Application multi-objective De-Novo programming for Optimizing Linear Programming to Determine the Water Requirements for Agricultural Crops

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Abstract:

In this paper, the actual needs of water to be given to agricultural crops are determined. The paper sample was chosen as agricultural crops (Barley, Clovers, Broad bean, Onions, Mung bean, Yellow corn, Watermelon, Yellow melon, Finally the sesame) in Iraq. In addition, the amount of water lost during the transfer of water to the cultivated land was determined. All this was done using simple linear programming, Multi - purpose linear programming (De novo programming) Using the software program (WinQSB). As the year was divided into four periods to determine water needs during each period, and it was found that the largest water needs were found during the months (April-June) due to overlap between winter and summer season.

Keywords: Linear programming, Targeted programming, De novo programming, WinQSB software.

1-Introduction (importance of irrigation and soil problems): -

Historical documents indicate that King Hammurabi enacted a law to regulate irrigation (Sumerian civilization – Iraq). Old and now agreed by all countries that water is a wealth of Iraq's important wealth it must be properly invested in our aspiration as an ancient people and in order to reach the lofty goal, we need to develop agriculture, and this requires a study that we call it with the water balance, For this balance, which carries water in the first pan, must carry in the second pan the areas eligible for agriculture and balance the areas and water, and we draw water for each crop and make a good land settlement to reduce the wasting of water as an economic resource and damage to physical and chemical properties of soil and thinking of lining tables and using the latest methods.

The idea of the paper is based on the determination of the field water requirement of the crops of one of the selected projects and identification of the lost water during the transport phase during the unplanned land and according to standard scientific equations approved (globally) and to reach the total water parameters and give a picture of the amount of waste in irrigation water and the additional areas which can be cultivated if the right facilities and management are available for optimal water use. Before talking about the importance of irrigation and problems in the soils, the benefits of irrigation should be determined. Irrigation means adding water to the soil for the following purposes [1]:

1- Provide soil moisture necessary for plant growth.

2- Protect the crop from droughts.

3- Moisture the soil and air to create favorable conditions.

4-Washing or reducing salt concentration in the soil.

5- Reduce the hardening of the surface crust of soil.

6- Facilitate tillage and service operations.

The importance of irrigation is determined by the fact that irrigation agriculture has better production efficiency than dry agriculture where it cannot rely on rain as the sole source of irrigation, especially if it is planned to obtain the ideal production so it was necessary to provide an irrigation system to provide the necessary opportunity to control-the humid levels. One of the problems that accompanies and replicates irrigation is the accumulation of salts in different quantities in the soil their value depends on the saline concentration of irrigation water, leading to changes in soil properties and composition, including the following [1-2]:

1- Soil construction is affected by changes in their moisture content between irrigation periods.

2- Soil construction is affected by salts, increased sodium exchange, organic content and conversion of some clay minerals.

3- Soil strength is affected by increasing the amount of clay and soils deposited in soil pores and loaded with water used in irrigation resulting in reduced soil permeability, the rate of surface water leakage to it, and pores properties and functions.

4- Chemical changes include the difference in concentration of the ground solution and the melting or deposition of calcium sulphate and calcium carbonate, and the redistribution of salts and the change in the exchange capacity of positive ions due to the addition of organic matter and other materials that suspended with irrigation water and oxidation and reduction, which tend to be reduced to the reduction side due to this moisture content. In addition, irrigation ater is added to the soil by fine elements such as boron, lithium, and fluoride with toxic effect at low concentrations depending on irrigation water quality [3].

5- The topography of the land and the characteristics of its sectors are affected after being introduced under the irrigation system as a result of the establishment of deep tillage and the addition of fertilizers and exposing the surface of the land to erosion by irrigation water. Interest in modern irrigation has increased in recent times and its systems have been implemented in most parts of the world, where they have played an important role in solving the problems of irrigated soils and erosion or physical and chemical degradation of rocks and minerals under normal conditions [1,3]. The development of agriculture and increasing its productivity and lack of space, there has been a lot of research to develop the specifications of the system of good irrigation and many studies are still taking place in more detail to determine the determinants and specifications of good irrigation according to the quality of soil and climate and the surrounding environment [2].

