IRRIGATION AND DRAINAGE MANAGEMENT IMPROVEMENTS BY OOIS MODEL

AMELIORATION DE LA GESTION D'IRRIGATION ET DE DRAINAGE EN UTILISANT LE MODELE OOIS

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ABSTRACT

Comprehensive knowledge of water delivery date to every field, water pipe and also applying a measured quantity of irrigation water help to increase operation efficiency of the irrigation systems. Experience has been shown any delay in off of flow could release extra water to the fields and cause land drainage problem. Similarly, sooner cut off of irrigation could also reduce the efficiency and crop yield. These problems arise due to inadequate knowledge of irrigation managers about operation, planning and the proper time of water delivery to the irrigation net work. Great field heterogeneity of most of the system and state variables create problems in planning by means of manual calculation and reveal problems in relation to accurate water delivery from source to fields. Many of these problems can be circumvented by using suitable software. For the present study, we have used a software, which has been designed to calculate accurate time and the amount of water to be applied to any field and point in the irrigation net work. The software calculates required amount of water delivery from early April to end March.

Key Words: *Field operation, Irrigation, Channel, Management, Improvements, Delivery, Water.*

RESUME

La connaissance globale de la date de distribution d'eau à chaque champ, le tuyau d'eau ainsi que l'application d'une quantité mesurée d'eau d'irrigation aide à l'augmentation de l'efficience d'exploitation des systèmes d'irrigation. L'expérience a indiqué qu'un retard dans

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l'arrêt de débit d'eau peut causer l'inondation des terres par l'eau supplémentaire qui à son tour donne lieu au problème de drainage des terres. De même, l'arrêt tôt de débit d'eau peut réduire l'efficience et le rendement agricole. Ces problèmes se posent en raison de la connaissance inadéquate des gestionnaires d'irrigation en matière de l'exploitation, de la planification et de la date exacte de distribution d'eau au réseau d'irrigation. La grande hétérogénéité des champs de la plupart du système et des variables d'état créent des problèmes de planification en raison du calcul manuel et des problèmes relevant de la distribution précise de l'eau de la source aux champs. Beaucoup de ces problèmes peuvent être évités en utilisant le logiciel approprié. Dans l'étude actuelle, on a utilisé un logiciel pour calculer le temps précis et la quantité d'eau à être appliquée à n'importe quel champ et point du réseau d'irrigation. Le logiciel calcule la quantité exigée de distribution d'eau dès avril jusqu'à mars de l'année suivante.

1. INTRODUCTION

One of the most important factors during the irrigation network operation is water delivery and distribution schedule. The delivery schedule refers to the method by which the irrigation district determines who will receive water from the district water distribution system and when they will receive it. The primary components of a delivery schedule are delivery flow rate, irrigation frequency and irrigation delivery duration. To permit an efficient operation it is necessary to adjust irrigation frequency to be within the water operator's flexibility and land conditions. This ensures that the farmers receive the requested water in right time. This estimation makes noticeable enhancement in irrigation and man power efficiency. The software oois-1; a software of irrigation network operation, provides facilities for planning the annual schedule of suitable delivery and distribution of water. This software has been designed in VB.NET2008 and uses SQL SEVER 2008 as the data base source.

2. METHODOLOGY

The importance of delivering irrigation water to water users at the right time, at the proper rate and for the desired duration cannot be overemphasized. In order to achieve this, the operating personnel are needed to regulate the water supply, operate control structures and pumps, and coordinate system functions with the water users. Some degree of automation is usually beneficial.

Proper Check Gate control is an important action to be done by operation personnel. Gate setting should be determined by using actual discharge as compared to assumed or target flows. Necessary gate adjustments should be made at proper time intervals to allow the flow reaching the next check structure in the system. Check gates should be operated in such a manner as to keep canals at the desired operating range. Tabulation of upstream or downstream limits for water surface elevations should be developed for each section of the canal.

For setting a proper water delivery program, the essential parameters like water flow, irrigation frequency and irrigation duration should be specified. The methods of water regulation and delivering have been summarized by Replogle and Merriam (1980) and are presented with minor modification in Table 1. These delivery schedules are broken down according to degree of flexibility given to the farmer in terms of flow rate, frequency, and duration of application and level within the delivery system at which irrigation delivery decisions are made. The types of major delivery schedules include demand, arranged, central system, and rotation.

