Economic Incentives & Water Demand Management

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Sultan Qaboos University Water Research Center
Ministry of Regional Municipalities, Environment & Water Resources

TRADITIONAL WATER HARVESTING SYSTEMS

AND

MANAGEMENT IN WADI HADHRAMOUT

YEMEN

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ABSTRACT

Wadi Hadhramout , a key area for agricultural production , is located in Southern East of Yemen . Yemeni civilization had prospered in an area where water is the most limiting factor . Traditional methods of water resources control , storage and delivery including soil erosion prevention , rainwater harvesting , and irrigation

and drinking water-delivery structures, some of which have survived for many centuries. This indigenous knowledge has neither been well documented nor scientifically analyzed in order to utilize it for supporting the sustainable development of rain-fed runoff and spate irrigated farming.

In some areas the water management and water rights are known as the Habits (ALAADAT) which other areas sometimes use these habits to solve unprecedented problems in water management and water rights in these areas .

A long experience in water harvesting and management as well as the maintenance of the irrigation structures systems are nearly to be disappeared and no record is known for this experience . During the period 1970 - 1990 of the Communist Regime in the Southern Governorate , the agricultural land was taken from its owners and distributed to others , thus participated in the negligence of the traditions . After the Unity the lands were returned to its owner. Also after the unity water acompanying oil add other problems.

It is of most impotant to find out the water management experienced in the water harvesting agricultural areas and test the possibilities to get lesson from it to improve water harvesting .

1 – INTRODUCTION

Yemen has a geographic area of (550,000)km2 and a population of nearly 20 million , more than 25% of the country `s total population is living in a widely scattered rural locations depending on agricultural and fisheries .

Scant natural resources and a harsh climate severely limit the country `s agricultural potential . Yemen `s climate and landscapes is unique compared to other countries in the Arab Peninsula .

Wadi Hadhramout , a key area for agricultural production , is located in Southern East of Yemen , and physically isolated by mountains and desert . Yemeni civilization had prospered in an area where water is the most limiting factor . Water harvesting and conservation have been developed and practiced for many centuries . Due to its location and the large differences in elevation and features of its mountainous area the Republic of Yemen (ROY) intercepts varying amounts of rainfall. Since early history , farmers have realized that agriculture is only possible by replenishing the plant available soil-water from limited and difficult to control water resources . Often , crop production is not possible under solely rain-fed condition and therefore runoff water harvesting and conservation are crucial for successful cropping.

Traditional methods of water resources control , storage and delivery including soil erosion prevention , rainwater harvesting , and irrigation and drinking water-delivery structures, some of which have survived for many centuries. These structures, being long lasting , indicate that advanced procedures had been followed in their design and construction .With their traditional knowledge , the farmers of ancient Yemen must have understood and analyzed data relating to rainfall , runoff , soils and climatic conditions associated with land and water resources management.

This indigenous knowledge has neither been well documented nor scientifically analyzed in order to utilize it for supporting the sustainable development of rain-fed runoff and spate irrigated farming The Wadis from upstream wadi Hadhramout are :-

1 - Wadi Doaan (Wadi Laiman ,Wadi Laiser , and Hajrain)

2 - Wadi Alain (Sudbeh , Hourah , Almokhainig)

3 - Wadi Amed (Amed , Horaidhah , Aandel)

4 - Wadi Rakhyah

5 - Wadi Hainen

6 - Wadi Sur (Shibam)

7- Wadi Bin Ali .

8 - Wadi Aedim

In some areas the water management and water rights are known as the Habits (ALAADAT) which are not documented from which other areas sometimes use these habits to solve unprecedented problems in water management and water rights in these areas . Some (Aadat) habits Known in Wadi Hadhramout are known as Follow from upstream Wadi Hadhramout :-

1- Aadat Alhajrain

2- Aadat Gabdhain

3- Aadat Sudbeh

4 - Aadat Aandal

5- Aadat Ghailan

6 - Aadat Jomaileh

7 - Aadat Shibam

2 – **METHODOLGY**

This study has been reached by reviewing the litreture in hand about Wadi Hadhramout , with field visits by the authors and personal experience and observations . Consultancy works done by authors in Wadi Hadhramout and other Yemen regions .

