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OPTIMAL MANAGEMENT OF IRRIGATION PROCESS USING DYNAMIC PROGRAMMING METHOD

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Due to the efficient use of irrigated lands in Azerbaijan, irrigation is delayed due to irrigation, mineral and organic fertilizers, accurate regulation of irrigation norms and methods, and in some cases changes, including water and mineral food, air and carbon dioxide. and that is the basis of management and is characteristic and attractive.

It is very difficult to influence the light and heat entering the plant. However, it is possible to increase and decrease the temperature on the ground surface and in the upper soil.

Optimal water supply allows the plant to form a large leaf surface, which enables it to be better oriented to the light. At the same time, it provides for the efficient use of light energy and provides its development phases.

As you know, dynamic programming allows you to accurately define the numerous tasks of optimization.

It is important to note that decisions for managing development processes that have been determined over time must be made at every step.

Key features of dynamic programming:

Correct expression of the optimization principle;

inclusion of a specific optimization task into a list of issues that can be solved more easily;

obtaining the final result in the form of reccentric-functional control related to the extreme price of the quality criterion.

The dynamic programming method does not provide a single algorithm for solving any extreme problem. At the same time, the approach to the solution of numerous tasks is based on the principles of their solution and i.a. the basis is taken.

Thus, the transition from the functional equation to the algorithms that provide them is extremely difficult, and in some cases, impossible.

Thus, the essence of the dynamic programming method is that the N-step solution is replaced by one-step, two-step, N-1, N-step solutions. At the same time, mathematical reporting rules prevail at every step to cardinally simplify the optimization procedure.

Using this approach clarifies the structure of the optimization of the irrigation regime of crops and the results of their solution.

The issue addressed is the step-by-step discrete process of making decisions about the importance of irrigation and the choice of irrigation norms.

Note that in this case the problem is fixed for any number of steps and refers to the structure independent of the number of steps.

Note also that the selection of irrigation norms at any step (for example, j-step) does not affect the previous (j-1) irrigation rate selection, and after several steps (for example, K), the remaining steps (e.g. The effect of criterion size (NC) depends on the position of the system at the end of the K- decision.

The applicable model of damage provided for the structure of the issue does not take into account the beginning of the process. That is, j irrigation does not depend on the cost of the previous ones.

Damage: - The agrotechnical measures envisaged during the full vegetation phase and the difference between the conditions of moisture supply, which allow maximum yield at the current level of soil fertility, are determined.

The same is determined by the price of the plant.

These are criteria for measuring the damage and requiring accurate reporting.

We obtain this formula by solving the probability equation to characterize the correlation of the entire process efficiency indicator with the performance of individual steps of the process:

Q = ∑_ (k = 1) ^ N▒ 〖(c_ FU (t) dt + P2k (Hk) =〗 ∑_ (k = 1) ^ N▒Qk

There are two main approaches to the solution (3).

The first is a rehearsal method, which consists of finding optimal solutions for approving or extending processes in a functional space.

The second approach is aproximation in the behavioral space or the method of interactions based on a preliminary review of the issue.

The interesional approach is practically defined for processes with infinite lengths.

For end-to-end processes, a recursive method is used to find the optimal solution.

The solution of functional equations of dynamic programming is used with the purpose of finding the optimal solution in determining the duration and norms of irrigation.

Components for the Optimization Problem We call the system state (in the area of irrigation) with the Y vector consisting of all components of the X vector and the components of the integral constraint vector, which are not included in the X components.

The first prerequisite for the functional equation is the combination of the X (Tn) and the right parts of Z. If no integral constraints are present, then Y

X: Y = X corresponds.

As mentioned earlier, dynamic programming method The essence of this is that the solution of the N-step problem with special recursive proportions is replaced by a sequential solution of one, two, and N-step problems. At this time, one-dimensional task of optimization is solved at every step.

The optimal solution to this problem is found in a two-stage reporting procedure. At the initial stage, the cost of conventional optimal control and quality functionality (contingent-optimal losses - irrigation costs and non-compliance with water resources is calculated for the N-issues).

The irrigation rate set at this time:

- average annual evaporation of vegetation days of crops (at least the last 5 years for a few years);

- average annual precipitation (at least the last 5 years for several years) of vegetation days of agricultural crops;

- the average annual (at least the last 5 years of the last 5 years) of vegetation days of agricultural plants, and the relative humidity of air;

- The availability of groundwater is determined by its rising altitude

Irrigation Rate:

Average daily water shortage;

- type of phenol and its phenological phase;

- length of root system of plants;

- type of soil;

- sustainability of the reporting phase of agricultural vegetation vegetation;

- Wetting surface of plants during pulse rains;

- the coefficient of water evaporation in the background of rain during rainfall;

- Climate coefficient of evaporation of plants in different phases is taken into account.