Table 1. Definitions of delivery scheduling method

System constraints schedule categories (1)	Frequency (2)	Rate (3)	Duration (4)
(a) Local control : demand schedules			
Demand	U	U	U
Limited – rate demand	U	L	U
Arranged – frequency demand	A	L	U
(b) Intermediate control: arranged schedules			
Arranged	A	A	A
Limited rate arranged	A	L	A
Restricted arranged	A	C	C
Fixed duration arranged	A	C	F
Fixed rate/restricted arranged	A	F	C
(c) Central control : central system schedules			
Central system	V	V	V
Fixed amount	V	F	F
(d)rotation schedules			
Rotation	F	F	F
Varied amount rotation	F	F(V)	F(V)
Varied frequency rotation	F(V)	F	F(V)
Continuous flow	-----	F(V)	-----

U= unlimited, no restriction, under user control; L = limited to maximum flow rate, but still arranged; A = arranged between user and water authority; C = constant during irrigation as arranged; F = fixed by central policy; V = varied by central authority at authority's discretion; V = varied by central authority seasonally by policy.

2.1.Rotation schedule

Rotation schedules are the most restrictive of all irrigation schedules. The rate, frequency, and duration are fixed by policy of the central water authority and remain fixed for the entire irrigation season. The most common methods are continuous flow schedules and varied amount rotation schedules.

2.2.Demand schedule

Demand schedules are the most flexible of all the irrigation schedules. In effect, they allow an unlimited amount of water to be taken from the system at userS' convenience. In many instances, such ideal systems are not practical and would be prohibitively expensive. The demand schedule involves both limited rate demand schedules and arranged frequency demand schedules.

2.3. Arranged schedule

Under arranged schedule, rate, frequency and duration are arranged between user (farmer) and water supply agency. Often, these arrangements are made on a local level, rather than on project level. This allows for more flexibility in arrangements (for example, last minutes changes in arrangement). This schedule is categorized into limited-rate arranged schedules and restricted arranged schedules.

2.4. Central system schedule

The idea behind this method, called system scheduling, is to improve the predictive ability of the project in estimating crop water needs several days ahead. Such schedules have not proven to be practical.

In this research, water flow delivered to every agricultural land, irrigation frequency, and delivery time will be set with reference to parameters like overall landscape and type of crops using the OOIS-1 software. In this method the water losses will be minimized and is compare of the other existing methods.

3. OOIS-1 SOFTWARE DESCRIPTION

OOIS-1 was designed as a versatile software to evaluate flow rate, water volume reaching each farm and pipe line beginning point (time of gate's adjustment). In Figure 1 the general view of the area of software application is shown. Figure 2 shows the software opening menu. The main menu has four options as follow:

a) File

This option leads software's managing functions

b) In Put

Generally, the input data are divided into three main categorize as below:

First part: involves identifying water source, pipe line, agricultural lands' name and specification like water losses, water speed, supplying line length, maximum flow and land area. Figures (3) to (7) show the method of data entry from various sources.

Second part: involves drawing irrigation timetable and crop yield specification based on previous data. Timetable presents useful information via irrigation depth, water requirement in the first and the subsequent irrigations.

Irrigation timetable is evaluated in base of SCS method for both fixed and varied depth. In Figures (6) and (7), the style of data entry was shown.

