

## METHODS OF CONTROL AND MANAGEMENT OF AGRICULTURAL PROCESSES

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**Abstract:** In the report the methods for controlling and managing the processes in agriculture are justified and systematized and a methodology for applying the statistical methods for analysis, control and management of the quality of the agricultural processes has been developed. Finally, the factors influencing the quality of technological processes in agriculture are also labeled.

**KEY WORDS:** STATISTICAL METHODS, QUALITY MANAGEMENT, TECHNOLOGICAL PROCESSES, SAFETY, EFFICIENCY, ANALYSIS, CONTROL.

Processes in agriculture are random, changing in time under the influence of a number of random controllable and unmanageable (controllable and uncontrollable) factors (Figure 1). All this

requires professionals to periodically control and manage their quality by following the agro-technical requirements set in crop technology.

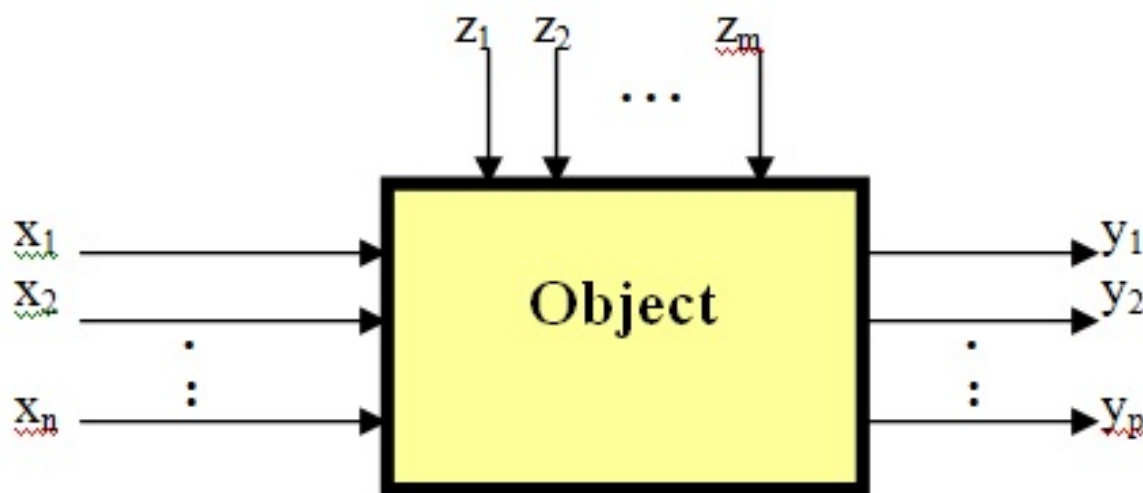


Fig.1. Cybernetic model of control-command object:  $x_i$  - input controllable factors;  $y_k$  - Entry unmanageable object factors;  $z_j$  - Object parameters

Fig. 2 shows the statistical methods for process control and management and in Fig. 3 the place of these methods in the process is defined. Where and when they are used.

An important place in the process of controlling and managing the processes in agriculture occupies the operator (tractor - driver) in the system "man - machine - object of labor"

The activity of the operator (tractor - driver) in the ergo - man - machine - object of work "system is varied and in general it can be presented as a system with four basic elements (fig.4): receiving information; Evaluation and processing of information; Making decisions; Implementation of adopted decisions.

An ergodic system is a system consisting of several interconnected elements where one of the elements is a person - operator (or group of operators) involved in information processing, making and decision making for efficient system management.

We will not look at all the indicators of the quality of the eric system, but we will only look at those that influence human activity or depend on the results of its activity.

