ENERGY SAVING IN PRESSURIZED IRRIGATION NETWORKS
(LEYLANCHAY PRESSURIZED IRRIGATION NETWORK)
ECONOMIE D'ENERGIE DANS DES RESEAUX d'irrigation sous pression
(RÉSEAU LEYLANCHAY d'irrigation sous pression)

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ABSTRACT

Iran is an aired and semiarid country with great need to utilize and control all its water resources. Rapid population growth mainly in the urban areas during the past few decades in turn raised the need for cultivating extra lands, as well as, directing production patterns towards high water consuming products. Water scarcity is one of the most prominent issues of discussion worldwide concerned with sustainable development, especially in the arid and semi-arid areas. According to weather conditions and arid and semi-arid climate in the most parts of Iran, water has a major role in agricultural economy.

Soil and water resources of dry lands can be managed to sustain the productive capacity of the land and to better cope with water scarcity.Therefore, optimal use of water and applying modern irrigation techniques is inevitable.

On the other hand, in pressurized irrigation methods, water is supplied for plant in trickle and sprinkler irrigation systems. Energy supply is essential be provided by the pumping stations and in certain circumstances by the height difference between the source and location of water supply intake.

In this paper, energy usage methods for providing requirement head for Leylanchay pressurized irrigation network are studied in two cases

1) by pumping stations
2) by Gravity Pressurized Irrigation Delivery System and using the height difference between Leylanchay reservoir dam to the beginning of pressurized irrigation network

In the first case, water is released from dam to downstream in the river. After that, by constructing a diversion dam, water is conveys to a pump station and pump station delivers water with required pressure to main pipeline and to the beginning of farm unit in Leylanchay pressurized irrigation network.

In the second case, GRP pipe - line with 1400mm diameter and 8 kilometer length delivers water from reservoir dam to main and sub - main pipe - lines.

The main pipeline and sub - main pipelines supply water to the beginning of farm unit with suitable pressure.

An understanding of the costs of and potential returns to irrigation provide growers with better information to use in determining whether to make the large investment decision. Two cases were evaluated on 4000 ha fields in Leylanchay irrigation and drainage network. This study focused on an economic analysis of irrigation costs,

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both ownership and operation, using partial cost budgets of each cases. The study highlights key differences in system design, cost and input requirements to provide stockholders with the background to choose a system that gives the best returns for their operation.
A system's operating pressure affects the cost of pumping water. Higher pressure makes irrigation more expensive.
In this study, annual operation expenses i.e fixed and variable costs were estimated for each case.
This paper presents and compares total energy and water use of irrigation systems with or without pumping station with the gravity delivery system using a case study in the Leylanchay pressurized irrigation network in East Azerbaijan province in Iran. It is concluded that using the height difference between Leylanchay reservoir dam to the beginning of pressurized irrigation network consumes less energy with more water savings than using centralized pumping station. It has better irrigation scheduling, seepage and evaporation reductions, less operation and maintenance costs, energy price bargains, and less labor.

1. INTRODUCTION

In pressurized irrigation methods energy supply is essential, this energy can be provided by the pumping station and in certain circumstances can be provided by the height difference between the source and location of water supply intake.

In Lelanchay pressurized irrigation network, minimum and maximum heights of watershed basin from Sea level are 1307 and 1460 m respectively. In this paper, providing require head for pressurized irrigation network are studied in two cases in order to replacing an open ditch irrigation delivery system and pumping stations with buried GRP and Polyethylene pipelines to distribute gravity pressurized irrigation water.

1) by pumping stations
2) by gravity pressurized Irrigation delivery system and using the height difference between leylanchay reservoir dam to beginning of pressurized irrigation network

For this purpose, two alternatives are defined for leylanchay irrigation and drainage network.

2. BASIC INFORMATION

The Leylanchay catchment area is located between 46°, 08' - 46°, 18' (E.long) and 37°, 07° - 36°, 55° (N.lat).

2.1. CLIMATOLOGY

Average annual precipitation of Leylanchay watershed basin is about 370 mm.
The different climatologically parameters are presented in the table.1

Table 1. climatologically parameters

Average annual precipitation	307 mm
Average annual temperature	12°C
Average annual relative humidity	61%
Average annual evaporation	1485.3mm
Average annual potential transpiration	1188.0mm
Average annual wind speed	2.5 m/sec

2.2. DAM PROPERTIES

The reservoir dam of Leylanchay is located at west northern part of Iran and at the west southern part of Eastern Azarbaejan Province.

Table 2. leylanchay dam properties

Dam Type	Earth fill with impervious core
Crest and river bed EL.	1495,1432
Crest Length & width	364,12 m
Volume of material in dam body	2.5 million m^3
Height of Dam from foundation & river bed	70, 63 m

2.3. IRRIGATION SYSTEM

Irrigation and drainage network of Leylan area, has a gross area of 7000 ha, from which 4000 ha are for new development and the remaining area (3000 ha) is regarded as water right provision.
The only resource of water for provision and development area of water is Leylan dam which is located 23 km away from Leylan town.
Because of rough topographic condition of Leylan area, Irrigation will be utilized by using pressurize irrigation systems such as sprinkler and trickle Irrigation systems.
The suggested cropping pattern for Leylan project is consisted of 80% annual crops (sprinkler Irrigation) and 20% orchard (Trickle Irrigation).

