IMPROVEMENT OF IRRIGATION AND DRAINAGE EFFICIENCY THROUGH PARTICIPATORY IRRIGATION MANAGEMENT AND DEVELOPMENT UNDER SMALL LAND HOLDING CONDITIONS IN AILWMP

AMÉLIORATION DE L'IRRIGATION ET L'EFFICACITÉ DU DRAINAGE À TRAVERS LA GESTION PARTICIPATIVE DE L'IRRIGATION ET LE DÉVELOPPEMENT DANS DES CONDITIONS TENANT DES TERRES EN PETITES AILWMP

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ABSTRACT

There has been a general trend towards construction of irrigation and drainage on-farm system by governments, aiming to enhance irrigation and drainage efficiency. Therefore, Alborz Integrated Land and Water Management Project[3], enjoying domestic funds of government of Islamic Republic of Iran, as well as loan of the World Bank is being designed and implemented. One of project objectives is demonstration of benefits of IWRM[4] in the water basin through increasing sustainable crop production by development and improvement of irrigation and drainage systems while taking advantage of PIM[5].

The project area is located in North of Iran and in Mazandaran province. This area encompasses about 52700 ha of irrigation and drainage farmland, including 77000 ha owned by small land owners. Hence, average size of farms is less than 1 ha. Of the above-mentioned area about 36200 ha is improvement area and the remaining (16500 ha) belongs to development area, and for 9000 ha of farmland in this area, tertiary irrigation and drainage system has been designed. At this point, having the design works finished, taking the farmers' opinion into account is an issue. In this paper some issues are taken into consideration as follows:

1- Design criteria and different alternatives for designing the alignment of the on-farm system (tertiary and quarternary canals) were prepared and the final decision was made.
2- Different alternatives for cross-section of tertiary canals were compared, in terms of technical and economical aspects and the most appropriate one was selected.
3- Layout of the irrigation and drainage system was prepared.
4- Activities related to establishment of WUAs[6] were carried out simultaneously and for development area six WUAs were established.
5- The alignments of tertiary canals and drains have been communicated to all stakeholders and WUAs and their comments were received and based on that, the alignments were amended and eventually the two bidding documents were prepared and presented to the Client, separately for areas of 3000 ha and 6000 ha.
6- As continuing the activities and while cooperating with WUAs, land consolidation and land leveling are to be designed and prior to that, it has been implemented in 1000 ha of farmland as a pilot.

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[4] Integrated Water Resources Management

[5] Participatory Irrigation Management

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Preface

During recent years implementation of on-farm irrigation and drainage systems has been brought into consideration of the governments and by the same token AILWMP is being designed and under construction taking advantage of both domestic funds of GOI and loan of the WB. One of the main objectives of this project is to demonstrate the advantages of IWRM within watershed (catchment area/basin) through increasing sustainable crop production by development and improvement of Irrigation and Drainage systems and applying Participatory Irrigation Management. The project area is located in north of Iran, Mazandaran province and irrigation and drainage area encompasses about 52700 ha, from which about 36200 ha belongs to improvement area and the rest (16500 ha) is development area and overall there are 13440 water users in this area. Tertiary irrigation and drainage network has been designed for 9000 ha of this area. In this paper, the activities performed in development area of the project including design works and method of applying farmers' opinions and comments are elaborated.

Location of the project area

The project area is located in Babol, Ghaemshahr, Jouybar and Babolsar cities areas in Mazandaran province. This region is bounded by Caspian Sea on the north, Alborz mountain chain on the south and Siahroud River on the east and Babol River on the west. Talar River is parallel to Siahroud and Babol rivers, passing right through midst of the plain. The project area is illustrated in figure 1.