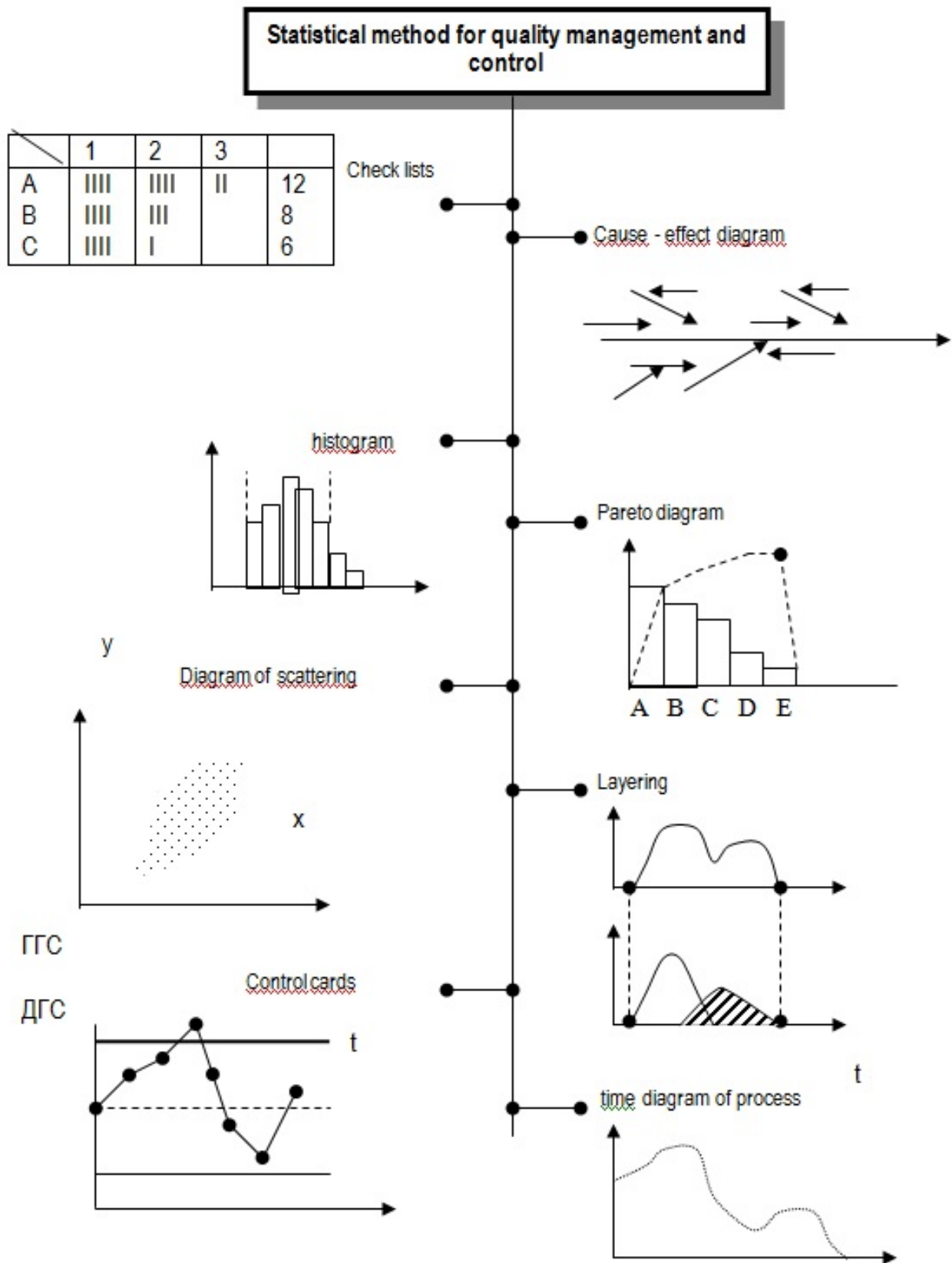
The time of passing information on the closed loop "man - machine - object of work" is determined:

$$T = \sum_{i=1}^k t_i \quad (1)$$

Where:

T is the time during which the information is held in the i-th element of the machine;

k - the number of successively connected elements of the system (technically, biologically).