Let us specify the reporting algorithms

Time is chosen as a discrete time of day. The maximum time interval of management was considered from the beginning to the end of the veg.

The following signs are accepted:

K = 1.2 .... The forward number of step N. The multiplication of k in the reverse movement corresponds to the beginning of the veggies: on the other hand, the number of the day, which is the beginning of the management interval, calculated from the end of the k -value and in the rehearsal procedure.

The beginning of the management interval TA = (N-K)

The end of Ts- coincides with the end of the veggie;

t-duration of the indicated interval;

vector:

L-daily irrigation rate from the beginning of the hl -gradation;

Conditional optimal condition of fn-system.

Following the recommendations (4,5), the sequence of functions fk (yl) is determined by the following rectangular ratio:

f1 (yN) = min QN (yN, HN)

fk = (YN-K + 1) = min QN-K + 1 (Y N-K + 1HN-K + 1) + fK-1 (Y N-K + P (Y N-K + 1HN-K + 1)) € ͠Ω N-K + 1

In the formula (7), the first phrase is to study the state of the system and the amount of irrigation rate for the last day, with the minimum required.

F2 = (YN-1) = min QN-1 (YN-1 HN-1) + fK-1 (Y N-1 + P (Y N-1HN-1) HN-1 € ͠ΩN-1

In (6), the condition vector is added at the beginning of the first day Yl + P (Yl Hl), ie when the system Hl control of the system is in the Y state;

L-day increase vector of component P (Yl Hl):

͠Ωl - (l-1) is the area of control that will be instantaneous

fk (yl) is the minimum cost of total losses at the beginning of the year. In other words, fk (Yl) - (l-l) is the minimum expected loss at the instant of the end of vesicle.

Before the next decision is taken, the condition of the system is Y and the optimal decisions are made at this time and in the future.

From (6.7), it is clear that the solution to the k-step problem is to solve the (k-l) step by adding one step to the problem and using the results obtained for the (k-l) steps.

L and K are functionally connected l = N-K + l, (7) - fk, which is a common member of equation:

fk = (Yl) = min Q1 (Y1 H1) + fK-1 (Y N-1 + P (Y1 H1) H1 € Ω̃1

The approach taken to solve dynamic programming functionality, or, accordingly, is to change the image in the situational phase, which also quantifies the level of each coordinate of the Y state in (7), including the location of the irrigation nodes and associated losses. structure.

The fk (Y) function is calculated on the specified nodes of the narrow structure of the function. The size of the grid structure corresponds to the size of the vector of Y.

The adopted step of the net determines the number of different points. It defines the number of points. It is possible to set fk (Y) prices at those points.

Thus, if the condition of the YN system is known at the last step, then the HN control (7) can be found in accordance with the first expression of the ratio. The difficulty is that when the management report for the next phase begins, during the planning process for all the vesicles - at the last step, not t (to the end of harvest), ie at the moment t (N-l) within the system.

T, t (N-l) depends on hydrometeorological conditions throughout the vesicle phase. Therefore, the state of the system at t (N-l), that is, the probability of the YN We have to give different assumptions to look at the situation and determine the optimal management for each.

In the last step, the probability-optimal parameters of the same fN (YN) efficiency and conditional-maximum control HN are obtained for the probability of the YN as a result of the expression (7).

Both components are registered in the memory of the CPA and take the next step.

(7) From the final equation of the ratio, it can be concluded that the value of the efficiency index in this step is defined as the sum of two multiples:

Q = QN + QN-1

It should be noted that the optimal control will be when the Q is at a minimum.

Because of that, the last two days have been lost

QN-1 € QN-1 (Y N-1) depends on the condition of the system at the time of review, the conditional-optimal losses are found in the following statement fK-1 (Y N-1):

fK-1 (Y N-1) = min QN-1 (YN-1) + QNYN)

where YN = Y N-1 + Π (Y N-1HN-1)

condition at the end of the last interval, Y N-1

Y at the beginning of the last interval of condition

Because it is independent of the first HN collected in (9):

fN-l = Y N-1 = min QN-1 (YN-1) + min Q (YN) = min QN-1 (YN-1) + fN (Y N)

The resulting arrays (fN-l (YN-1) and (HN-1 (YN-1) are stored in memory) and the transition to the next step occurs. In the N-2 interval, the results obtained in the interval N-1 are used. , We obtain optimal controls for optimal losses and possible multiplication of the system at a manageable stage.

The optimal solution is then determined using the solution of the previous step. This is the basis of such rehearsal-dynamic programming.

A “straight back” is made after “going back”. This time

$$Y (TH) = Y0$$

A management strategy that is suitable for the initial conditions is used.

Conditional-optimal controls are chosen during the "straight-line" to suit the real state of the system. The optimal controls obtained at each step of the "straight walk" are printed.

At the end of the procedure, generalized results of the optimization are included.