COOPERATION OF USERS AND IMPLEMENTING AGENCIES IN IRRIGATION AND DRAINAGE NETWORK PLANNING AND OPERATION

COLLABORATION DES USAGERS ET DES AGENCES DE MISE EN ŒUVRE DANS LA PLANIFICATION ET L'EXPLOITATION DU RESEAU D'IRRIGATION ET DE DRAINAGE

Seyedalireza Hosseinzadeh Tabrizi[1] Gholamreza Fani[2]

ABSTRACT

Insufficient attention to the study, design and implementation of Irrigation & Drainage Networks (IDN) have made them inefficient. There is a lack of referral systems to IDN users and operators. This article deals with the titles and details of the modern IDN operation and maintenance requirements to be observed in their Feasibility, Final Design and Implementation stages to minimize the operation difficulties.

In this paper, some of the major issues such as realization of social and economic goals of IDN, Elaboration and updating instructions including organizational charts for IND operation and maintenance, qualitative and Quantitative monitoring, etc., have been discussed.

Key words: *Requirements, operation, implementation, network, irrigation.*

RESUME ET CONCLUSIONS

Une attention insuffisante à l'étude, à la conception et à la mise en œuvre du réseau d'irrigation et de drainage (IDN) donne lieu à l'inefficience. Il existe un manque de systèmes de référence aux usagers et aux opérateurs d'IDN. Ce rapport traite les titres et les détails de l'exigence d'exploitation et de maintenance de l'IDN moderne. Ces systèmes sont requis pour suivre les étapes de faisabilité, de conception définitive et de mise en œuvre pour minimiser les difficultés d'exploitation.

1 Ms in Hydraulic structures, East Azarbaijan Regional water Corp ,surface water operation group, P.O. Box 5156917737; Operation Expert , E-mail: alialireza@yahoo.com

2 Ms in irrigation and drainage, East Azarbaijan Regional water Corp surface water operation group, P.O. Box 5156917737; Chief of Group, E-mail:gholamreza_fani@yahoo.com

Dans ce rapport, sont discutées certaines questions importantes telles que la réalisation des objectifs sociaux et économiques des IDN, l'élaboration et la mise à jour des instructions, y compris les organigrammes d'exploitation, de maintenance et de surveillance qualitative et quantitative de l'IDN.

La cohérence, les effets de l'étude et les étapes de la direction de projets IDN, exigent plus que jamais, la connexion mutuelle des constructeurs et des opérateurs d'IDN et ce n'est pas possible à moins que les exigences pertinentes et les processus sont établis et la compétence humaine est réalisée.

L'expérience d'experts sur l'utilisation d'IDN dans les dernières années montre que pour atteindre les objectifs ultimes de la mise en œuvre d'IDN, à savoir l'utilisation optimale des ressources en eau et des sols, la conception unifiée et la tendance à l'étude, il est nécessaire d'avoir les étapes de la mise en œuvre et de l'utilisation.

Mots clés : *Exigences, exploitation, mise en œuvre, réseau d'irrigation.*

1. INTRODUCTION

By reviewing the present conditions and background of Irrigation and Drainage network (IDN) operation in the country, it is understood that, the operation and maintenance stage suffers great inefficiency. Major reasons of this are insufficient attention paid in the study, design and implementation phases to the operation and maintenance aspects of IDN installations and equipment. The present routine of IDN implementation is such that, those engaged in the construction are cutoff from the realities of the desired function of the constructed systems. There is a lack of a definite referral system to IDN final users and operators to get their feedback. Duly regarding the importance of the subject, elaboration and compiling some criteria is a must to meet expectations of IDN operators and users. Obviously, presence of IDN-operation oriented experts is the basic pre-requisite for executing proper guidelines in different stages of study and construction. Authors believe that, elaboration and enforcement of the requirements is a vital pre-requisite in favor of systematic changes from the present designer-implementer-oriented approach to a more operator-user-oriented approach. This shall in turn bring about a proper interaction between the makers and users of IDN, minimizing the difficulties in the long term operation period.