*Fig.2. Types of statistical methods for control and management of the quality of agricultural processes*

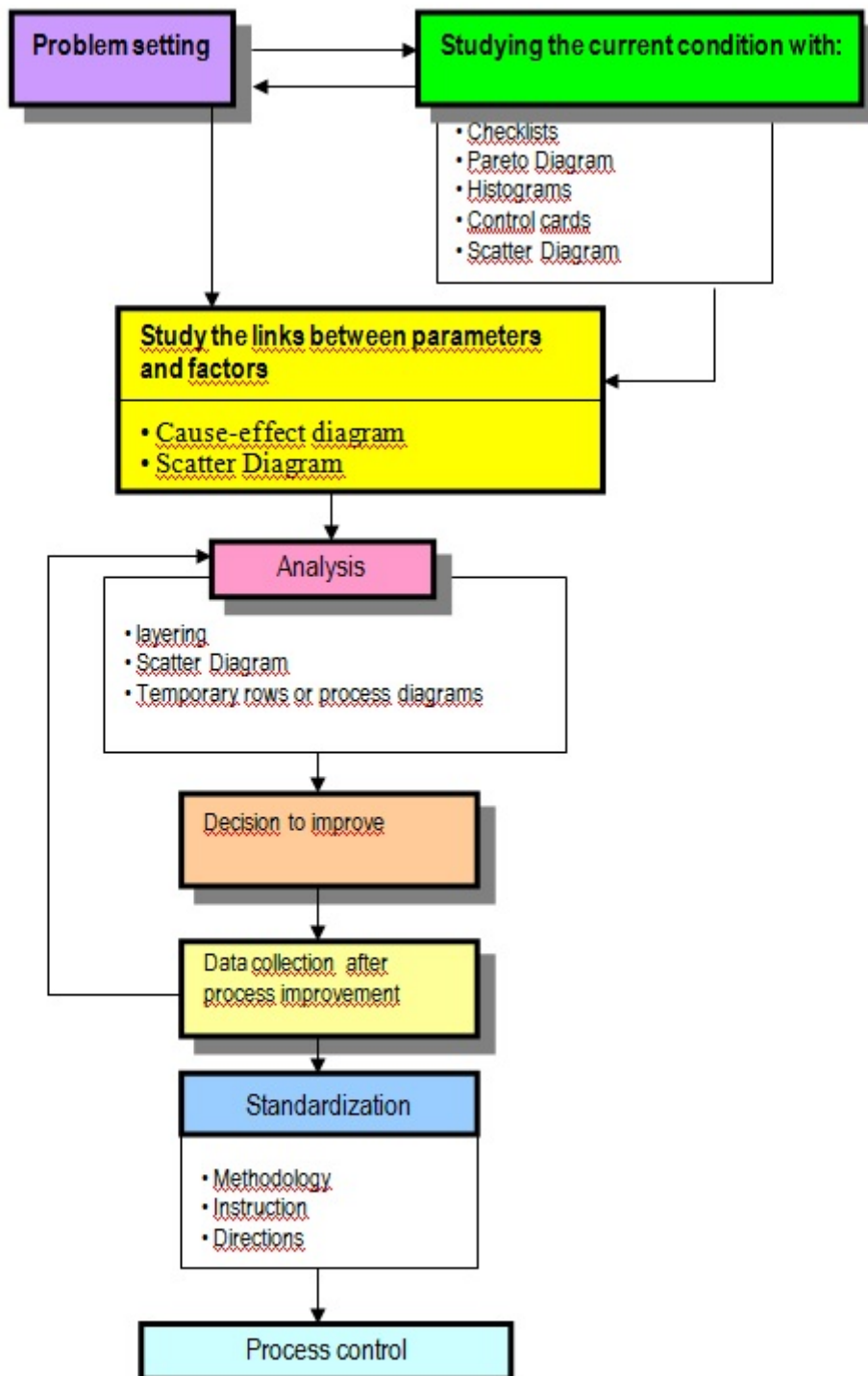


Fig. 3. Scheme for application of statistical methods for analysis, control and management of agricultural processes

The reliability of the system is characterized by the correctness of the decision tasks ( $P_{IP}$ ) and is defined by the dependence

$$P_{IP} = 1 - \frac{m_{FP}}{N}$$

Where:  $m_{FP}$  and  $N$  are the number of wrong decisions and the total number of solved tasks.