Fig. 1. Area of Software application

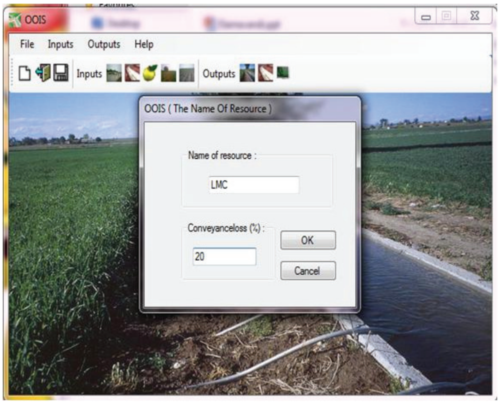


Fig. 2. Data entry form for water resource's definition

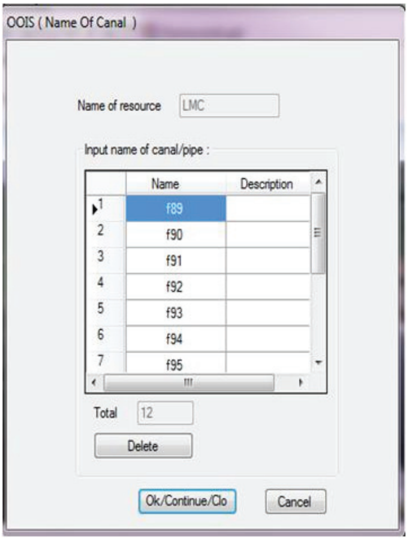


Fig. 3. Data entry form for water pipeline's name

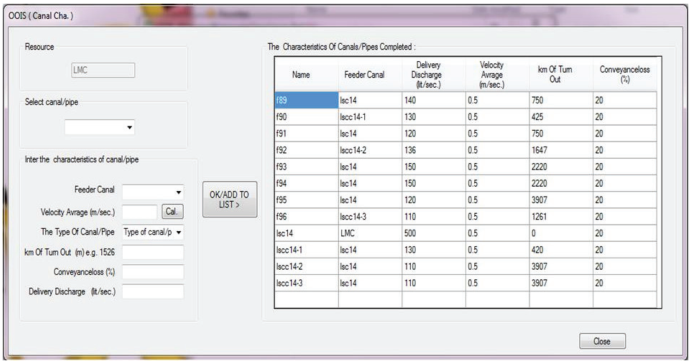


Fig. 4. Data entry form for water pipeline's definition

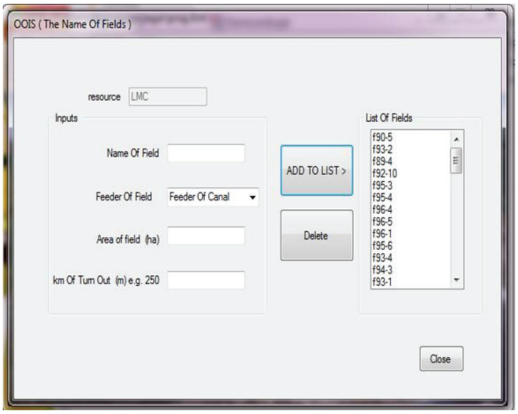


Fig. 5. Data entry form for field's definition

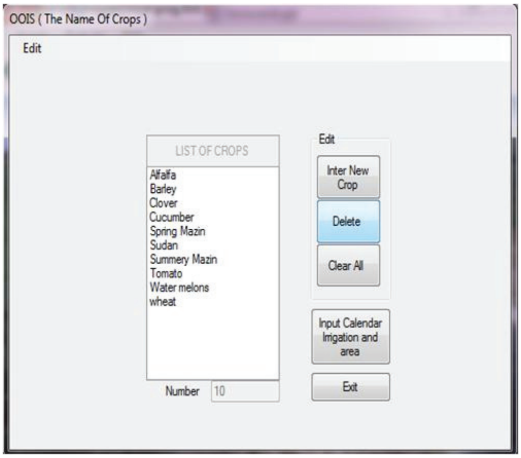


Fig. 6. data entry form for crop pattern definition

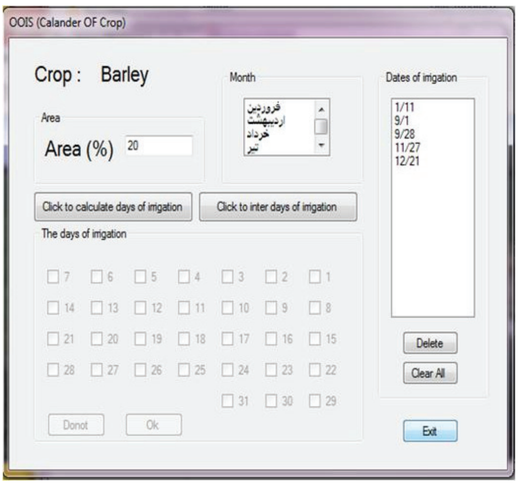


Fig. 7. Data entry form for irrigation schedule

Third part: in this part the essential items like the specification of related year crop is entered. It is Necessary to note that the smallest unit of agricultural function is known as irrigation unit and usually cultivated by one crop. The maximum area of each land field varied between 10 to 20 hectares irrigated by the fourth sub canal that directly provides water for border strips, rills and sub laterals. Water flow for each field is fixed from 20-45 L/S. it is possible to estimate the closure, flow time and water volume