2. DETAILS OF OPERATION REQUIREMENTS IN PHASES 1, 2 AND 3 OF MODERN IDN PROJECTS

2.1 Phase-1: Feasibility Stage

2-1-1-Carrying out the social and economic studies and elaborating the Project Operation System in accordance with the approved Scope of Services.

2-1-2- Estimation of annual operation and maintenance costs and incomes

- Preliminary estimation of manpower costs for operation, maintenance and repairs.

- Preliminary estimation of machinery, equipment and materials costs.
- Preliminary estimation of miscellaneous costs.
- Preliminary estimation of IDN information systems.
- Preliminary estimation of IDN incomes.
- Estimation of overall annual IDN operation& maintenance costs and incomes.

2-1-3-Implementing the Pilot Project to determine the Crops Net Irrigation Requirements, Farm Efficiency and Finalizing the Crop Pattern

Design factors of IDN are of special importance, as they directly affect the irrigation programming and thereby, the operation and maintenance management of IDN. Failing to be precise in such factors, results in failing to provide the water needed by the plants in proper time and adequate quantity. Ultimately, the users lose their confidence in IDN management. For instance, using approximate figures for irrigation efficiencies and water requirement of crops results in an approximate and imprecise value of water demand by irrigated lands. In addition, it causes problems in enforcement of rules and regulations, entails difficulties in operation and maintenance, dissatisfaction of farmers with the water delivery and finally reduction in crop yield. To rectify these problems, the following are needed:

- Reviewing the conditions prevailing in different parts of the IDN (Soil texture, microclimate, land slope, etc.)
- Selecting the sample area(s)
- Adopting the best scientific and practical method for determining the crops net water requirement, farm

Irrigation efficiency, and reviewing the crop pattern, determining the orchard and agronomic species regarding the conditions in the sample area

- Procurement of required equipment, technical apparatus and staff for implementation of pilot project
- Elaboration of project timetable
- Implementation of pilot project in coordination with Jahad Keshavarzi (Agricultural Jihad) Organizations within the project area

2.2 Detailed Design Stage (Phase-2)

2-2-1-Realization of the goals of social, economic and operational system studies

- Using the results of social, economic and operational system studies in IDN design.
- Using the results of social, economic and operational system studies in attracting the attention and financial contribution of the beneficiaries

2-2-2-Programming a Staged Utilization of IDN

Considering the fact that, IDN are implemented and ready for utilization in lots, it is not advisable to postpone utilization of a finished lot until all other lots are ready to use. Therefore,

operation program of the finished lots must be elaborated in design phase supplying their software and hardware means so that as soon as an irrigation lot is ready, it is utilized with ease being followed by implementation and utilization of remaining lots.

- Gaining declarations from Jahad Keshavarzi Organization in respect of priority of water delivery to the lands covered by the IDN
- Foreseeing the hardware& software issues of the plan such as preparation of the IDN's physical body, equipments, staff, etc.

2-2-3-Elaboration of Operation and Maintenance Instructions (As per the Approved Scope of Services)

One of the challenges faced in the IDN is lack of or out-dated operation instructions. A review of IND in use shows most of the IND in the country operate at below-expected efficiencies. One of important reasons of this is lack of technical criteria for IDN operation and maintenance. Now, after years of IDN utilization experience and regarding the restricted water resources in the country, there is no doubt that, operation and maintenance instructions must be provided at the same time with the studies of the project clarifying the construction procedure, adequate organizational chart, required construction machinery, and other issues. To gain an executive version of the above, the following must be done:

- Using results of social, economic and operation management studies in elaboration of operation and maintenance instructions
- Employing results of social, economic and operational system in elaboration of operation and maintenance instructions

Note: Part of the instructions relating to IDN equipment, will be presented in Phase-3

2-2-4-Environmental Forecasting and Presentation of Qualitative and Quantitative Measurement Systems (Monitoring) within the limits of IDN

One of the issues most neglected is the need for qualitative and quantitative monitoring of water resources.