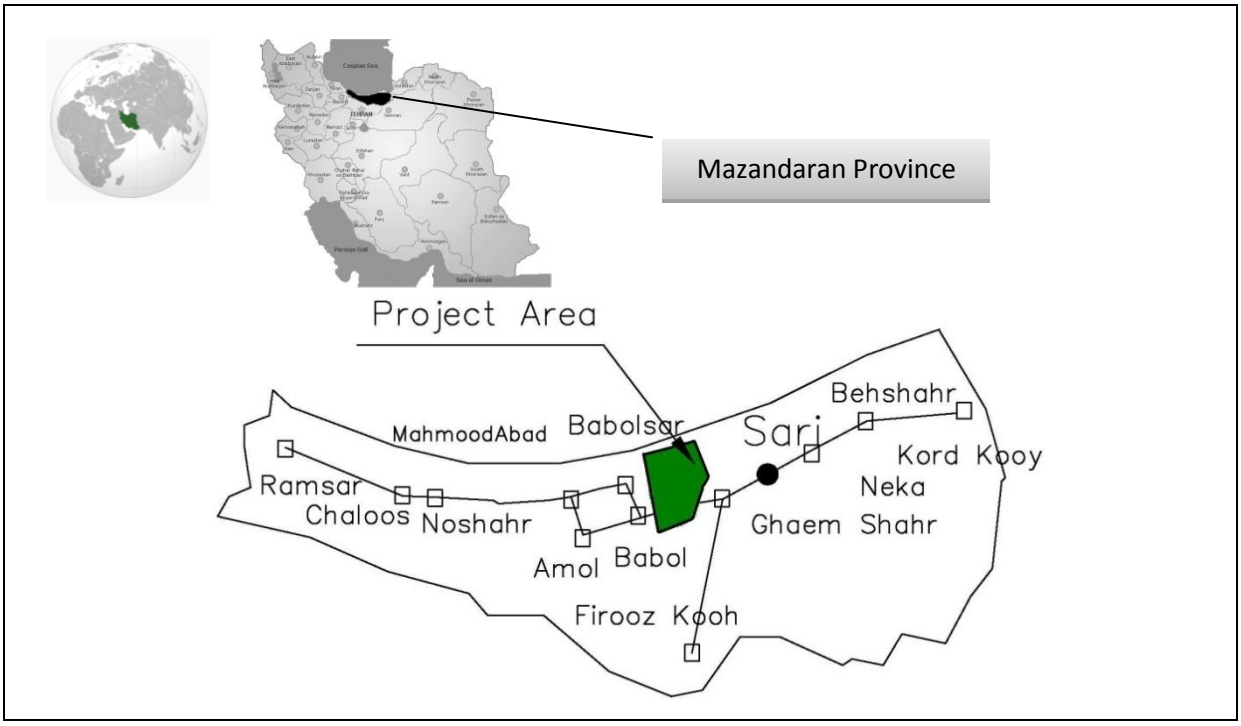


Figure 1. Location of the Project Area (Localisation de la zone du projet)

Project scheme

The main objective for designing of Alborz reservoir dam (Pashakola) is meeting agriculture water requirement for farmlands located between Babol and Siahroud rivers. For this, the mentioned reservoir dam has been constructed on Babol River, 40 km far away from Babol city on South-East. Ganjafrouz and Raeiskola diversion dams have been constructed on Babol River, about 14 and 17 km on the south of Babol city respectively, in order to supply and distribute water in farmlands of development and improvement area.

The main canal bifurcated from Ganjafrouz diversion dam (naming MCC) supply the existing channels along its alignment and located between Babol and Talar rivers at its beginning and then between Talar and Siahroud rivers in addition to feeding some of the existing channels in this region, it finally distribute water between two main canals of 24 and 25. This main canal with maximum capacity of 23.32 cms is originated at Ganjafrouz diversion dam and continues with approximate length of 18.5 km up to the point where 24 and 25 canals are to be bifurcated. Also, Raeiskola canal with capacity of 1.30 cms is branched from Raeiskola diversion dam and at relative distance of km 4.5 of this canal, having Halidasht pumping station constructed with capacity of 630 lit/s, water would be pumped to southern high lands of the plain.

In addition, 24 and 25 canals with approximate length of 18 and 24 km respectively, are envisaged to irrigate farmlands in development area and a part of improvement area located between Talar and Siahroud rivers. The 24 canal would irrigate western farmlands within the development area and 25 canal would supply water to eastern farmlands of the area. Main goals for designing of these canals are irrigating farmlands within the development area as well as feeding primary canals and in some cases secondary and tertiary ones.