2-Water requirement for crops

The most important thing to know about any agricultural project and before embarking on its design is the water needs under which tables and spindles can be designed and through available water, the quality of agriculture and the appropriate agricultural cycle are determined [1]. It is noticeable that the plant's water needs are increased in dry weather due to the high gradient of water and plant energy, and in this case; most of the available water is transferred from the soil to the plant and then vaporized from the plant surfaces and the soil is adopted and processed the plant with water so if the processing rate of the soil to the water of the plant less than the water lost by the process of transpiration we notice a decrease in the water content of plant tissues this may lead to a decrease in the water content of plant tissues, leading to the occurrence of wilt. When the water in the soil is very strong that the water potential is low, we notice that the amount of water that the plant can obtain from the soil is small and depends on the amount of work done by the plant to obtain this quantity and it is clear from this that the rate of water needs depends on the surrounding weather conditions and the work of the plant to obtain these needs depends on the total water effort in the soil and on the plant's forces to get the water from under the soil and when moisture is distributed homogenously, we note that the amount of water extracted by the plant depends on the number of active roots in the soil which are concentrated in areas near the soil surface. Some concepts will be explained to understand the water needs for the plantings [3]:

2.1 Water consumption for the plants Means the amount of water stored in the root zone of the soil that being consuming by the plant and evaporated from its leaves in a transpiration manner in addition to the amount of water evaporated from the land cultivated by plant and estimated by millimeters or centimeters.

2.2 Field water demand It is the water consumption of the plant plus the amount of water lost in the field these estimates under the circumstances of Iraq for winter crops are estimated at 33% of the consumption of water for the plant, 40% for the summer crops, as for the orchards estimated at 33% of the water consumption of plants.

3-Types of irrigation: The irrigation is related to the field by transferring of water from its source to the field using a network of channels or pipes and then distributed to the irrigated areas with the aim of moistening the soil within the root growth area of the growing plan. Irrigation methods are divided into:

3.1 Surface irrigation:n Man has defined surface irrigation: spread water on the surface of the soil through thousands of years and this method was developed in the world, and each country has its own distinctive way and the practical development has helped in electing the most efficient methods that help to use modern field operations and which is based on the process of water control and its optimal use. And here we observe the following surface irrigation methods [3-4]:

A- Surface irrigation: Despite this method become old it is still used so far. This method is to allow water to flow in one side of the irrigation channel on the surface of the land to be irrigated. But the added water is relatively large, so this method is considered to be water consuming and cause the increase of soil salts.

B- Spray irrigation : It is one of the modern methods and it has become common practice to irrigate many different crops and cultivated all kinds of land and on topography dissimilar. It was especially used in humid areas as a means of additional irrigation in dry times. The water is added to the spray method in a manner similar to rain, spray or artificial rain.

C- Drip irrigation: It is the latest method of irrigation and was used for the first time to irrigate crops grown in greenhouses. But in recent years this method has been developed so that it can be used in agricultural fields, but the cost of this method is high. And the summary of this method consists of a network of perforated plastic pipes placed over the surface of the soil, extending crop lines and equipped with water from the main pipe, and it is noticeable that the openings are designed to allow water to flow in droplets rather than in continuous flow.

3.2 Undersurface irrigation: This method has the potential to control the level of ground water and reduce the amount of water lost by evaporation, whether from the surface of water or wet soil, and the absence of obstacles such as pipes or channels that impedes the conduct of agricultural operations like other irrigation methods [5].And we note that there is a network of perforated and buried pipes under the surface of the soil through which the water passes under a certain pressure and it is filtered into soil and this method is effective in soil that possesses high horizontal or vertical permeability. The disadvantage of this method is that the pipes may be endangered in the case of deep tillage.

3.3 The Lining: The idea of lining the irrigation channels (a small river) to reduce the water shortage by leaching known since ancient times in 1800 BC in the time of Hammurabi and found many evidence about the difficulty of accumulation of sediment (Or may accumulate in small and limited quantities). The lining small rivers are reducing the cost of maintenance and does not appear the problems of growth of reed and grass. The channels are not lining, it facilitates the growth of reeds and grasses, which leads to a reduction in the speed of water, which in turn leads to an increase in quantities of sediment and this makes the maintenance process is a daunting process [3,6].

4- Data collection: /dce3olazx9u897r54][=The land area of the research sample is 6275 acres distributed over 20 irrigation units and exploited by 55 peasant families; these lands are irrigated from 12 watercourses (Small River), it is approximately 20-188 km long and its discharge is 8 m^3/s, and its width is estimated 2 meters. Note that all these lands are obtained, but the weakness of the management of the land and its investment in a suitable manner led to a rise in the rate of salinity in it again. Table 1 shows the size of cultivated land and the type of agricultural output.