delivered to each field. If more than one crop is cultivated in the field, or the land grows autumn crop also, this software could be used in a same manner. The related data should be gathered in the first of each water year and use as field input. In Figures (8) and (9) the progress of data entries is presented. Also Figures (10) to (12) show the default form for calculating time of delivery to field.

c) Out Puts

The program outputs are the exact time for closure-reflow in a year; additionally, information on the calculate required water discharge and volume for each field and beginning of laterals, pipelines and delivery points to enhance efficiency and reduce water losses rate are also obtained. In Figures (13) and (14) forms of outputs are shown and in Figures (15) and (16) some examples for output are presented.

d) Help

It is presented useful manual for operators.

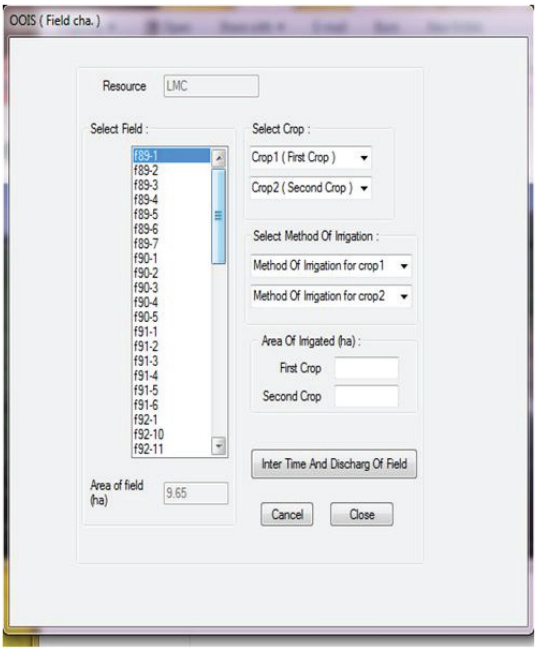


Fig. 8. Data entry form for farm and cultivated crop of each water year

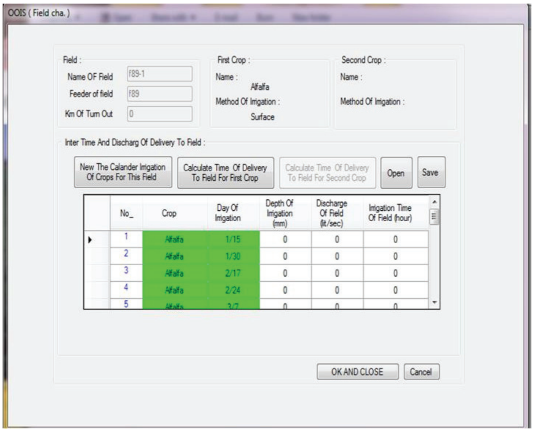


Fig. 9. Data entry form for irrigation definition of under interested field of each water year