In addition to development area, some of existing channels in improvement area located between Talar and Siahroud Rivers would also be fed by 24 and 25 canals. Eventually the turnouts of tertiary canals are supplied through the main system including primary and secondary canals. Also in this project, the importance of land consolidation and rehabilitation is emphasized and respective design works are schedule in work plan. Regarding the fact that on-farm network is only designed in the development area, the activities carried out for designing of on-farm network only in the development area, therefore the activities carried out for designing of on-farm network, only within the development area and establishment of WUAs and the consequent results and its influences on the on-farm system are explained in this paper and no information is presented about the improvement system.

The project scheme is demonstrated in figure 2.

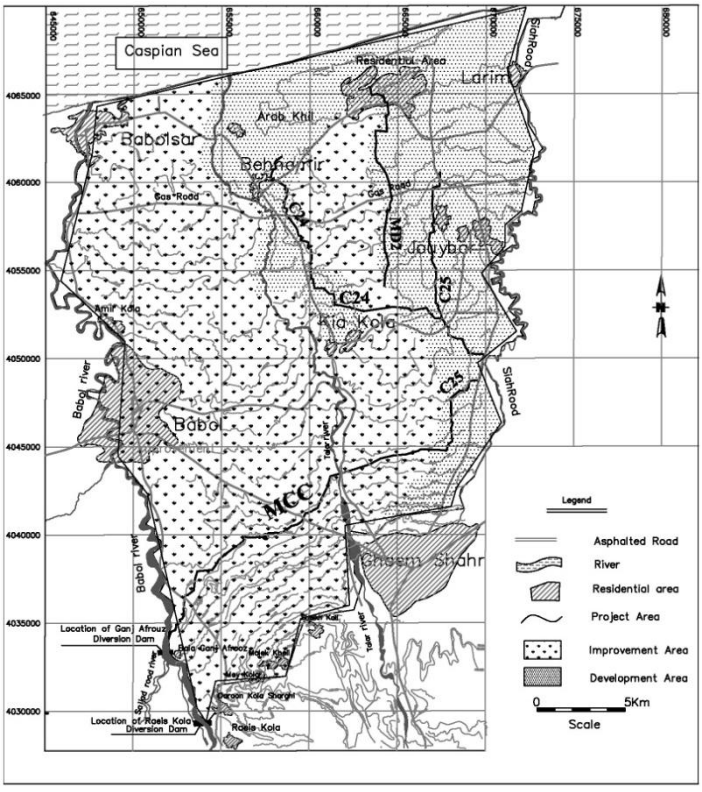


Figure 2. Layout of the Project (Mise en page du projet)

Expected efficiencies in the project

As it was mentioned before, development area is a part of project area in which main and secondary systems are being designed and under construction and simultaneously the activities related to establishment of WUAs is being performed by another consultant and its details are elaborated further in latter parts of this paper. After complete implementation of the irrigation and drainage network and provided proper operation of the project and taking advantage of cooperation of WUAs, it is expected to have irrigation efficiencies as presented in table 1.

Table 1. Irrigation Efficiencies in Development Area of AILWMP (Efficacité de l'irrigation dans la zone de développement de AILWMP)

Water resource – crop	Conveyance efficiency ec%	Distribution efficiency ed%	Application efficiency ea%	Total efficiency ep%
Surface - rice	95	88	--	83
Surface - non paddy	95	88	66	55
Groundwater – rice	94	90	--	85
Groundwater – non paddy	94	90	65	55

Correlation between designing consultant and the WUAs establishment consultant

Alignment of tertiary canals and drains has been determined based on the project design criteria and then it has been submitted to the consultant responsible for establishment of WUAs, in order to be investigated in terms of social aspects.

A team of experts from both consultants started field investigations in order to study social issues, land use, familiarizing farmers with the project objectives and alignment of canals and drains, obtaining opinions and comments from the farmers and land owners. The WUAs' establishment consultant has held several meetings, coordinated with the Client, in order to content the representative members of local authorities, city hall, Islamic village council and related service centers.

Afterward, some meetings were held with presence of the farmers' representatives and managers of the cooperatives to convince and persuade them. These meetings were usually held in public places within the villages. Regarding previous announcement by the farmers' representatives and submission of invitations, almost absolute majority of water users have been attending in the meetings. As for holding these meetings, the best time from participants' points of view was tried to be selected, so that more project stakeholders could participate in the meetings and share their opinions.