Table (1): represents cultivated areas for the agricultural season 2015-2016

	rop	d area / acres
1	Barley	4200
2	Clovers	500
3	Broad bean	50
4	Onions	100
5	Mung bean	300
6	Yellow corn	485
7	Watermelon	350
8	Yellow melon	275
9	Sesame	15

Source: Ministry of Agriculture records

Based on the available information on cultivated areas identified (6275) acres and compared to the lands exploited for the agricultural season 2015-2016, noticed that there are large areas left in the form of fallow (land is not suitable for agriculture). The misconception that water isn't a scarce resource, thus, the attention is drawn to other agricultural determinants such as land reclamation, the provision of improved seed varieties and the use of fertilizers scientifically proven to other agricultural requirements or determinants controlled by them. Annually, an agricultural plan is adopted according to which the decision of the areas to be cultivated for this year is determined. But the issues related to the water quota are not discussed and whether they will be fully insured for the planting season or not. For this reason, this research aims at showing the needs of the cultivated plants for the 2015-2016 season and then calculating the rumors about irrigation water transport because the channel (Irrigation River) is not padded. Which proves the contrary perception of the majority that there is no problem with the provision of water quota and consider water is a valuable and cheap. A particular crop differs from another in its water needs here is a paragraph that must stand where the thinking of the water component of the agricultural workers come later after providing the requirements of other agricultural production in which it is supposed to determine the water quota first before embarking on agriculture. Crops with low water needs and production must be economically viable; this makes us think of water as the first determinant of agriculture rather than later. Table (2) shows the discharge in cubic meters / second.

Table (2): illustrates the water discharge of the agricultural season 2015-2016 for the area of the research sample

f the year	buted	charge m^3/min	charge m^3/months
January	**30**	0.67	28944

February	30	1.67	67334.4
March	43	1.196	53389.44
April	25	0.5	21600
May	20	0.35	15624
June	20	0.35	15120
July	23	0.438	19552.32
August	18	0.295	13168.8
September	0	0.35	15120
October	25	0.5	22320
November	35	0.854	36892.8
December	35	0.854	38122.56
Total	**347188.3**		

Source: Department of Operation and Maintenance Ministry of Agriculture

Water loss per acres was calculated for each of the crops in the research sample. The twelve tables that irrigate cultivated land as mentioned previously are unpackaged and are originally spanned by sand lands and therefore are lost from water during transport and during irrigation. Table 3 shows the loss of water per acres during the irrigation of cultivated crops, as well as in front of each species. The loss of water during irrigation is according to the need of each type of agricultural crops for water, the plant which likes to irrigate with water a lot we see that lost from water in the land in which the plant is relatively few of the plant that is not satisfied with little water, therefore, the water lost in the land in which it is planted is large compared to other crops.

Table 3: represents the amount of water lost during irrigation for agricultural products

No.	Type of crop	Water lost m^3/month
1	Barley	6.239
2	Clovers	4.7
3	Broad bean	2.3
4	Onions	2.8
5	Mung bean	1.3
6	Yellow corn	6.9
7	Watermelon	3.3
8	Yellow melon	5.2
9	Sesame	2.8

Table 4 shows the actual need for each of the nine crops of water per month depending on the size of the cultivated land (see Table 1) and as shown for each species.

Table 4: The amount of water needed by each type of

No.	Type of crop	Crops need of water m^3\month	The month in which it is grown inside Iraq	Duration of Agriculture and End of Crop
1	Barley	3401.75	October	6-7 months
2	Clovers	2048	October	6-7 months
3	Broad bean	2139.5	October	4 months
4	Onions	3104	February\August	4 months
5	Mung bean	**4727.2**	**April\June**	**4 months**
6	Yellow corn	**3942.7**	**March\July**	**4 months**
7	Watermelon	**6169.5**	**February\July**	**2 months**
8	Yellow melon	**2609**	**February\July**	**2 months**
9	Sesame	**4569.75**	**April\ June**	**5 months**

The last column in Table 4 can summarize the need for each of the nine crops of the sample to look for water in the months of the year, as shown in Table (5)Table (5): represents the months that crops need from