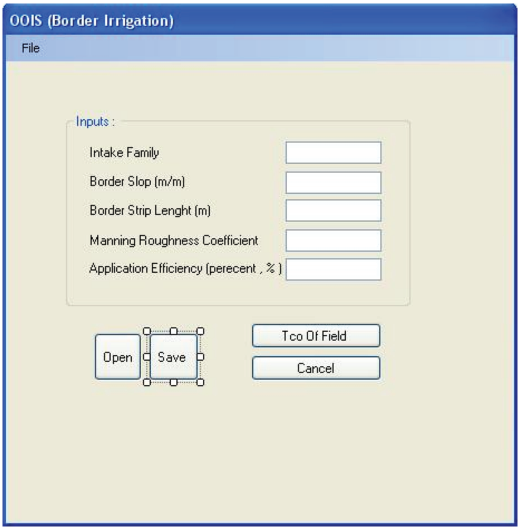


Fig. 10. Form related to calculation of surface irrigation time

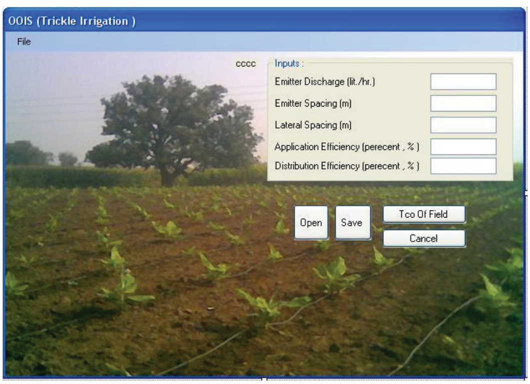


Fig. 11. Form related to calculation of drip irrigation time

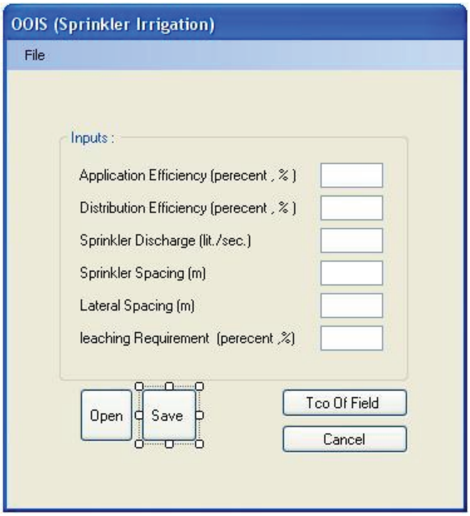


Fig. 12. Form related to calculation of sprinkler irrigation time

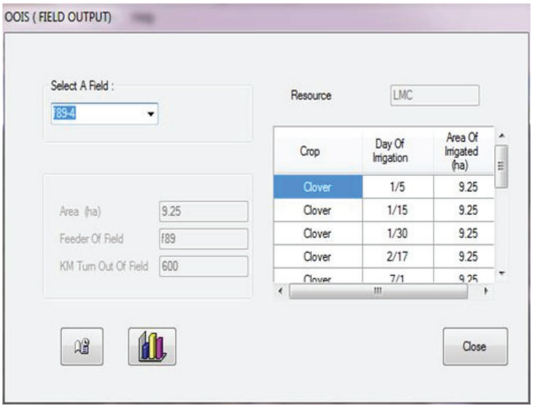


Fig. 13. Output form of fields

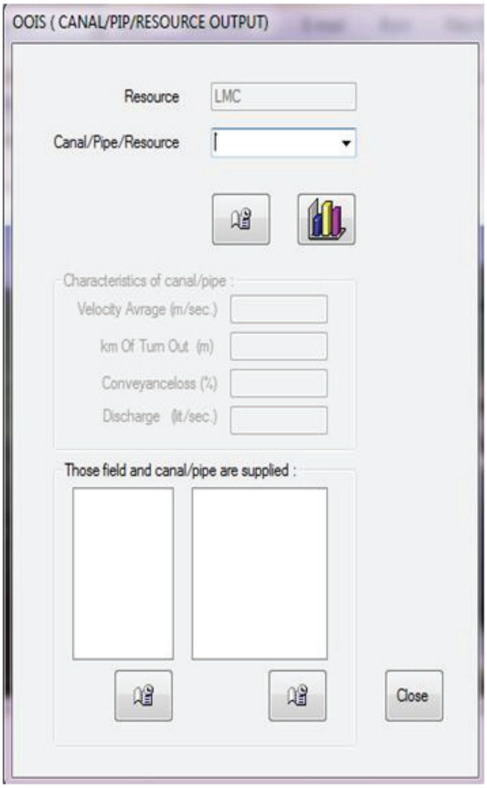
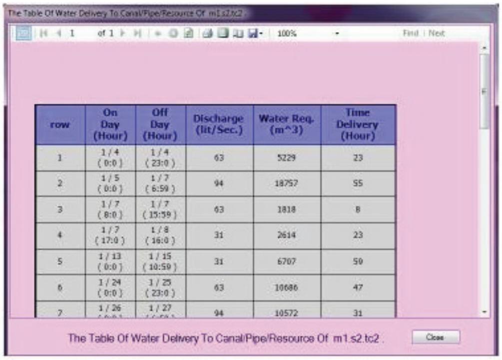