In general, quantitative monitoring system for water consists of collecting mode of the data on quantity of water delivered, skilled human force for water measurement and mode of data analysis.

Regarding the qualitative requirements of irrigation water and the environmental restrictions set forth in utilization stage of IDN, qualitative monitoring system of water also finds a special importance. Yield loss in crops, deterioration of soil quality, groundwater pollution, destruction of hydraulic structures due to biological and electrochemical processes are among the prominent examples of neglecting water quality issues.

- Making the necessary forecasting and planning to prevent environmental pollution within the IDN covered area
- Review of the IDN operation and maintenance instructions and extracting its monitoring means

- Review of monitoring means and supplying the needed equipment, human force and buildings

2-2-5-Proposal and Approval of Organizational Chart for the Operation and Maintenance Unit

Organizational chart for the IDN operation and maintenance and is among the basic requirements of IDN utilization neglecting which in design stage brings about great difficulties in IDN utilization phase.

In this connection, different variants like IDN operation and maintenance by the owner, conferring the same on Water Users' Cooperative (WUC), etc. should be compared and an organizational chart be proposed and approved for the most appropriate option regarding the particulars of the IDN.

- Elaboration of suggestible short term& long term charts for operation& maintenance unit as well as IDN Operators in case of conferring them the IDN management.

2-2-6-Final Estimation of Costs and Incomes of IDN Operation and Maintenance

IDN financial aspects in the operation and maintenance stage is one of the controversial issues of IDN utilization management, therefore, estimation of costs in the study phase on such utilization is a pre-requisite for any operational programming and organizational forecasting, etc. Cost estimations must be close to financial realities to be faced in the IDN utilization stage.

- Final estimation of human force costs subdividing it into operation, maintenance and repairs costs
- Final estimation of required machinery, equipment and construction materials costs subdividing it into operation, maintenance and repairs costs
- Final estimation of miscellaneous costs
- Final estimation of computerized information system costs
- Final estimation of IDN operation and maintenance annual costs
- Final estimation of IDN income
- Financial analysis of IDN costs and incomes and making the necessary suggestions for delegating the operation and maintenance to the beneficiaries.

2-2-7- Preparation of Digital and Analog IDN Cadastre Maps

To practice an optimal IDN management, it is necessary to determine the exact limits of the lands, to estimate the water needs of crops and to deliver the adequate quantity of water to the farmers. Unfortunately, in the IDN constructed many years ago, this problem blocks proper programming for water distribution. Among advantages of cadastre maps one may point to expediting the surface measurement of lands covered by the IDN, information o precise area of lands and possibility of checking such areas, and finally using them as a reference in the contracts concluded with the farmers resulting in issuance of fair subscription and water use bill and to collect price of the whole water delivered to farmers.

2-2-8- Predicting the necessary arrangements in the design pressurized pipes and open channels

- Possessing of pipeline and service road routes.
- Predicting water discharge pipeline routes and pathways needed to reach flood pathways and Rivers and ensuring that water discharge routes are open.
- Predicting structures that are suitable for pressure decreasing near basins of discharge pipeline to prevent land degradation in times of discharging.
- Considering type of soil, ground water level, soil minerals in terms of corrosion in pipes at designing of pressurized pipes for considering the necessary arrangements to protect them and the possibility of monitoring during operation.
- Determining the standards required for pipelines and service roads crossing with other facilities such as electricity and telecommunications cables, roads, and railways.
- Predicting safety and protection Installations against floods, including irrigation network's emergency discharging Installations.
- Considering intense climatic changes such as extreme heat and cold in the design of irrigation and dependent water Installations

2.3 Implementation Stage (Phase-3)

2-3-1-Designing the Communication and Telemetry Networks, Supplying the Fixed and Mobile Equipment, Logistic and Safety Means, Including Spare Parts, Warning Signs, Insurance, etc.