No.	Type of crop	Months in which the crop needs water
1	Barley	From October to March
2	Clovers	From October to March
3	Broad bean	From October to January
4	Onions	From February to May From August to November
5	Mung bean	From April to July From June to September
6	Yellow corn	From March to June From July to October
7	Watermelon	From February to March From July to August
8	Yellow melon	From February to March From July to August
9	Sesame	From April to August From June to October

5- Linear Programming Method

It is a method used to develop or plan agricultural programs through data that contribute to the development of assumptions. In this paragraph a linear programming model is created in the mathematical formula as follows [7]:

$Max\ Z = C_1X_1 + C_2X_2 + \text{------} + c_nX_n$

Where (Z) refers to the total water needed by the nine products during the planting season per month in the areas included in the agricultural plan. And C1 is the amount of irrigating water in the area of barley planted during irrigation and C2 is the amount of water irrigating in the area of clovers planted during irrigation and so for the other variables (See Table 4). While the numbers in the target function indicate the total actual water requirement for each crop (See Table 1). And qualifications can be written as follows [7-

$\sum_{i=0}^{n} a_{ij}\, x_i \leq \sum_{j=0}^{m} b_j$ Where i= Number of products; j= Number of months

Whereas:

$\sum_{i=0}^{n} a_{ij}\, x_j$, represents the amount of water lost during the irrigating of the product Xj (see Table 3).

b_j represents total water needed by the product in the months corresponding to this constraint (see Table 2).

In order to achieve the results of the mathematical form of the target function and delineated determinants, the following was calculated [10]:

1- Calculate the water needs per crop per acres.

2- The area occupied by each agricultural crop of the total area.

5.1 The mathematical model of the target function

Depending on Table 4, the target function to be reduced is:

$$Max\ Z = 3401.4X_1 + 2048X_2 + 2139.5X_3 + 3104X_4 + 4727.2X_5 + 3942.7X_6 + 6169.5X_7 + 2609X_8 + 4569.75X_9$$

In terms of water resource constraint, it was calculated on the basis of water need per one acres per crop during its productive life and cultivated area (see table 5, 4).

$$\begin{array}{llllllllll}
6.239x_1 & +4.7x_2 & +2.3x_3 & & & & & & & \leq 28944 \\
6.239x_1 & +4.7x_2 & +2.3x_3 & & & & & & & \leq 67334.4 \\
12.478x_1 & +9.4x_2 & & +2.8x_4 & & +6.9x_6 & +3.3x_7 & +5.2x_8 & & \leq 53389.44 \\
 & & & +5.6x_4 & +1.3x_5 & +13.8x_6 & & & +2.8x_9 & \leq 21600 \\
 & & & +8.4x_4 & +2.6x_5 & +20.7x_6 & & & +7.84x_9 & \leq 15624 \\
 & & & & +3.9x_5 & +27.6x_6 & & & +21.952x_9 & \leq 15120 \\
 & & & & +5.2x_5 & +34.5x_6 & +6.6x_7 & +10.4x_8 & +61.4656x_9 & \leq 19552.32 \\
 & & & +2.8x_4 & +6.5x_5 & +41.4x_6 & +9.9x_7 & +15.6x_8 & +172.1037x_9 & \leq 13168.8 \\
 & & & +5.6x_4 & +7.8x_5 & +48.3x_6 & & & +481.8903x_9 & \leq 15120 \\
18.717x_1 + & 14.1x_2 + & 5.29x_3 & +8.4x_4 & & +55.2x_6 & & & +1349.293x_9 & \leq 22320 \\
24.956x_1 + & 18.8x_2 + & 12.167x_3 & +11.2x_4 & & & & & & \leq 36892.8 \\
31.195x_1 + & 23.5x_2 + & 27.9841x_3 & +14x_4 & & & & & & \leq 38122.56
\end{array}$$

$x_j \geq 0,$ where j=1,...,9

So that the right side is the sum of the water that is sent to the crop by the agricultural plan (see table 2).

6- Solve the uni-goals mathematical model:

The simplex table was used to solve this model using the ready-made program (WinQSB). Where the table puts the model to find the best solution for it in a particular mold helping in solving it in a way that is moving from one stage to another until the optimal solution is reached. This maximizes yield in the light of qualifications, determinants and target function in the production unit. As shown in Figure 1. Figure 2 shows the optimal solution using the ready-made program (WinQSB). This achieves the total maximization of irrigation water by (13630834 m^3).

