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SOME TASKS OF INNOVATIVE DESIGNING IN MODERN TECHNOLOGIES OF INDUSTRIAL FISH FARMING

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У цій статті розглядаються деякі задачі і напрямки інноваційного проектування в сучасних технологіях промислового рибництва в відкритих водоймах. Запропонований підхід базується на поєднанні високоефективних технологій вирощування риб у відкритих континентальних водоймах з динамічним моделюванням системи економічної ефективності. Подано загальний вид прогнозуючої економетричної моделі, яка пов’язує прогнозну інтегральну ефективність аквакультури з іншими показниками на усьому технологічному циклі від зариблення ставків до реалізації товарної риби. Центральною стороною статті є опис первинного інформаційного забезпечення економетричної моделі.

Ключові слова: економетричне моделювання, промислове рибництво, індуктивне моделювання, аквакультура, індикатори

In this paper the some tasks and directions of innovative designing in modern technologies of industrial fish farming in open inland water reservoirs are considered. The proposed approach is based on the combination of highly efficient technologies of fish growing in open continental water with dynamic modeling of system economic efficiency. Given general view of the system predictive econometric model, that links the predictive integrated efficiency of aquaculture with other relevant indicators on all fisheries technological cycle from the moment of stocking ponds to the sale of marketable fish. The central position of this article is the primary information basis formation.

Keywords: econometric modeling, industrial fish-farming, inductive modeling, aquaculture, indicators.

В этой статье рассматриваются некоторые задачи и направления инновационного проектирования в современных технологиях промышленного рыбоводства в открытых водоемах. Предложенный подход базируется на сочетании высокоэффективных технологий выращивания рыб в открытых континентальных водоемах с динамическим моделированием системы экономической эффективности. Представлен общий вид прогнозирующей эконометрической модели, которая связывает прогнозную интегральную эффективность аквакультуры с другими показателями на всем технологическом цикле от зарыбления прудов к реализации товарной рыбы. Центральной стороной статьи является описание первичного информационного обеспечения эконометрической модели

Ключевые слова: эконометрического моделирования, промышленное рыбоводство, индуктивное моделирование, аквакультура, индикаторы

INTRODUCTION

The important condition of high efficiency of fish farming in continental open waters is the maximum use of the growing season, which is for Europe middle band in ranges from 90 to 120 days in the warm season. The intensive technology of industrial fish cultivation is the systemic combination of manufacturing operations, methods and techniques targeted at maximum utilization of the physiological properties of fish under the given climatic conditions throughout the all growing season. This is stated in many works, such as [1, 2] and so on. Such technologies are first and foremost focused on the efficient use of water biological resources, as well as the cultured fish throughout the ontogenesis at the expressed variety of environmental factors [2].

Apparently, the production in this case is clearly prevails over issues of economic type.

On the other hand, purely economic benefits should not prevail over the protection of the natural environment, compliance of the hydro-chemical and hydro-biological indicators in optimal water, that is, comfortable ranges of parameters for aquatic living resources (ALR). Such research are also carried out as of today, such as [3, 4] and others.

PURPOSE OF WORK

From the standpoint of system-economical production of ALR, there are necessary conditions of productivity in open continental waters are not only compliance with specific technologies aquaculture. To such technologies is important to enroll sanitation, integrated land reclamation of “water-bed” [1, 2] and other.

A special place in cost price of intensive technologies in aquaculture, including breeding, is the most costly part –fish feeding with expensive and balanced feeds. The main criterion of the system in this case should be an economic aspect maximization of income (profitability) business from the sale of live fish and fish products under high quality and customer satisfaction.

It can now be considered as the global trend in the market research of fish breeding [5, 6]. This means that our common problem must includes the system-marketing problem as a subset of the general class of system information-analytical research. From here task logically raises econometric forecasting system of profitability growing aquatic biological resources at the moment of their future realization at current real or a certain way given conditions.

A particular direction of maintaining of optimal water exchange is the modern automated process control systems (APCS). One of the priority tasks that should be resolved within the APCS is support of both hydro-chemical and hydro-biological indicators in optimal ranges, that are comfortable ranges of water indicators, such as aquatic living resources in fattening ponds [7, 8].

The main purpose of this paper is formulation of the initial information basis for further stages of automated process control systems creation, which were highlighted earlier [7, 8]. In addition, in the specification are given some basic system which had to be resolved in this technological system.

In addition, in the paper given clarifying of some basic tasks which had to be resolved in this technological system.