Fig. 14. Output form of water pipelines


The Table Of Water Delivery To Canal/Pipe/Resource Of m1.s2.tc2

row	On Day (Hour)	Off Day (Hour)	Discharge (lit/Sec.)	Water Req. (m^3)	Time Delivery (Hour)
1	1 / 4 (0:0)	1 / 4 (23:0)	63	5229	23
2	1 / 5 (0:0)	1 / 7 (6:59)	94	18757	55
3	1 / 7 (8:0)	1 / 7 (15:59)	63	1818	8
4	1 / 7 (17:0)	1 / 8 (16:0)	31	2614	23
5	1 / 13 (0:0)	1 / 15 (10:59)	31	6707	59
6	1 / 24 (0:0)	1 / 25 (23:0)	63	10686	47
7	1 / 26	1 / 27	94	10572	31

The Table Of Water Delivery To Canal/Pipe/Resource Of m1.s2.tc2 .

Fig. 15. Sample Table of output

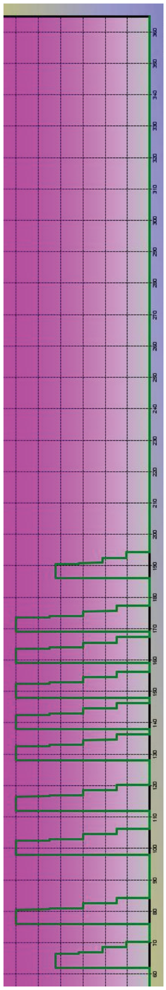


Fig. 16. Sample of curve output

4.TYPICAL PLAN

Using this software, delivery and distribution schedule for canal LSC-14 was presented. This canal is the secondary canal number 14 that branched from main canal of DASHTE LAGHAR irrigation and drainage network. This network is located between Ghir and Laghar village in Fars province. The main canal LMC is 35 km long with 9.8 m3/s discharge at the start and 1.6 m3/s at the end. Main canal covers 9111 ha of agricultural lands and 15 sub canals branched from main canal. LSC-14 has branched from length of 34 kilometer. The length of this canal is 3907 m and LSC-14 supports 440 ha of surrounding area also has 8 sub division canals. In Figure (17) the general layout of recommended crops in LSC-14 downstream is shown.

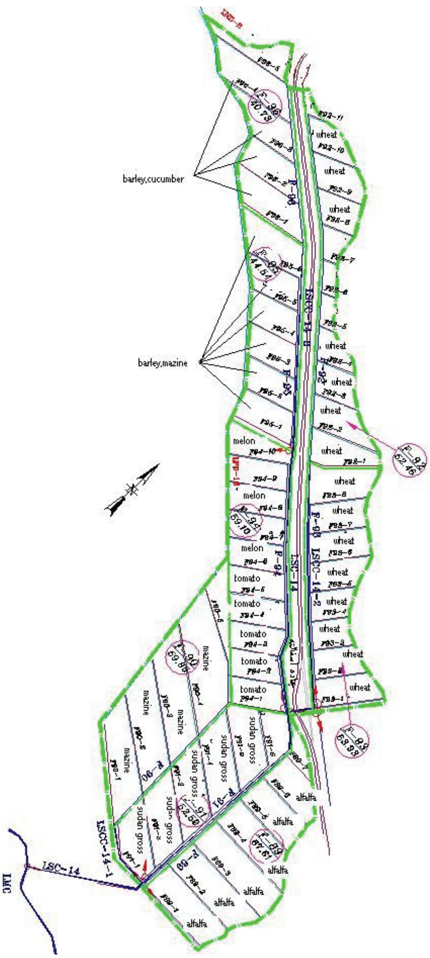


Fig. 17. Recommended location for crop pattern of LSC-14

Main canal brings water to the blocks of our interest and has been used in data entries with 20% reduction in flow due to deliver and distribution losses. Additionally, farms, canals and crops identification enter into software data frames. For exaple, in Tables 2 and 3 the field F-91 and cultivated crop specification was presented.