- Supplying the spare parts for pumping stations, gates, main regulators, and other IDN installations
- Supplying telecommunicate equipment like telephone lines, cars and operation& maintenance buildings radio systems and warning signs.
- Conclusion of life and installations insurance contracts.

2-3-2-Employment, Appointment and Training of Operation and Maintenance Personnel

To practice a national sustainable IDN operation and maintenance management human force capacity building is unavoidable. Unfortunately, the IDN studied, designed and constructed by spending immense costs, are utilized by spending sums far below standard. A survey of educational level of operation personnel reveals that, they are either of low education or lack the required skill. These two factors are of crucial effect on quality of operation services. Defining the activities to be fulfilled in IDN utilization, human force required by each section, compiling details of jobs to be performed by these personnel and qualifications to be met to occupy each post are necessary. Training and its programming must be thought of as a routine part of operation& maintenance personnel. Basically, these personnel should be in connection with the planners of training courses in a coordinated and dynamic organizational system to realize the training goals. Training courses aim at the establishment of an efficient instruction system and need expert and skilled human force in two stages. First, planning the

training courses using committed specialists and second, performing the planned training programs in a practical mode.

- Elaboration of timetable for recruitment of operation and maintenance staff
- Performing the recruitment program
- Appointment of operation and maintenance staff
- Making list of the necessary training courses for the staff regarding their organizational duties
- Elaboration of human force training program taking into account the defined needs
- Performing the staff training program.

2-3-3-Forming the IDN commissioning Committee

- Determination of formation date of commissioning committee (When 50% physical progress of the first lot is attained)
- Preparation for holding the committee meeting with the presence of representatives from Regional Water Authority Utilization Deputy and Plan& Development Deputy, Provincial General Administration of Water Affairs, Project Manager, and the Expert in Charge of IDN Operation)
- Gaining the list of representatives from their organizations and issuing them the appointment notice.
- Compiling the committees scope of duties and gaining opinions of Utilization Deputy and Plan& Development Deputy in this respect
- Elaborating the job performance chart of the committee.

2-3-4-Forming the Project Technical Documents Archive

- Collection and classification of all design drawings, as built drawings and general layout of the IDN (In analog and digital formats)
- Preparation of documentation list of the drawings and documents
- Supplying the adequate software and hardware for digital documentation of drawings and other Information and commissioning the same (As far as possible)
- Determining the shortcomings of the documentation and making effort in removing them
- Estimating the required limits (the land strips to be kept free of installations, etc., to be used for IDN

  Servicing) and preparation of information booklets for land acquisition
- Review of documents and drawings of IDN installations and equipment and extracting their specifications
- Preparation of identity booklets including all the information on IDN installations and equipment
- Presenting the adequate plan and performing the documentation in different study and implementation stages.

2-3-5- Equipment of IDN with Measurement Device and Quantitative measurement of water is one the major tools in optimizing irrigation water use, and improvement of its efficiency basically depends on exact measurements. Selecting the proper type of measurement structure must be done considering the measurement precision, construction costs, structure protection mode, particular technical issues concerning the IDN utilization, and physical conditions of installation place. Usually one or some of the mentioned points are neglected in selecting the measurement structure type. It should be reminded that, design and installation of these structures must be done duly regarding the requirements of IDN utilization time. For instance, type of measurement structures may be different in a particular time from other times depending on policies of water sale to farmers, when water sale is practiced by volume; more precise structures are to be employed.

Water Flow Controllers, Ensuring their proper Calibration, and Presenting the Discharge-Gage Tables (Rating Curves)

- Identification of sites, structures and necessary equipment for water flow measurement based on Operation instructions and their classification.
- Elaboration of drawings for implementation of water flow metering structures.
- Implementation of water flow metering structures.
- Presenting the final rating curves for each flow metering structure.
- Finalization of rating curves in the IDN tentative operation.