Variable -->	X1	X2	X3	X4	X5	X6	X7	X8	X9	Direction	R. H. S.
Maximize	3401.4	2048	2139.5	3104	4727.2	3942.7	6169.5	6609	4569.75		
C1	6.239	4.7	2.3							<=	28944
C2	6.239	4.7	2.3							<=	67334.4
C3	12.478	9.4		2.8		6.9	3.3	5.2		<=	53389.44
C4				5.6	1.3	13.8			2.8	<=	21600
C5				8.4	2.6	20.7			7.84	<=	15624
C6					3.9	27.6			21.952	<=	15120
C7					5.2	34.5	6.6	10.4	61.4656	<=	19552.32
C8				2.8	6.5	41.4	9.9	15.6	172.10368	<=	13168.8
C9				5.6	7.8	48.3			481.890304	<=	15120
C10	18.717	14.1	5.29	8.4		55.2			1349.292851	<=	22320
C11	24.956	18.8	12.167	11.2						<=	36892.8
C12	31.195	23.5	27.9841	14						<=	38122.56
LowerBound	0	0	0	0	0	0	0	0	0		
UpperBound	M	M	M	M	M	M	M	M	M		
VariableType	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous	Continuous		

Figure 1: Demonstrates the linear programming model of the search problem using the ready-made program (WinQSB).

	22:58:33		Friday	March	29	2019		
	Decision Variable	Solution Value	Unit Cost or Profit c(j)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c(j)	Allowable Max. c(j)
1	X1	1,178.90	3,401.40	4,009,894.75	0	basic	2,718.61	7,569.95
2	X2	0	2,048.00	0	-514.36	at bound	-M	2,562.36
3	X3	48.13	2,139.50	102,977.32	0	basic	961.34	3,051.29
4	X4	0	3,104.00	0	-653.13	at bound	-M	3,757.13
5	X5	1,938.46	4,727.20	9,163,496.00	0	basic	4,050.68	M
6	X6	0	3,942.70	0	-30,422.67	at bound	-M	34,365.38
7	X7	57.45	6,169.50	354,465.91	0	basic	4,194.17	7,199.89
8	X8	0	6,609.00	0	-3,112.64	at bound	-M	9,721.64
9	X9	0	4,569.75	0	-251,454.33	at bound	-M	256,024.08
	Objective	Function	(Max.) =	13,630,834.00				
	Constraint	Left Hand Side	Direction	Right Hand Side	Slack or Surplus	Shadow Price	Allowable Min. RHS	Allowable Max. RHS
1	C1	7,465.83	<=	29,908.80	22,442.97	0	7,465.83	M
2	C2	7,465.83	<=	27,014.40	19,548.57	0	7,465.83	M
3	C3	14,899.86	<=	53,389.44	38,489.59	0	14,899.86	M
4	C4	2,520.00	<=	21,600.00	19,080.00	0	2,520.00	M
5	C5	5,040.00	<=	15,624.00	10,584.00	0	5,040.00	M
6	C6	7,560.00	<=	15,120.00	7,560.00	0	7,560.00	M
7	C7	10,459.20	<=	19,552.32	9,093.12	0	10,459.20	M
8	C8	13,168.80	<=	13,168.80	0	623.18	12,600.00	26,808.48
9	C9	15,120.00	<=	15,120.00	0	86.73	0	15,802.56
10	C10	22,320.00	<=	22,320.00	0	79.28	7,206.53	22,873.54
11	C11	30,006.13	<=	36,892.80	6,886.67	0	30,006.13	M
12	C12	38,122.56	<=	38,122.56	0	61.47	37,200.00	63,935.70

Figure 2 shows the best solution for the search problem using the ready-made program (WinQSB).

Figure 3 shows the optimal solution summary

03-29-2019 23:00:48	Decision Variable	Solution Value	Unit Cost or Profit C(j)	Total Contribution	Reduced Cost	Basis Status
1	X1	1,178.90	3,401.40	4,009,894.75	0	basic
2	X2	0	2,048.00	0	-514.36	at bound
3	X3	48.13	2,139.50	102,977.32	0	basic
4	X4	0	3,104.00	0	-653.13	at bound
5	X5	1,938.46	4,727.20	9,163,496.00	0	basic
6	X6	0	3,942.70	0	-30,422.67	at bound
7	X7	57.45	6,169.50	354,465.91	0	basic
8	X8	0	6,609.00	0	-3,112.64	at bound
9	X9	0	4,569.75	0	-251,454.33	at bound
	Objective	Function	(Max.) =	13,630,834.00		