Table 2. Downstream farms specifications

Third Sub canal	Fourth sub canal	Area Under support of fourth sub canal (hectares)	Irrigation network length (m)	crop	Irrigation closure (hour)
F91	F91-1	7.78	200	Sudan grass	90
	F91-2	8.72	200	Sudan grass	110
	F91-3	9.09	200	Sudan grass	110
	F91-4	9.52	200	Sudan grass	110
	F91-5	8.48	200	Sudan grass	110
	F91-6	3.83	200	Sudan grass	50

Table 3. Cultivated crop time table in plan

Crop	Parameter	October (mehr)	November to May (aban to ordibehesht)	June (khordad)	July (tir)	August (mordad)	September (shahrivar)
Sudan gross	Irrigation frequency	1	-	2	2	3	2
	Irrigation date	7	-	1,15	20,6	25,15,5	5,15
	Net deep or irrigated water (mm)	50	-	50,70	70	70	70

After setting the layout of selected cultivated crop, the software provides related report. In Figure (18) the distribution and delivery curve for third sub canal and in Figure (19) the distribution and delivery curve for LSC-14 in the delivery point are presented.

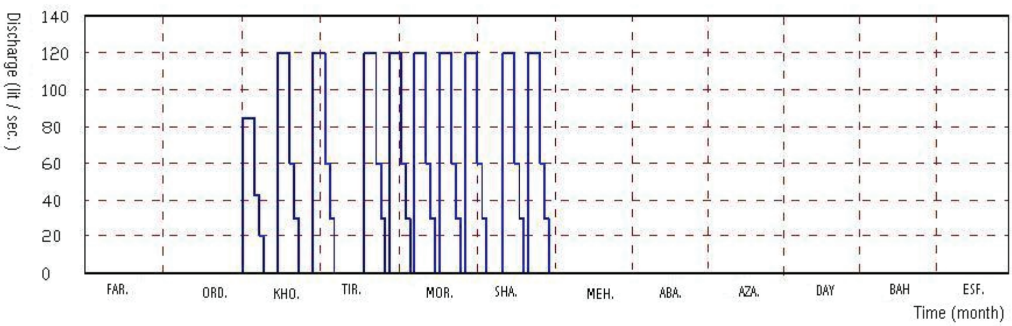


Figure 18. distribution and delivery's curve of sub canal f-91 branched from LSC-14

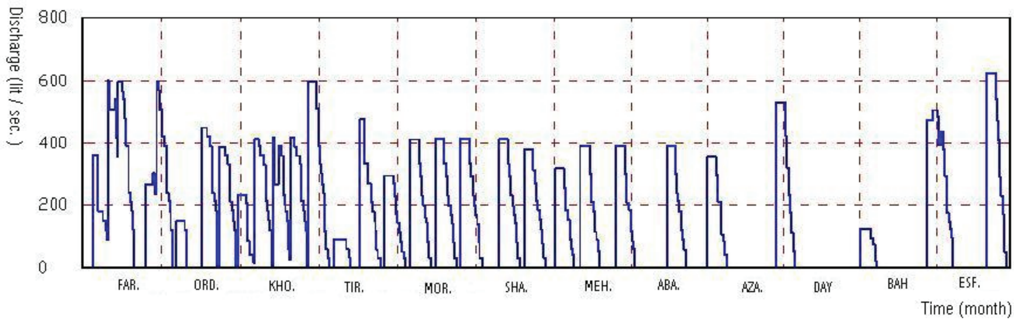


Figure 19. distribution and delivery's curve of sub canal LSC-14

5. CONCLUSIONS

The use of the software in the present study permitted: Enhancing the irrigation efficiency and reaching to design efficiency by calculating the exact time and delivery amounts.

- Improving the irrigation knowledge and managing level of network
- Increasing the man power efficiency due to detailed plan and water access in right time for each user with specified schedule(decreasing the losses and manpower costs)

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