In such meetings, layout of the on-farm system was explained to the attendees, by the expert designer. Also establishment method of WUAs which is one of the main project objectives, as well as method of water allocation to each WUA, operators functionality and responsibilities of each WUA and duties of the project stakeholders and operators were explained.

Then, comments and recommendations of those farmers whose pieces of land have been influenced by the canals, were gathered in form of minutes of the meetings which were collected after being signed and sealed by the village Islamic council. Later, these have been submitted to the designing

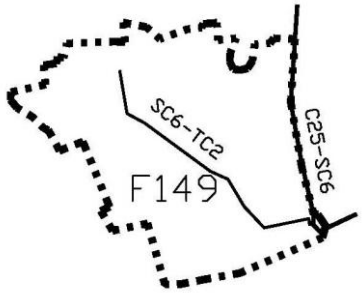
consultant as validation report and finally required modifications have been made to the alignment of tertiary canals with regard to the farmers' comments. The validation reports consists of name of farmlands along the alignment of each canal names of owners and indicating the farmers' agreement or disagreement, reason for disagreement and proposing of new alignment. In addition, after asking the farmer, it has also been stated in the report whether they are about to change the land use in the future.

Also the expansion maps of cities and villages in the project area have been obtained and given to the designing consultant. Then having this report available and received data and maps, the designing consultant has revised the alignment of tertiary canals and drains while taking technical restrictions into account and according to the farmers' opinion and recommendations of WUAs establishment consultant, in order to satisfy the farmers' requirement.

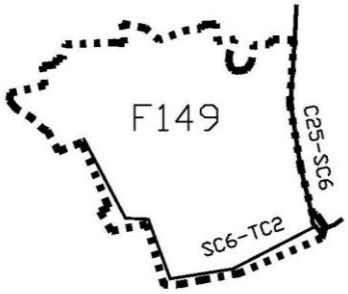
It is worth mentioning that, in some cases the modifications asked by the farmers were not possible as they result in hydraulic problems and issues. In such cases, the reasons have been conveyed to WUA establishment consultant in written form.

After making the corrections and revising and modifying alignment of some of the tertiary canals and drains, final alignments were prepared for hydraulic design and calculation. During hydraulic design, any other modification caused by hydraulic influences and/or changes of the main system layout was applied in layout of the on-farm system and the changes were announced to respective consultant to be investigated and validated once more.

For instance, primary and final alignments of a tertiary canal namely SC6-TC2 in the farm unit No. 149 which is 120 ha is illustrated in figure 3.



Primary alignment by designing consultant



Proposed alignment by WUAs establishment consultant

Figure 3. primary and final alignments of SC6-TC2 tertiary canal in farm unit No. 149 (alignements primaire et finale du canal tertiaire SC6-TC2 dans le # 149 unité agricole)

Figure 4 shows the overall correlation between the consultants and the Client through different stages.