2-3-6- Explaining Measurement, Testing and Commissioning Methods of IDN Installations and Equipment Measurement, testing and commissioning of IDN installations and equipment is a pre-requisite to guarantee a sustainable and logical utilization of the IDN. Presenting the installations testing and commissioning instructions by the consulting engineers is one of the requirements for project utilization.

- Compiling and classification of the documents pertaining to IDN installations and equipment.
- Preparation of booklets including the information for commissioning of all kinds of IDN installations and Equipment (As per the classification made).
- Holding common meetings with the Utilization Deputy on commissioning methods of IDN installations and equipment.
- Priming the hydraulic installations like canals, gates, regulators, siphons, flumes, spillways, etc and removing their probable defects and re-commissioning them.
- Visiting the IDN pumping stations if any, testing and commissioning them.

2-3-7-Construction and Equipment of Operation and Maintenance Buildings

- Determining the site, size of roofed areas needed, and elaboration of the executive drawings, emphasizing the incorporation hall
- Implementation of the buildings and equipping the same
- Realization of green space.

2-3-8-Elaboration of Mathematical Model of Water Intake Mode and Quantity and in General Water Distribution in the Irrigation Network

- Review of different mathematical irrigation network water distribution models
- Selection of the best-fit model
- Design of mathematical irrigation network water distribution
- Explanation and documentation of application of the mathematical irrigation network water distribution Model.

2-3-9-Design and Presentation of Computerized Subscribers Affairs System

Today, with the advancement of industries and technology, providing the facilities of service or product presentation by organizations and companies is among most important decisions to be made and several internal and external organizational factors affect it. Most of organizations addressing many subscribers, who have to issue bills and pursue their collection, and keep the subscribers' accounts, have designed sophisticated and large systems and avail themselves of the strong collection levers. Subscribers Affairs is one the most important parts of IDN operation and maintenance management. Many of utilization management activities are in connection with this section directly or indirectly and it is clear that all managerial measures are influenced by the discipline prevailing in Subscribers Affairs.

Manual or semi-mechanized systems employed in Subscribers Affairs of some of the IDN in the country, do not meet the present needs of operation and maintenance management, and regarding their time-consuming nature, failing to produce clear and up-dated financial statements, difficult information retrieval for other utilization management sectors like IDN manager, entails great difficulties and dissatisfaction of farmers due to repeated reference. Therefore, establishing a mechanized system in favor of IDN management seems necessary.

- Extraction of subscriber's records and information
- Elaboration of a comprehensive software system of subscriber's affairs adaptable to Geographic Information System (GIS).
- Estimation and supplying the hardware required for realization of computerized subscribers affairs
- Commissioning of computerized subscribers affairs system and removing the probable defects.
- Issuing the operation licenses

2-3-10-Realization of GIS

Today, strong Decision Support Systems (DSS) have brought about vast facilities for different management complexes including that of IDN. Among these systems one may point to GIS that enjoys the parameter of place and this advantage, when mixed with other information and analysis parameters, realizes a comprehensive database required by the IDN operation and maintenance management.

- Clarifying the expectations and short term and long term objectives of GIS realization

- Realization of GIS and backing up the same for at least one year after full operation of the IDN.

2-3-11-IDN Tentative Operation

- Announcing the tentative operation timetable to the pertinent authorities at least six months in advance
- Supplying the required tentative operation means and fulfilling the coordination with the Utilization Deputy of the Regional Water Authority
- Presentation and performing the tentative IDN operation program
- Documentation of defects and shortcomings enfaced in the course of tentative operation and presenting the solutions to remove them

Note-1: Tentative operation of the IDN shall be carried out at the discretion of the Regional Water Authority Plan& Development Deputy

Note-2: Costs of operating the IDN will be supplied out of the project credits until the IDN operation attains adequate income.