SOME RESEARCH RESULTS AND DISCUSSION

The analysis of the available analytical sources and our own system-analytical studies shown that within the APCS of modern fishery complex (fish-economic complex) should be resolved the following basic system tasks:

- operational choice of ensembles of factors that most significantly impact on the system-efficiency criterion on the given interval of ontogenesis and classification of states fodder perception (it could have been called as “the feeding perception”) of cultured fishes by ensembles of factors that have been synthesized;
- monitoring of selected informative factors by means of floating robotic vehicles and specialized sensors in the on-line transfer and accumulation of information at the central node (server, for example);
- operational forecasting of “feeding perception” periods by grade activity;
- econometric forecasting and strategic planning activities for fish-economic complex using the inductive system-analytical technology and giving out the optimal solutions regarding strategic actions of technologist (with predictive marketing positions).

Of course, the term “feeding perception” is not a professional fisheries term, but in our case, let it would play the role of one of the leading output factors in the problem that considered here.

It should especially be noted that the expressed problems should be resolved specifically for each individual fishery complex taking into account the many local climatic and economic factors;

Proceeding from the listed system tasks, the ideology of creating a system should be aimed at functioning in the following directions [8]:

- system analysis of primary operational, regulatory, expert and other relevant information, as well as the data of current measurements (in on-line), etc .;
- econometric modeling and prediction of breeding enterprise, based on the preliminary analysis and the current data measurement informative parameters;
- synthesis and the issuance of a limited set of optimal operational actions and strategies on management breeding processes according of the integrated performance criteria in a convenient form for decision making.

The system predictive econometric model that links the predictive integrated efficiency of aquaculture $\psi_{sys}(t_f)$ with other relevant indicators on all fisheries technological cycle after stocking of ponds to the realization of fish can be represented as follows:

$$\psi_{sys}(t_f) = \varphi\{X_n, X_\varepsilon^{\tau_0}, X_\varepsilon^{\tau_f}, X_w^{\tau_0}\},$$

where: $\{X_n\}$ - the set of natural indicators;

$\{X_\varepsilon^{\tau_0}\}$ - the set of the current economic indicators;

$\{X_w^{\tau_0}\}$ - the set of the current values of the factors that determine the environmental conditions of water biological resources;

$\{X_\varepsilon^{\tau_f}\}$ - the set of forecasting economic indicators at the time of marketable fish sales.

The primary traditional information basis. Among the indexes of intensification of fishing industry functioning, there are so which fundamentally different from conventional agriculture. Many experts in this field suggest to apply different sets of natural indicators and cost factors [5, 6 ets.].

However such indicators reflect mainly static, that it can not be acceptable for operational and, moreover, the strategic management of technology aquaculture. Therefore, according to the inductive technology of system information-analitycal technology [9], which will be used in developing the appropriate innovative project, the indicators that are traditionally captured in modern fisheries management activities can only be considered as a primary information basis I_b^1.

The preliminary information-analytical studies [8] have shown that in the information base of system econometric model makes sense to include the following subsets of factors:

I. The natural indicators $\{X_n\}$*:*

1) yield of larvae or fry of fish from one female;
2) planting fish density per one hectare of pond of all age categories;
3) mass ratio grown fish to planted for growing;
4) average weight of fish been grown of all age categories;
5) yield from wintering yearling fish and older age groups;
6) gross production of fish;
7) fish productivity of fattening ponds and other water bodies in fish farm;
8) the fish production per employee;
9) natural food base of fish: phytoplankton and zooplankton, zoobenthos;
10) the industrial returning of fish when of fish stocking of natural water bodies.

In order to optimize and current correction of technologies feeding cultivated of fish species, the concept offered by us system, besides the listed natural indicators, the system econometric model requires taking into account an economic factors as in the current period (the data of current unit costs of the enterprise, and the data from routine monitoring of the market), as well as predicted values of macroeconomic indicators at the time of sales.

In addition, the correction of technological dispatching schedules can not be done without taking into account factors of environmental conditions of water bioresources. The list of these set of indicators suggested to enroll the following.

II. Current values of economic indicators $\{X_{\varepsilon}^{\tau_0}\}$ *:*

1) the specific cost of fixed assets in 1 quintal of marketable fish;
2) unit cost of growing in 1 quintal of marketable fish without feed;
3) the share the cost of feed on 1 quintal of cultivation of marketable fish;
4) current prime price of 1 quintal of marketable fish;
5) current cash sales revenue of possible of fish mass (options);
6) the current selling price of 1 quintal of marketable fish;
7) current a net profit from the sale of fish including taxes;
8) current profitability of fish farming and fisheries;
9) current breeding efficiency.