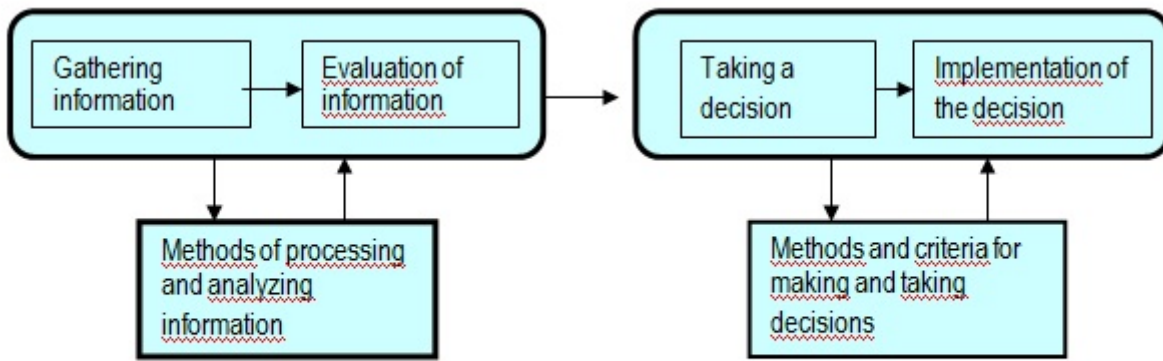


Fig.4. Elements and tasks that are solved by the "man-machine-object of labor"

An important characteristic of the operator's activity is the accuracy of his work, which is quantified by dependence:

$$y = I_H - I_{HP}$$

Where:  $I_H$  Is the actual or nominal value of the parameter that is measured, set or adjusted by the operator;

$I_{HP}$  - The actual measured or adjusted operator parameter value.

The timeliness of solving the tasks of the system is assessed with the probability that the assigned task will be solved for a time not exceeding the permissible:

$$P_{CB} = P\{T \leq T_{\Delta}\} = \int_0^{T_{\Delta}} \varphi(T) dT$$

where:  $\varphi(T)$  Is the function of the density of the time to solve the task by the system;

$T_{\Delta}$  - The time allowed to pass the information on the system contour.

This probability can also be calculated in a nonparametric way, by the expression:

$$P_{HP} = 1 - \frac{m_{HC}}{N}$$

where:  $m_{HC}$  Is the number of untimely solution tasks from the system;

$N$  - The total number of tasks to be solved.

The overall system reliability metric ( $P_{CM}$ ) is determined by the formula

$P_{CM} = P_{HP} - P_{CB}$ , Because the system's performance is evaluated for a certain time interval and the inadequate performance of the tasks leads to the failure of the tasks set up before the system. The work safety of man in the system is assessed on the probability of safe work ( $P_{BT}$ ):

$$P_{BT} = 1 - \sum_{i=1}^n P_{boi} \cdot P_{zpi}$$

where:  $P_{boi}$  is the likelihood of a hazard or human-induced manufacturing situation of this type;

$P_{zpi}$  - the probability of incorrect operation

of the operator in the i-th situation;

$n$  - the number of possible traumatic situations.

The degree of automation of the system is characterized by the amount of information processed on the automatic devices and is determined by the formula:

$$K_a = 1 - \frac{H_{on}}{H_{cm}}$$

where:  $H_{on}$  is the amount of information processed by the operator;

$H_{cm}$  - the total amount of information circulating in the system.

The economic indicato ( $W_{cm}$ ) that characterizes the full cost of the system is determined by the expression

$$W_{cm} = C_e + E_H (C_{on} + C_u),$$

where:  $C_u$  are the costs of creating (purchasing) the mechanical elements in the system;

$C_e$  - the operating costs of maintaining and operating the system;

$C_{on}$  - costs of training and qualifying of the operator;

$E_H$  Is the coefficient of efficiency of capital investment.