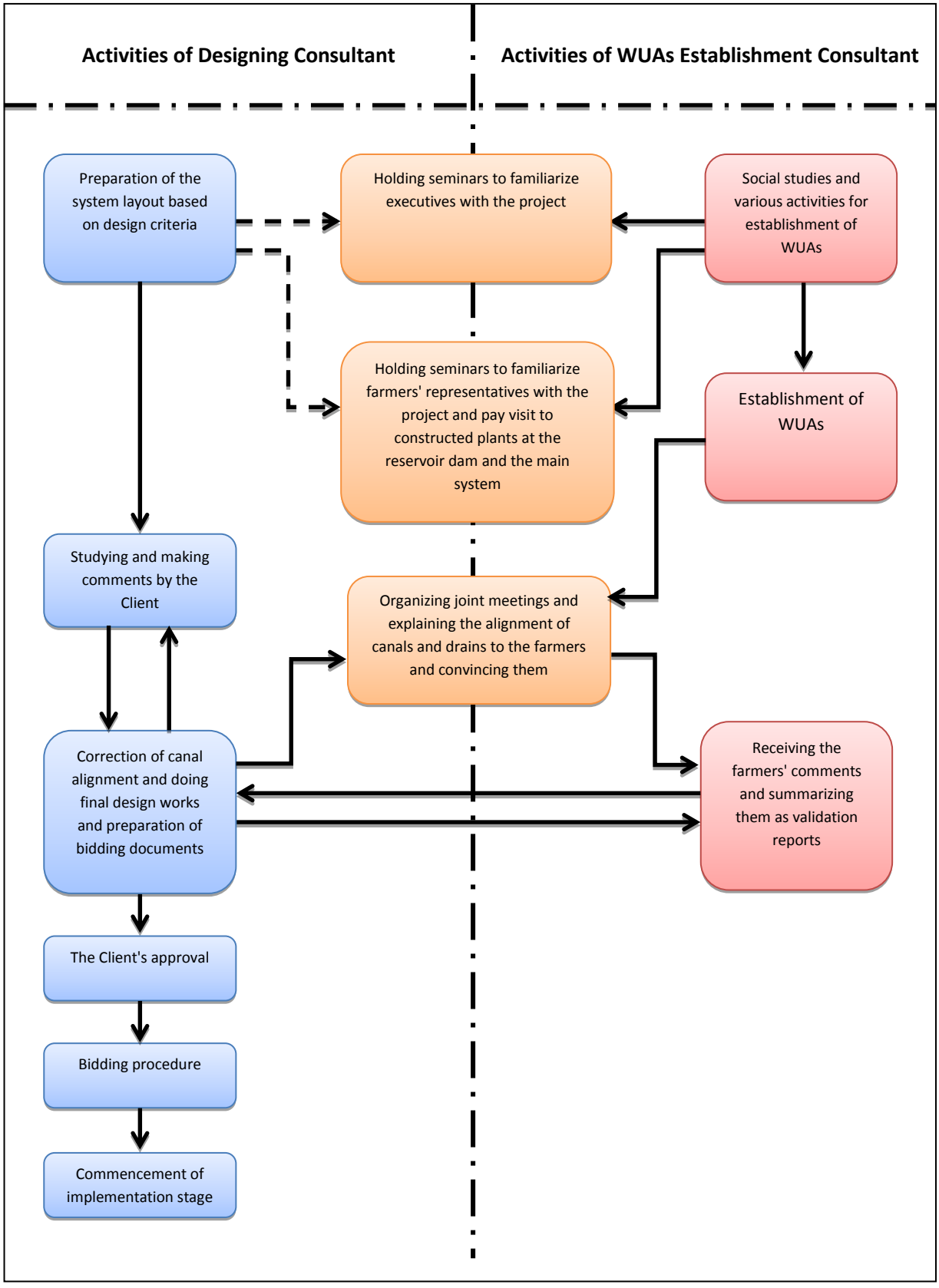


Figure 4. Overall correlation between the Consultants and the Client (corrélation globale entre les consultants et le client)

WUAs status at present situation

First of all, general explanations about method of establishment of WUAs which are as cooperatives and being done based on drawings and maps prepared by designing consultant shall be presented.

Procedure for establishment of WUAs

Work plan on WUAs establishment starts from delimitation of boundaries for each WUA and ends with official registration stage and detailed procedure is as follows:

- Delineation and printing of WUAs layout map
- Preparation of WUAs' profile
- Assessment of existing irrigation and drainage facilities, gathering of farmers' requests for repair and rehabilitation, etc.
- Planning meetings with agricultural service centers and other authorities about rehabilitation and renovation of existing plants
- Meeting with farmers
- Choosing representatives of WUAs by the farmers
- Training the representatives of WUAs
- Selection of WUA – cooperative establishers
- Validation of list of field lots and ownerships
- Preparation of documents and registration of WUA – cooperative

Criteria for delimitation of WUAs boundaries

Boundary of potential sites for establishment of WUA has been defined based on following criteria:

a) Area related to each WUA shall be bounded by defined and clear water boundaries such as irrigation and drainage canals, rivers or traditional channels
b) Field lots located in one WUA are being supplied through one common water resource or are to be so.
c) Command area of each WUA shall ensure economical expectations of operation affairs of that WUA (i.e. it shall be big enough and financial stability of the cooperative shall be provided)

   In AILWMP, range of this area is defined as 1000 to 4000 ha.

d) One village shall be covered by one WUA as far as possible, due to some reasons as follows:

   - Durability of existing social and economic communications and participation in management and development of infrastructures and water plants of village
   - Being familiar with important role of Islamic Council in villages and social and economic affairs, coordination between organizations and local social communities
   - Avoiding problems which may be faced by the farmers due to being a member of two or more WUAs

Status and general specifications of WUAs within development area are presented in table 2.