2-3-12-Completion and Updating the Operation and Maintenance Instructions

- Completion and preparation of the final operation and maintenance instructions
- Collecting the opinions of the pertinent bodies on the draft operation and maintenance instructions
- Finalization of the operation and maintenance instructions and submitting it to for approval and

Notice: Modification and updating the IDN operation and maintenance instructions at the end of tentative Operation.

Note: Should the tentative operation be carried out in more than one stage and in different times the updating Task should be done by the consulting engineers at the end of each stage. The consultant should also wrap up and present the finalized operation instruction after the fully irrigated operation is realized.

2-3-13-Updating the IDN Cadastre Maps

2-3-14-Presentation of Computerized System of Management Evaluation of IDN Operation and Maintenance

It is clear that, aging and inefficiency of elements in any system, takes place gradually. IDN too, lose their efficiency by time. System users, executive personnel, and project managers in particular, get accustomed to it and do not feel the accumulation of changes and their adverse effects on the IDN functioning. Evaluation of the system operation prevents this negligence and warns the use at any time about disability, inefficiency, low precision, and outcomes of any deficiency in the system.

- Presenting the program of management evaluation mode.
- Selecting the base irrigation network as a reference of IDN management comparison
- Defining the evaluation indices
- Allocating importance factor for the indices
- Evaluation of IDN management in the fully irrigated operation period by the pertinent consultant.

2-3-15-Supporting the Water Right Users Guilds

Partnership is a free activity with awareness and sense of responsibility. Man is deemed axis of development. It goes without saying that his partnership in the affairs relating to him is of great importance. Due to inefficiency of the government-managed IDN, and limited partnership of users in their operation and maintenance, and disability of many governmental organizations in collecting water fees, resulted in the late 1980's and at the global level in conferring the irrigation management on water users as a world movement. This reduced role of governments in IDN operation and maintenance in return for increasing role of local water users' guilds. Supporting the farmers to undertake responsibility of IDN operation and maintenance is an activity with different cultural, economic, social and political aspects and considering all such aspects is a requirement for attaining success in this area.

- Identify the present conditions of water right users' guilds and their difficulties
- Determining the guilds prospective support plans
- Presenting the action plans for guilds support such as training and extension programs
- Performing the action plan.

2-3-16-Preparation of Operation Contract Documents

Note-1: Operation contract documents shall be prepared if there is the possibility of delegating the IDN management to the water right users guild.

Note-2:-In case delegating the IDN management to the water right users' guild is not possible, the Bid Documents will be prepared and the job will be referred to a contractor according to the routine of the Regional Water Authority.

2-3-17-Determining of financial resources required during operation

2-3-18-Delivery from design and construction Unit to operation unit according to existing laws and relevant process.

3. CONCLUSIONS AND RECOMMENDATIONS

Coherence and effects of different study and executive stages of IDN projects, demands more than ever, the mutual connection of IDN builders and operators and this is not possible unless the pertinent requirements and processes are compiled and human force capacity making is realized. Experts' experience on the IDN utilization in the recent years shows that,

to attain the ultimate goals of IDN implementation, namely the optimal utilization of water and soil resources, unified outlook and propensity in all study, implementation and utilization stages is a must.

To realize the operation and maintenance requirements mentioned in this article, following suggestions are made:

- Recruitment and training of utilization experts to pursue performance of operation and maintenance requirements and elaboration of duties list, and relation mode of such experts with the pertinent units
- Compilation of the required processes in the framework of organizational procedures for realization of operation and maintenance requirements and clarifying their execution methods
- Continued supervision on performance of operation and maintenance through creating a managerial and logistic mechanism
- Elaboration of periodical reports by responsible utilization experts in connection with the furtherance of operation and maintenance requirements enforcement in each of the projects
- Preparation of checklist for the delivery of the whole project by Design and Development Deputy of the Regional Water authority to its Utilization Deputy. Such a checklist will be known as a delivery reference and used by the Delivery Commission.

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