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SCIENTIFIC RESEARCH IN THE MODERN WORLD

PROCEEDINGS OF VIII INTERNATIONAL SCIENTIFIC AND PRACTICAL CONFERENCE JUNE 1-3, 2023

TORONTO 2023

SCIENTIFIC RESEARCH IN THE MODERN WORLD

Proceedings of VIII International Scientific and Practical Conference

Toronto, Canada

1-3 June 2023

Toronto, Canada

2023

UDC 001.1

The 8th International scientific and practical conference "Scientific research in the modern world" (June 1-3, 2023) Perfect Publishing, Toronto, Canada. 2023. 639 p.

ISBN 978-1-4879-3795-9

The recommended citation for this publication is:
Ivanov I. Analysis of the phaunistic composition of Ukraine // Scientific research in the modern world. Proceedings of the 8th International scientific and practical conference. Perfect Publishing. Toronto, Canada. 2023. Pp. 21-27. URL: https://sci-conf.com.ua/viii-mizhnarodna-naukovo-praktichna-konferentsiya-scientific-research-in-the-modern-world-1-3-06-2023-toronto-kanada-arhiv/.

Editor
Komarytskyy M.L.
Ph.D. in Economics, Associate Professor

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e-mail: toronto@sci-conf.com.ua

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UDK 620.953

METHODOLOGICAL APPROACHES TO THE OPTIMIZATION OF MACHINE TECHNOLOGIES OF ANIMAL WASTE DISPOSAL

Skliar Oleksandr Hryhorovych,
Ph.D. Eng., Professor
Skliar Radmila Viktorivna,
Ph.D. Eng., Associate Professor
Komar Artem Stanyslavovych,
engineer
Dmytro Motornyi Tavria State Agrotechnological University

Summary. The article provides an overview of methods of research and optimization of machine technologies for the disposal of livestock waste, namely manure and droppings. The advantages of making optimal decisions using personal computers, statistical models in the form of unidimensional and multidimensional regression equations and dynamic systems, linear and non-linear programming methods in research on the mechanization of agricultural production processes are considered.

Key words: research methods, optimization, utilization, manure, litter, mathematical models, technology, technological process.

Depending on the nature of the study of technological processes, various mathematical research methods are used. The presence of a large number of technologies and technical means intended for the disposal of manure and droppings, as well as various possibilities of agricultural enterprises, led to the need to develop methods of designing rational, most effective and adapted technologies for the given conditions [1, p. 264].

Unformalized and formalized methods are used for decision-making. With informal methods, a person makes decisions without any justification at all, guided by so-called common sense, experience or intuition. Making formalized decisions is creativity, such decisions are made according to clear recommendations. These

decisions are made based on two main methods: logical modeling and optimization.

In logical modeling, so-called rules are used, which are made by highly qualified specialists, and rules are applied by users who make decisions [2]. The rules determine what should be done in certain cases. Such rules are a good guide when making decisions for lower-skilled performers.

Making optimal decisions using a personal computer has two significant advantages [3]: it gives a quick answer to the question and provides an opportunity for extensive experimentation, which is often simply impossible to do on a real object.

Statistical models in the form of unidimensional and multidimensional regression equations are widely used in research and optimization of parameters of agricultural machines and aggregates, as well as agricultural technological processes [4, p. 123]. However, classic regression analysis without taking into account the peculiarities of agricultural processes leads to model errors and even their instability, which makes their further use impossible.

The task of statistical model identification is to obtain reliable values of coefficients ai from the data obtained in the process of passive or active experiment. To solve this problem, Gauss proposed an algorithm called the method of least squares.

Solving problems implemented by linear programming methods due to their simplicity and universality became the most widespread. Such dependencies are called linear, in which the variables are formalized only in the first degree and there is no mathematical operation of the product of the variables [1, p. 263].

When using linear programming methods, the task is described by a system of linear equations. The most common method of solving linear programming problems is the simplex or method of successive improvement of the plan. This method allows you to find a solution to any linear programming problem by making a limited number of steps (iterations), each of which is an algebraic transformation made according to established rules.

The economic-mathematical model of the transport problem can be used for

the distribution of technical means by types of work [5, p. 25].

Problems in which mathematical models contain variables not in the first degree or are a product of variables are solved by methods of nonlinear programming [5, p. 26]. Quadratic programming is the most developed among them. This method is used when solving planning and economic problems of the maximum (minimum) of the quadratic function under linear constraints.

A fairly large number of works are devoted to the identification of dynamic systems. The task of optimizing the composition, structure and use of agricultural technical equipment can be solved using a network model, which is a type of logical model [4, p. 124].

One of the main tasks during research on the mechanization of agricultural production processes is obtaining reliable statistical models (solving the problem of identification), their research and optimization in relation to specific criteria or conditions of production. Various heuristic methods are used to solve the problem of identification in relation to dynamic systems, but a universal mathematical apparatus similar to the method of least squares has not yet been developed. In practical calculations, various algorithms and methods are used, which have significant differences, but all these tasks have a common feature - they belong to the class of search tasks, for example, searching for a finite number of variables in a user-specified hyperspace. In order to compare the methods and analyze their capabilities, works on the identification of the reference model by various methods were performed. As a result of the comparative analysis, recommendations were developed for solving such problems [6, p. 119]. The process of optimization by applying the identification algorithm by the method of nonlinear programming does not depend on the initial conditions [7, p. 172]. Practically, the calculation can be started from zero initial conditions. The identification process is very stable. Optimization of processes in agricultural production by applying the identification algorithm by the method of integration of a differential equation and decomposition of input and output disturbances into a Fourier series on a specific example made it possible to achieve results quite close to the actual values, but their error is greater than when using the

method of nonlinear programming [8, p. 184].

In agricultural production, much attention is paid to the adoption of optimal options [4, p. 124], from route maps to technological lines, from optimization of technical means to conditions and conditions to technical means to optimization of technologies, etc., with the help of which it becomes possible to manage the production process. Considering the different degree of detailing of project decisions at all levels except the last one, there cannot be an exact criterion for evaluating and selecting project decisions. So, at the first level, it is impossible to form a criterion that allows you to choose one optimal variant of the principle scheme of the technological process. This is due to the fact that the idea of the projected process here has a purely principled character and is detailed and refined at the following levels. In connection with the heuristic nature of the criterion for selecting the most rational solutions, the functioning of multi-level systems of automated design is carried out in such a way that at each intermediate level of design, not the only best option is selected, but something closest to it [4, p. 125]. At the last stage, one final option is selected, which has the largest or smallest value of the complex quality criterion against the others. The analysis of the totality of technological processes of manure (excrement) utilization and relationships with influential factors determines significant a priori uncertainty of conditions. The variety of goals and means of solving tasks determine the need to involve additional information of an interdisciplinary nature, especially the theory of the course of biochemical processes. In this regard, there is currently a tendency to intellectualize the processes of forecasting the state of the object being studied or the phenomenon based on the implementation of theoretical provisions, practical developments in informatics and artificial intelligence in the space of solving the tasks.

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