2.4. PROJECT DEVELOPMENT ZONES

The Leylan region with regarding the limitation of soil surveying, natural side effects and the boundary of villages possessing is divided into 9 developmental zones. The general data of the above-mentioned zones are presented in Table.3

Table 3. The general data of developmental zones

No	Name of village	Gross Area (ha)
1	Tazeh Kand	341
2	Jogalou	786
3	Lotfabad	236
4	Hassan abad	350
5	Leylan	856
6	Abdol abad	115
7	Gandehar	612
8	Gareh Khezr	659
9	Hossein abad	195
Total		4611

3. IRRIGATION AND DRAINAGE ALTERNATIVES

Two alternatives for leylanchay irrigation and drainage network are identified for this evaluation.

3.1. Alternative A

Joghaloo diversion dam was designed on leylanchay river near joghaloo village, downstream of leylanchay reservoir dam.

This diversion dam diverts all or a portion of the flow of a leylanchay river into a main canal (FC) and pumping station no1. (figure.1)

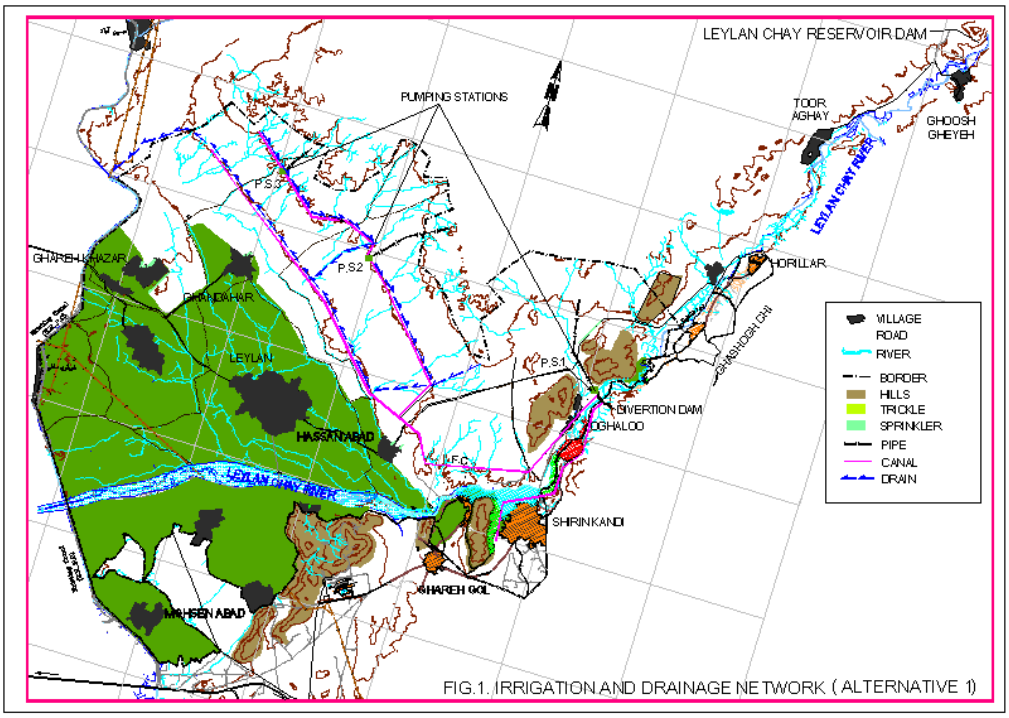

FIG.1. IRRIGATION AND DRAINAGE NETWORK (ALTERNATIVE 1)

Pumping stations no2 and no3 deliver irrigation water from main canal into pressurized irrigation system.

In this alternative, pumping stations supply pressure head and irrigation water for 1550 Ha of sprinkler and trickle irrigation system farms. The water is then applied to crops through sprinkler systems, typically moving sprinkler irrigation.

Surface irrigation used for 2450 Ha of project area.

3.1.1. ALTERNATIVE A COMPONENTS

3.1.1.1. Pumping stations

Table.4 shows characteristics of main pumping stations in alternative A

Table. 4 characteristics of main pumping stations

	Pumping station No1	Pumping station No2	Pumping station No3
Discharge(cms)	0.458	0.333	0.417
Conveyance pipe length(m)	850	1000	1300
Pumping height(m)	53	53	87
Required Pump No.	3+1	2+1	3+1
Required Energy(kw)	450	300	610

3.1.1.2. Diversion dam
Joghaloo diversion dam was designed on leylanchay river near Joghaloo village, downstream of leylanchay reservoir dam.
Diversion dam specifications are:
Spillway type: concrete ogee crest
Spillway length: 40 m
Design flood discharge: 203 CMS
Height: 8.5 m
3.1.1.3. Others
Total concrete canal length: 35 km
Total earth drain length: 20 km