III. The predicted value of economic indicators at the moment of future product sales$\{X_{\varepsilon}^{\tau_f}\}$*:*

1) the forecasted cost of fixed assets in 1 quintal marketable fish;
2) the forecasted specific cost of growing on 1 quintal marketable fish without of feed;
3) the forecasted specific cost of feed on 1 quintal of cultivation of marketable fish;
4) forecasted prime price of 1 quintal of marketable fish;
5) forecasted selling price of 1 quintal of marketable fish;
6) reasonable forecasted sales volume (forecast of market share fishery businesses in a particular region);
7) forecasted a net profit from the sale of fish including taxes;
8) forecasted profitability of fish farming;
9) forecasted sales revenue of possible of fish mass (options);
10) forecasted breeding efficiency (the ratio of funds from the sale of purposeful predictive weight of fish to fish production costs per hectare of water surface and/or per 1 quintal of marketable fish.

Most of these indicators are related to the total, and some of them (can be selected using inductive GMDH algorithms, for example [10, 11]) must enter into a strategic econometric forecasting model.

However, according to our vision of construction of management technology for fish farming in open water, this model is the result (in the dynamic sense) managements adopted on the basis of operative models (identification, forecasting etc.). The latter are synthesized based on operational (current) requirements for state of water bodies and living conditions of fish.

IV. The current factors of environmental conditions of water biological resources $\{X_w^{\tau_0}\}$.

To such factors are often considered by experts more than 15 indicators, some of them such as:

1) chromaticity of water and water clarity;
2) dissolved oxygen, mg / L;
3) pH value of water;
4) alkalinity, mg eq. / L;
5) the total salinity and others.

CONCLUSIONS

Undoubtedly, today the global aquaculture has already achieved the real good results. Developed and tested a large number of advanced fish farming technologies, acquired extensive practical experience of intensive methods of cultivation of aquatic biological resources.

However, as of today there are still the important issues in the field, which was delineated in this article.

First of all it is worth noting the following:

- how to choose strategy of fish farming from the current moment until the product sales;
- how to choose the strategy of fish farming from the current moment until the product sales;
- which is the best set of feed in the current period and at a certain range of forecast (up to 30 days, for example);
- and many other questions.

REFERENCE

[1]. Baltadzhi R.A. Technology reproduction of herbivorous fish in inland waters of Ukraine / R.A. Baltadzhi //. Kiev. 1996. – 65p. [ukr]

[2]. Andryushchenko A.I. Aquaculture artificial reservoirs. Part II. Industrial aquaculture / A.I. Andryushchenko, N.I. Vovk. – K .: NUBiP, 2014. – 586p. [ukr]

[3]. Osypenko V. P. Seasonal and spatial changes in the content and molekular mass distribution of carbohydrates in the surface water. Hydrobiological Journal. – 2014 – V. 50, № 5 – Pp. 89-98.

[4]. Vasylchuk T.A., Osypenko V.P., Yevtukh T.V. The peculiarities of the migration and distribution of main groups of organic matter in the water of the Kyiv reservoir depending on the oxygen regime. Hydrobiological Journal. – 2011. – Vol. 47, № 2. – Pp. 97-106. [ukr]

[5]. Venglyazhy Karol. Pond system of cultivation and feeding of carp to meet current production and consumption requirements in Poland / K. Venglyazhi // Intern. Scient.-Manuf. Conf. "Actual problems of aquaculture and aquatic resources management", Kyiv, 25-30-th September, 2005. – 23p. [rus]

[6]. Wenglarzy K., Lysak A. Stawowe systemy wychowu i zywienia karpia w swietle aktualnych wymogow rynku producenta i konsumenta. – 2003. [pol]

[7]. Osypenko V.V. Intelligent systems for optimum control of fish-farming technologies on continental waters. Part I. Methodological Aspects / V. Osypenko // Fish industry of Ukraine. 2006. – №2. – Pp.43-52. [ukr]

[8]. Osypenko V.V. The concept of information-analytical decision support systems in intensive aquaculture technologies / V. Osypenko // Scientific and methodical journal behalf of Petro Mohyla complex "Kyiv-Mohyla Academy" – Mykolaiv, 2012. – Vol. 173, No.163 – Pp. 67-73. [ukr]

[9]. Osypenko V.V. Info-logical structure of inductive technologies of the searching system-information-analytical researches / V. Osypenko // Journal of National University "Lviv Polytechnic", a series of "Computer science and information technology" Lviv, 2013. – Vol. No. 751 – 2013. – Pp. 315-319.

[10]. Madala Rao. Ivachnenko A.G. Inductive learning algorithms for complex systems modeling / R. Madala, A.G. Ivachnenko. – CRC Press, Boca Raton, 1994. – 350p.

[11]. Self-organizing methods in modeling: GMDH type algorithms / Ed. by S. J. Farlow. – N. Y., Basel: Marcel Decker Inc., 1984. – 350p.