The variety of factors influencing the quality of technological processes in agriculture can be grouped into three groups (Figure 5).

Indicators of the quality of the technological processes in agriculture can be divided into three groups.

**The first group** refers to the indicators characterizing the duration and duration of the works. As it is known, the productivity of the agricultural production depends on the term of the technological processes, which is one of the characteristics of the agricultural production. Only when the field works are carried out in the best, shorter terms the best yields per hectare are reached.

**In the second group** are included the indicators, which characterize the technological process, ie. These changes occurring as a result of the treatment (depth of processing, degree of loosening, reversal of the soil layer, shear height, clean weeding, degree of contamination of the production with impurities, etc.).

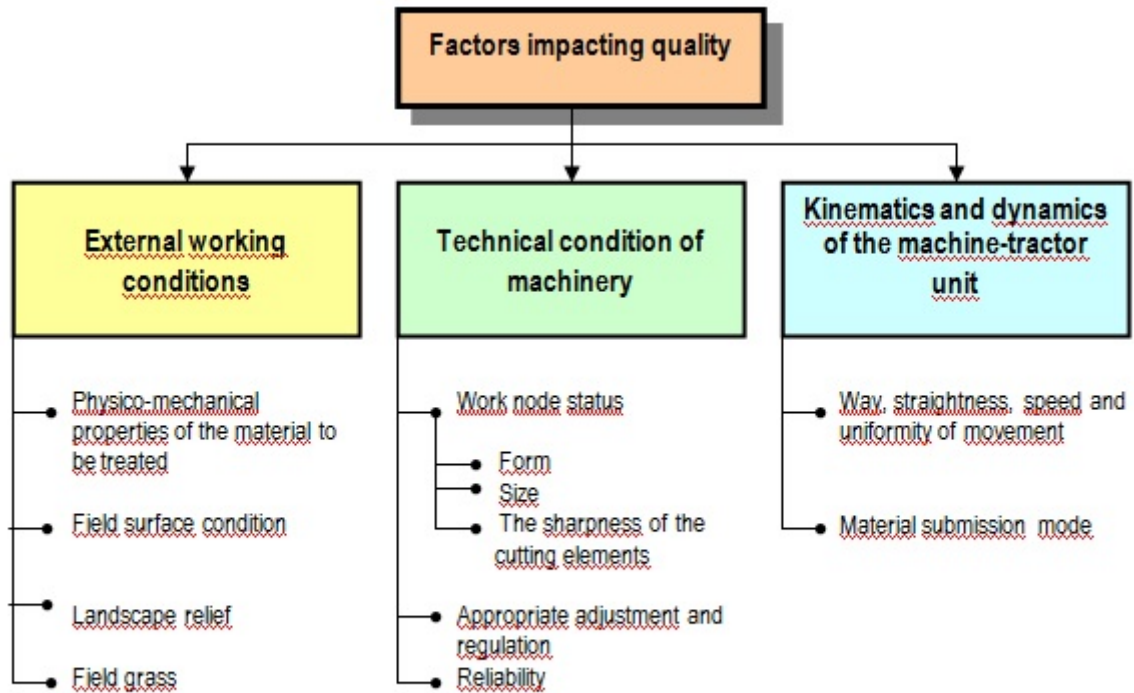


Fig.5.. Classification of factors influencing the quality of technological processes in agriculture

**In the third group** are included the indicators describing the material consumption as well as the quantitative and qualitative losses of production (seed consumption, chemical consumption, degree of seed crushing, etc.).

Main conclusions:

1. The methods for control and management of agricultural processes are outlined and methods for their application are proposed.

2. The location of the human operator (or group of operators) in the ergonomic, related to information processing, elaboration and decision making for efficient system management is specified.

3. A classification of the factors influencing the quality of technological processes, which allows to manage agricultural processes in a targeted manner, is proposed.

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