation production in the marine economy of the Kaliningrad region is particularly topical, since due to the exclave position of the region the price of dry feed supply increases. In order to estimate alternatives for a particular project the

[6] *Site of Astrakhan State Technical University*, available at: http://www.astu.org/; *Department of Technology and Expertise ASTU goods*, available at: http://astu. astu.org/science/catalogue_innovation/web/new_page_54.htm

"decision tree" method can be used in any given aquaculture development project. In assessing the investment component of an aquaculture development project, a sensitivity analysis is important to study the change in the integrated project efficiency, net discounted income in the first place, rate of return, payback period; it is necessary to be guided by official guidelines of investment projects evaluation [3]. In modern conditions for records and accounts it is advisable to use special project management software, containing risk management function (for example: Microsoft project, Spider project, Primavera, etc.) For example, an analysis based on the Microsoft project platform allows us to assess the seriousness of the consequences of certain risks to the project, to plan emergency and risk reduction strategies, to connect risks with the project objectives, to keep documentation of the project, as well as to connect risks with each other factors.

4. After the analysis and relevant calculations are carried out, the risk manager and the aquaculture project management should place each of the project risks in the appropriate risk level of the parent organization of the project: strategic, operational or financial ones. This should be done on the basis of the qualitative and quantitative impact of risk on the operation of the parent organization and its strategic goals, as well as operational and financial performance.

5. After correlating the project risks and the project parent organization risks, the risks from all the three above-mentioned levels shall be considered by risk managers of the parent organization together using the ERM concept.

Based on the authors' research and the management systems research methodology, Figure 3 shows a schematic model of the risk management system of the project for a valuable fish breeding enterprise creation. It consists of the following elements:

1. The subjects of risk management: parental organization management of the valuable fish breeding enterprise project; management of the valuable fish breeding enterprise project.

2. Objects of management: risks of different nature in the aquaculture development projects, risks related to the activity of the parental organization of the valuable fish breeding enterprise project.

3. Methodological support systems: methodology of risk management project, ERM methodology (Enterprise risk management).

4. Information and technological support systems: software for business management and project management, having functions of risk management.

In the development of project risk management systems as a project management subsystem, it is important to understand the need to use special forms and management technologies that make it possible to include the activity on risk management in the project in the overall context of the project parent organization [8]. The application of this model to the formation of a risk management system of a particular fish breeding enterprise will allow the management of the project parent organization to develop a systematic approach to the entire range of issues related to risks, as well as to solve the synchronization problem of the functional areas of projects management and organization management, which is typical of project activity. The result described above was achieved by using the model of risk management for valuable fish breeding enterprise project (as a part of comprehensive guidelines

and suggestions for aquaculture project management, developed with the participation of the authors) in a number of parent organizations of aquaculture development projects of the Kaliningrad Region (FGU "Zapbaltrybvod", the Union of Fishing Collective Farms of the Kaliningrad region) participating in the federal and regional projects and programmes aiming at the development of aquaculture in the region.

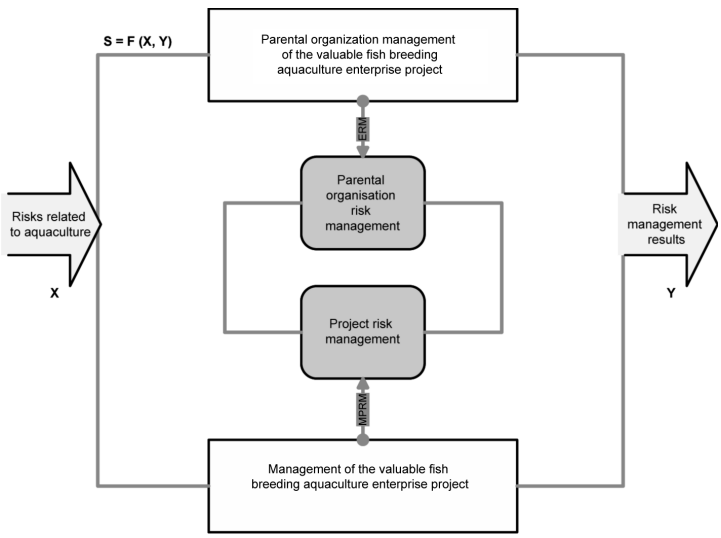

Fig. 3. Risk management model for the valuable fish breeding enterprise project: ERM — Enterprise Risk Management (integrated approach to risk management of the parent organization) MPRM — methodology of project risk management; F — transition function; S = F (X, Y) — the graph of the system

Note. Developed using the methodology of system analysis

Experience has proven that during the implementation of aquaculture development projects in different regions of the country, top priority is the need to correctly identify a complex of methodological approaches to project management. Particular attention should be given to risk management of such projects, as this function of project management, along with the basic parameters of the project triangle "cost, time and quality", acquires critical importance, particularly because of the innovative character of large-scale aquaculture development projects in Russia. The present study allowed us to consider the various aspects of forming a comprehensive risk management system of innovative aquaculture projects, their features, and problems.

The results of the study can be summarized in the following way: there are typical aquaculture project risks common for aquaculture development in lagoons. These risks can be analysed using the "risk tree"; the algorithm of the risk assessment process in aquaculture and the measures to respond to it have been identified; the conceptual approach to risk assessment as a complex multi-step problem based on the “decision tree” methodology has been developed; the authors’ model of risk management system for a valuable fish breeding enterprise project has been developed.

In conclusion, it should be noted that the value of the research and its results goes beyond the scope of this particular topic. The value of the research results is in the proposed methodological approach and tools that can be used for research and development in other areas in order to improve the management of innovative projects for the economic development in the region.

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