Table 2. Status and general specifications of WUAs within development area (Situation et caractéristiques générales des associations d'usagers d'eau dans la zone de développement)

Water resource	WUA area	Name of cooperative	Number of villages covered	Number of water users	Area of farmlands covered	Establishment date
C24	*C24-1*	*Mirabkola*	*11*	*1184*	*1054*	*March 2010*
	C24-2	*Khazar Bahnamir*	*9*	*1786*	*2860*	*July 2008*
Subtotal 1			*20*	*2970*	*3914*	-
C25	*C25-1*	-	*22*	*2733*	*4084*	*About to be established*
	C25-2	-	*9*	*2636*	*1766*	*About to be established*
	C25-3	*Shaltook Jouybar*	*13*	*2818*	*2340*	*October 2009*
	C25-4	*Khazar 22 Bahman Jouybar*	*11*	*2283*	*2607*	*July 2008*
Subtotal 2			*55*	*10470*	*10797*	
Total			*75*	*13440*	*14711*	

Final design

After receipt of comments of WUAs' members and being approved by the WUA establishment consultant, final design has been prepared and presented. Whole design works related to the on-farm system within the development area consists of two packages of bidding documents titled as:

Talar Right Bank (IDM/W301)
Siahroud Left Bank (IDM/W302)

The on-farm system would be fed through the main system. Summary of specifications of the main system is demonstrated in table 3. More details of performed design works about the on-farm system and activities carried out for commencement of implementation stage are as presented below. Also a summary of status of on-farm canals and drains is presented in table 4.

I. Talar Right Bank Contract (IDM/W301)

Contract documents of this area have been awarded to the contractor and construction activities have been started.

Works subject to the contract:
Subject of this contract is construction of on-farm surface irrigation and drainage system including provision, supply and installation of tertiary canals as semi-ellipsoidal canalet, construction and rehabilitation of tertiary drains as earthen trapezoidal, construction of service and access roads and implementation of related technical structures. Details of the works are as follows:

- Provision and transportation of all required materials for construction of canals and drains, roads and related structures.
- Provision, transportation, installation, testing and commissioning of hydromechanical equipment

Components of the contract:

- Construction of 35 tertiary canals as semi-ellipsoidal canalet with length of 39.8 km
- Construction of 22 connecting drain as open and trapezoidal, with length of 6 km
- Construction of 10 tertiary drain as open and trapezoidal with length of 9.3 km
- Dredging of existing drains with length of 7.3 km
- Construction of about 725 structures of various types

- Provision and installation of 913 sets of slide gate

II. Siahroud Left Bank (IDM/W302)

The bid is already advertised and some contractors have purchased the bidding documents. Bidding procedure is proceeding.

Works subject to the contract:

Subject of this contract is construction of on-farm surface irrigation and drainage system including provision, supply and installation of tertiary canals as semi-ellipsoidal canalet, construction and rehabilitation of tertiary drains as earthen trapezoidal, construction of service and access roads and execution of related technical structures. Details of the works are as follows:

- Provision and transportation of all required materials for construction of canals and drains, roads and related structures.
- Provision, transportation, installation, testing and commissioning of hydromechanical equipment

Components of the contract:

- Construction of 74 tertiary canals as semi-ellipsoidal canalet with length of 82.7 km
- Construction of 36 tertiary drain as open and trapezoidal with length of 36 km
- Construction of 40 connecting drain as open and trapezoidal, with length of 16.7 km
- Dredging of existing drains with length of 8.7 km
- Construction of about 1384 structures of various types
- Provision and installation of 2054 sets of gate

Table 3. summary of specifications of the main system of canals and drains within development area (zone de résumé des caractéristiques du système principal des canaux et des drains dans le développement)