3.2. Alternative B

In this alternative, conveyance pipe (CPL), delivers water directly from Leylanchay reservoir dam to pressurized irrigation network and pressure head for sprinkler and trickle irrigation farm systems is supplied by height difference between leylanchay reservoir dam to beginning of pressurized irrigation network. (figure.1)

3.2.1. ALTERNATIVE B COMPONENTS
3.2.1.1. Gravity conveyance pipe

Gravity conveyance pipe specifications are:
Length: 9 km
Diameter: 1400 mm
Type: GRP
Nominal pressure: 6 bar

3.2.1.2. Total main pipes
Main pipes specifications are:
Length: about 62 km
Diameter: from 125 mm to 1400 mm
Type: GRP and HDPE
Nominal pressure: From 6 bars to 10 bar

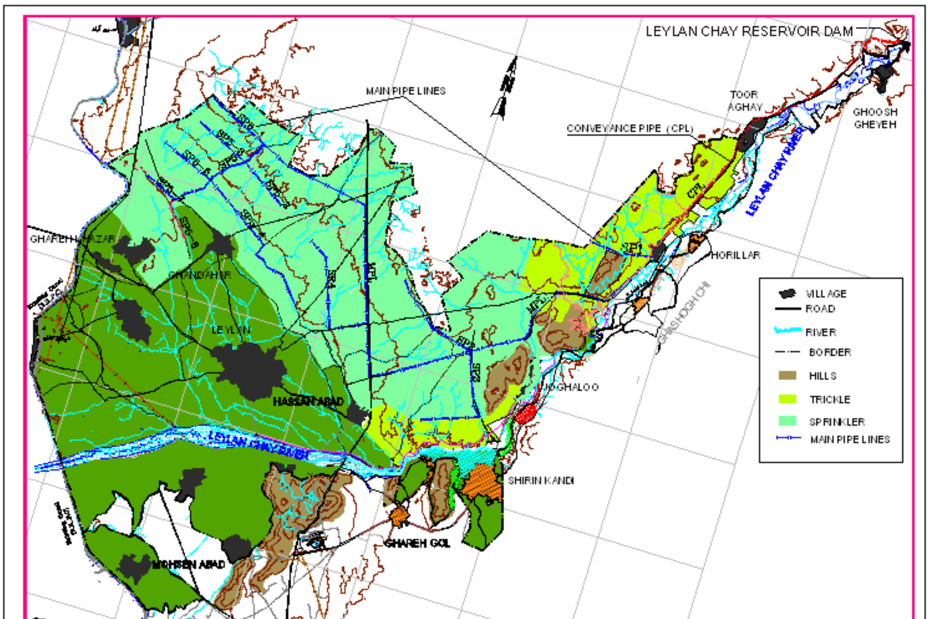

FIG.1. IRRIGATION AND DRAINAGE NETWORK (ALTERNATIVE 2)

4. SUMMARY AND CONCLUSIONS

Irrigation and drainage network in alternative B includes the construction, operation and maintenance of GRP and Polyethylene pipelines that provide for the delivery of gravity pressurized irrigation water to approximately 4000 Ha surrounding Leylan plain, eliminating most of the need for pumping powered by electric motors. Water would only be drawn from the pipe when irrigation is required, eliminating overflow to the Leylanchay River. This network would eliminate about 90% of the water seepage loss from the canals and would eliminate the need for approximately 1,400 KW from electric pump motors.

Pipelines are slowly gaining acceptance as a viable alternative to open canal as a means of distributing irrigation water.

Land tenure problems can be lessened to the point of elimination with pipe line, especially when a distribution system has to be routed through existing farmland having small, irregular and fragmented holdings. A pipe underground occupies no land that can be used for crops, nor does it interfere with land boundaries. Management losses, the biggest single contributor to canal water loss and low efficiencies, are potentially close to zero with closed or semi-closed pipeline.

Flexible delivery systems, in which the farmer is encouraged to take water as and when he requires it, are achievable with a pipeline but far more difficult with open canals.

Irrigation and drainage network costs in two alternatives are presented in table.5 and table.6

Table 5. Irrigation and drainage network Costs-with diverted dam alternative A

No.	Note	Cost (M.RLS)
1	Main network and related structures	50506
2	Joghaloo Diversion Dam costs	18458
3	sub main network with farm pumping stations	67702
4	Leveling costs	24350
5	Main pumping stations Costs	22605
6	Row 1 to Row 4	183622
7	Total with coefficients	290985

Year: 2006 Million Rials

Table 6. Irrigation and drainage network Costs-without diverted dam alternative B

No.	Note	Cost (M.RLS)
1	Main network and related structures	85500
2	sub main network	94500
3	Row 1 to Row 2	180000
4	Total with coefficients	285246

Year: 2006 Million Rials

Table.5 and 6 show that, total cost of pressurized irrigation system in alternative B is less than alternative A and gravity pressurized Irrigation delivery system eliminates the need for approximately 1,400 KW from electric pump motors and save electrical energy about 3.1 MWH.

5. REFERENCES

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