Figure 3: A summary of the best solution using the ready-made program (WinQSB)

7- Solve the mathematical model using the method (De novo): The normal ideal way (Simplex Method) that assuming that the level of the resources available is the right side of the qualifications is constant and known [11-13]. In this method it will explain the method to finding the best solution among the alternatives available as this method was used by the scientist (Zeleny) in1982 to solve customization problems. The (Denovo) method differs in the terms of the hypothesis with the normal optimization method. This method assumes that the level of available resources (the right side) is also one of the decision variables that affect the value of the target function. This is why the linear programming model for the search problem will come as follows [14-18]:

$Max\ Z= C_1X_1+C_2X_2+\text{------}+c_nX_n$

$$\sum_{i=0}^{n} a_{ij}\, x_i - \sum_{j=0}^{m} b_j = 0;\ where\ i = Number\ of\ products\ j = Number\ of\ months$$

$$\sum_{j=0}^{m} b_j \le B \text{ where } B = \text{is the given total budget}$$

Therefore, the linear programming model using (De novo programming) will be as follows:

$$Max\ Z=3401.4X_1 +2048X_2 +2139.5X_3 +3104X_4 +4727.2X_5 +3942.7X_6 +6169.5X_7 +2609X_8 +4569.75X_9$$

S.to

$$\begin{array}{llllllllll}
6.239x_1 & +4.7x_2 & +2.3x_3 & & & & & & & -b_1 = 0 \\
6.239x_1 & +4.7x_2 & +2.3x_3 & & & & & & & -b_2 = 0 \\
12.478x_1 & +9.4x_2 & & +2.8x_4 & & +6.9x_6 & +3.3x_7 & +5.2x_8 & & -b_3 = 0 \\
 & & & +5.6x_4 & +1.3x_5 & +13.8x_6 & & & +2.8x_9 & -b_4 = 0 \\
 & & & +8.4x_4 & +2.6x_5 & +20.7x_6 & & & +7.84x_9 & -b_5 = 0 \\
 & & & & +3.9x_5 & +27.6x_6 & & & +21.952x_9 & -b_6 = 0 \\
6.239x_1 & & & & +5.2x_5 & +34.5x_6 & +6.6x_7 & +10.4x_8 & +61.4656x_9 & -b_7 = 0 \\
 & & & +2.8x_4 & +6.5x_5 & +41.4x_6 & +9.9x_7 & +15.6x_8 & +172.1037x_9 & -b_8 = 0 \\
 & & & +5.6x_4 & +7.8x_5 & +48.3x_6 & & & +481.8903x_9 & -b_9 = 0 \\
18.717x_1 + & 14.1x_2 + & 5.29x_3 & +8.4x_4 & & +55.2x_6 & & & +1349.293x_9 & -b_{10} = 0 \\
24.956x_1 + & 18.8x_2 + & 12.167x_3 & +11.2x_4 & & & & & & -b_{11} = 0 \\
31.195x_1 + & 23.5x_2 + & 27.9841x_3 & +14x_4 & & & & & & -b_{12} = 0
\end{array}$$

$$b_1+b_2+b_3+b_4+b_5+b_6+b_7+b_8+b_9+b_{10}+b_{11}+b_{12}=347188.3$$

$$x_i \ge 0,\ where\ i=1,2,\ldots,9$$

$$b_j \ge 0,\ where\ j=1,2,\ldots,12$$

The right hand side of the variants of the new decision is the sum of water provided for irrigation (See total in Table 2).

After converting the problem into a simplex table using the ready-made program (WinQSB) of the model using (De novo programming), which maximizes yield in the light of qualifications, determinants and target function in the production unit. Figure 4 represents the optimal solution using the ready-made program (WinQSB) which achieves total irrigation water magnification by (18327766 m^3). The summary solution is optimized using the extracted method (De novo programming) shown in Figure 5.