Name and number of contract	Main canal		Main drain		Primary canal		Secondary canal		Primary and secondary drain	
	Name and quantity	Length (km)	name and quantity	Length (km)	quantity	Length (km)	quantity	Length (km)	quantity	Length (km)
A part of main MC canal* IDM/W201	Part III (1)	6	-	-	-	-	-	-	-	-
Main system IDM/W204	C24 (1)	17.8	-	-	-	-	-	-	-	-
	C25 (1)	23.5	-	-	-	-	-	-	-	-
	-	-	MD2 (1)	14.9	-	-	-	-	-	-
Talar Right Bank IDM/W205	-	-	-	-	2	12.8	2	5.6	1	10
Siahroud Left Bank IDM/W206	-	-	-	-	3	30.2	16	45.3	14	54
Total	3	47.3	1	14.9	5	43	18	50.9	15	64

* In addition, construction cost of Ganjafrouz diversion dam and part I of MC canal (with length of 3.7 km) and part II of MC canal (with length of 8.9 km) has been covered by domestic funds of government of Iran. Total length of main canal is about 18.5 km.

Table 4. summary of specifications of the on-farm system of canals and drains within development area (zone de résumé des caractéristiques du système de la ferme des canaux et des drains dans le développement)

Name and number of contract	Tertiary canal		Number of covered farmlands	Tertiary drain		Length
	quantity	length km		type	quantity	km
Talar Right Bank IDM/W301	35	39.8	43	Designed and under construction	10	9.3
				Using the existing drains (dredging)	11	7.3
				Connecting drains (designed and under construction)	22	6
Siahroud Left Bank IDM/W302	70	78.2	70	Designed and under construction	35	36
				Using the existing connecting drains	10	8.7
				Connecting drains (designed and under construction)	40	16.7
Total	105	118	113	-	129	84

Summary and Conclusion

During design works of the irrigation and drainage network (particularly farm network) the designing consultant has been practically informed about the requests and comments of the farmers and land owners within the project area of AILWMP on the alignments of farm canals and drains. This has been made possible with coordination and cooperation of Water Users Associations establishment consultant.

Before any construction work, the requests and objectives of the project stakeholders have been considered. Also, the boundaries of Water Users Associations have been studied and chosen with high accuracy by the Water Users Associations establishment consultant, taking advantage of data about the irrigation and drainage network.

Through joint meetings with the farmers and presentation of sufficient information to the stakeholders by the two consultants, more efficient participation has been achieved. As a result of cooperation between the two consultants, the designing consultant has been able to apply the comments of the farmers and land owners in the design works. This has resulted in correction and modification of alignment of some of the tertiary canals and drains. Consequently, at the time of construction of irrigation and drainage network, opposition by the farmers would be less and also during operation and maintenance, cooperation of the farmers will be increased and therefore there would be more effective operation and maintenance in the network and also irrigation efficiencies.

Résumé et conclusion

Durant les travaux de conception du réseau d'irrigation et de drainage (réseau agricole notamment) le consultant la conception a été pratiquement informés sur les demandes et commentaires des agriculteurs et des propriétaires de terrains situés dans la zone du projet de AILWMP sur l'alignement des canaux et des drains agricoles. Cela a été rendu possible grâce à la coordination et la coopération des utilisateurs d'eau consultant création Associations.

Avant tout travail de construction, les demandes et les objectifs des parties prenantes du projet ont été pris en considération. En outre, les limites de Water Users Associations ont été étudiés et choisis avec

une grande précision par le consultant des utilisateurs d'eau mise en place des associations, profitant de données sur les réseau d'irrigation et de drainage.

Grâce à des réunions conjointes avec les agriculteurs et la présentation des informations suffisantes pour les parties prenantes par les deux consultants, une participation plus efficace a été atteint. À la suite de la coopération entre les deux consultants, le consultant la conception a été en mesure d'appliquer les commentaires des agriculteurs et des propriétaires fonciers dans la conception des œuvres. Cela s'est traduit par la correction et la modification de l'alignement de certains des canaux tertiaires et des drains. Par conséquent, au moment de la construction du réseau d'irrigation et de drainage, l'opposition par les agriculteurs seraient moins et aussi pendant le fonctionnement et l'entretien, la coopération des agriculteurs sera accrue et par conséquent, il serait plus efficace le fonctionnement et l'entretien du réseau et d'irrigation efficacité.

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