	12:33:45		Saturday	March	30	2019		
	Decision Variable	Solution Value	Unit Cost or Profit c(j)	Total Contribution	Reduced Cost	Basis Status	Allowable Min. c(j)	Allowable Max. c(j)
1	X1	0	3401.40	0	-506.15	at bound	-M	3907.55
2	X2	0	2048.00	0	-895.66	at bound	-M	2943.66
3	X3	0	2139.50	0	0	basic	1952.91	2641.63
4	X4	5904.56	3104.00	18327766.00	0	basic	2513.99	3932.60
5	X5	0	4727.20	0	0	basic	397.70	5478.45
6	X6	0	3942.70	0	-30639.56	at bound	-M	34582.27
7	X7	0	6169.50	0	0	basic	5215.99	94091.80
8	X8	0	2609.00	0	-7112.64	at bound	-M	9721.64
9	X9	0	4569.75	0	-149640.84	at bound	-M	154210.59
10	X10	0	0	0	0	basic	-M	218.32
11	X11	0	0	0	-218.32	at bound	-M	218.32
12	X12	16532.78	0	0	0	basic	-210.72	35.67
13	X13	33065.55	0	0	0	basic	-105.36	147.96
14	X14	49598.33	0	0	0	basic	-70.24	98.64
15	X15	0	0	0	-192.63	at bound	-M	192.63
16	X16	0	0	0	776.41	at bound	-M	M
17	X17	16532.78	0	0	0	basic	-210.72	295.93
18	X18	33065.55	0	0	0	basic	-105.36	112.37
19	X19	49598.33	0	0	0	basic	-270.14	53.29
20	X20	66131.11	0	0	0	basic	-277.14	190.53
21	X21	82663.88	0	0	0	basic	-14.00	31.25
	Objective	Function	(Max.) =	18327766.00				

Figure 4 shows the optimal solution to the search problem based on (De novo programming) by using the ready-made program (WinQSB).

03-30-2019 12:29:19	Decision Variable	Solution Value	Unit Cost or Profit C(j)	Total Contribution	Reduced Cost	Basis Status
1	X1	0	3401.40	0	-506.15	at bound
2	X2	0	2048.00	0	-895.66	at bound
3	X3	0	2139.50	0	0	basic
4	X4	5904.56	3104.00	18327766.00	0	basic
5	X5	0	4727.20	0	0	basic
6	X6	0	3942.70	0	-30639.56	at bound
7	X7	0	6169.50	0	0	basic
8	X8	0	2609.00	0	-7112.64	at bound
9	X9	0	4569.75	0	-149640.84	at bound
10	X10	0	0	0	0	basic
11	X11	0	0	0	-218.32	at bound
12	X12	16532.78	0	0	0	basic
13	X13	33065.55	0	0	0	basic
14	X14	49598.33	0	0	0	basic
15	X15	0	0	0	-192.63	at bound
16	X16	0	0	0	776.41	at bound
17	X17	16532.78	0	0	0	basic
18	X18	33065.55	0	0	0	basic
19	X19	49598.33	0	0	0	basic
20	X20	66131.11	0	0	0	basic
21	X21	82663.88	0	0	0	basic
	Objective	Function	(Max.) =	18327766.00		

Figure 5: shows the summary of the optimal solution depending on the (De novo programming) by using the ready-made program (WinQSB).

8- The conclusion: When the model (the problem of search) was solved in normal ways, we found that the target function, which represents the amount of water used by the nine agricultural products under study, is equal to (13630834) cubic meters of water and by using (De Novo), it is equal (18327766) m^3, this shows that the use of available materials (right-hand) in the decision variables makes the target function improve by more than 4 million cubic meters of water which will go to water the nine agricultural crops, specifically by (4696932 m^3). It is noted that the largest water need is during the months (April - June) this is due to the overlap between the winter and summer season. This is an important and serious observation that was not taken by entities authorized to irrigate agricultural crops (Ministry of Irrigation) due to consideration and justifications related to crops where some take off before the end of his life as onions and the other is sponsored by animals such as clover (See Table 2). And depending on the wet surrounding, which has been scientifically estimated and the use of the index of the water-borne transport in the dusty channels, And which is determined by specialists in the Ministry of Irrigation, taking into account the length of the channel and water level in which the estimated water rumors by transportation m^3/ for every three months attributed to the increase and decrease in the amount of water losses by transportation depending on the quantities of water competent at each stage. And the table that mentioned above referred to the field water needs which we talked about in the previous pages where the last field of the table refers to non-economic water rumors which represent the waste and extravagance in the water resource, which was extracted after the release of water rumors of transportation and water needs of the field of the water system approved by the facility: padding irrigation channels and its economic effects (See Table 3). Finally, the increase in the amount of water that goes by watering is applied by (De novo programming) this leads to reduced water lost during watering and lost water which may sometimes lead to damage to agricultural crops and the loss of planting (Lack of water), and the other damage to the roots of agricultural crops (Frequent or abundant water).

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