3- THE PROBLEM

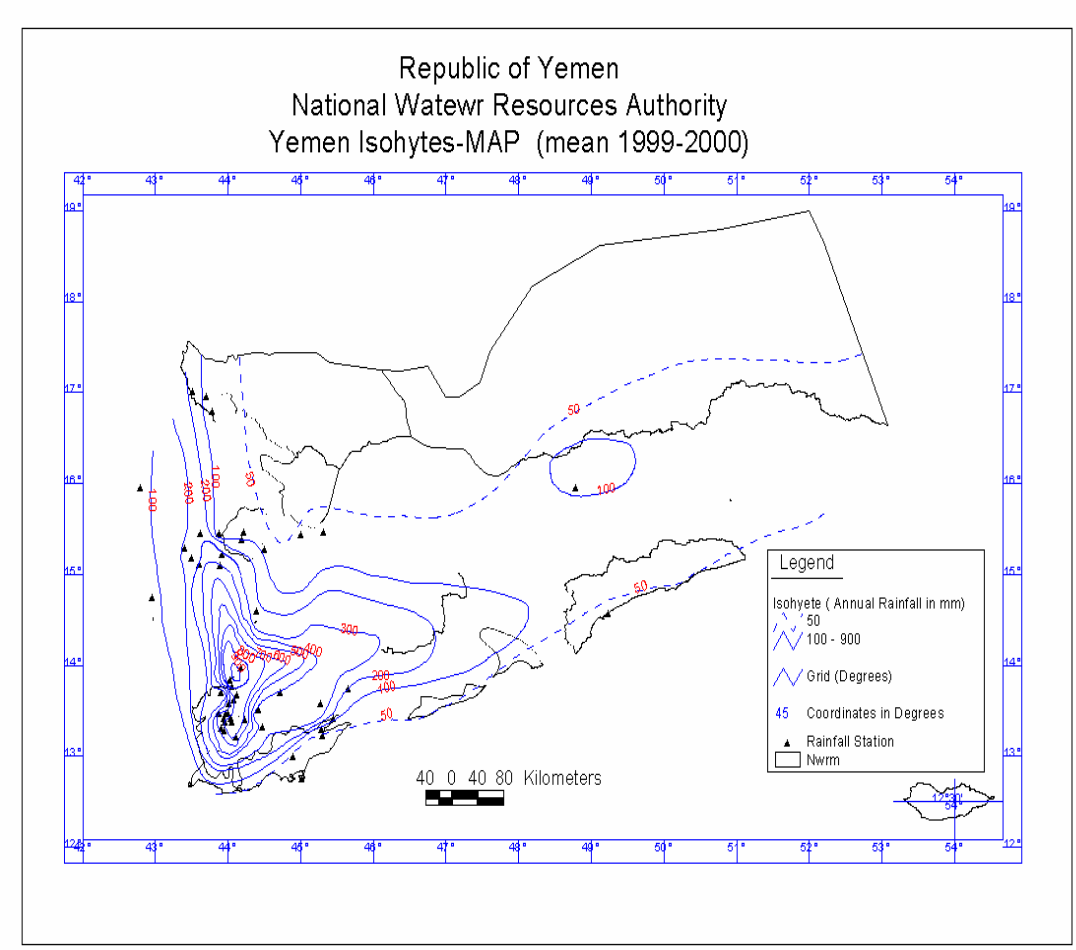
A long experience in water harvesting and management as well as the maintenance of the irrigation structures systems are nearly to be disappeared . Few or no record is known for this experience in many regions . During the period 1970 - 1990 of the Communist Regime in the Southern Governorates , the agricultural land was taken from its owners and distributed to others , thus participated in the negligence of the traditions if not add new problems . After the Unity the lands were partly returned back to its owners. A new problem started with the oil production in Masilah (1993) when the oil produced acompany water water with varing quantities .

4 – **WATER RESOURCES IN WADI HADHRAMOUT**

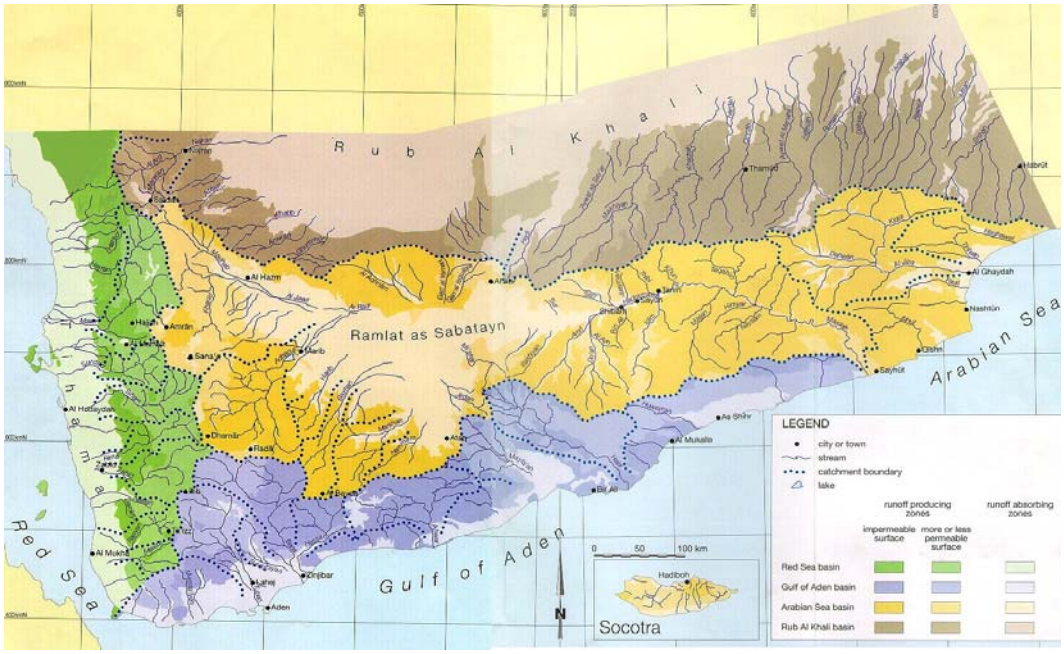
4 – a - Surface Water

4-a-1- Rain water:

The rain source is mostly the isolated comulative clouds , this phenomina coused the rain fall on different isolated places which caused floods in some branches of wadi Hadhramout while other branches are dry . If it happened the clouds and then the rain spread over different branches samiltaniously the floods from different branhes accomulate and caused sever damage as it happened in the seveties .



Wadi Hadhramout catchment area recieves main anual rainfall of a density ranges between 50 mm and 300 mm , the catchment layes over mountens in the west and far north west ,deseret in northwest and wadi course and tributries in the north and south platou . The catchment area is the largest in the Arab Peninsula .



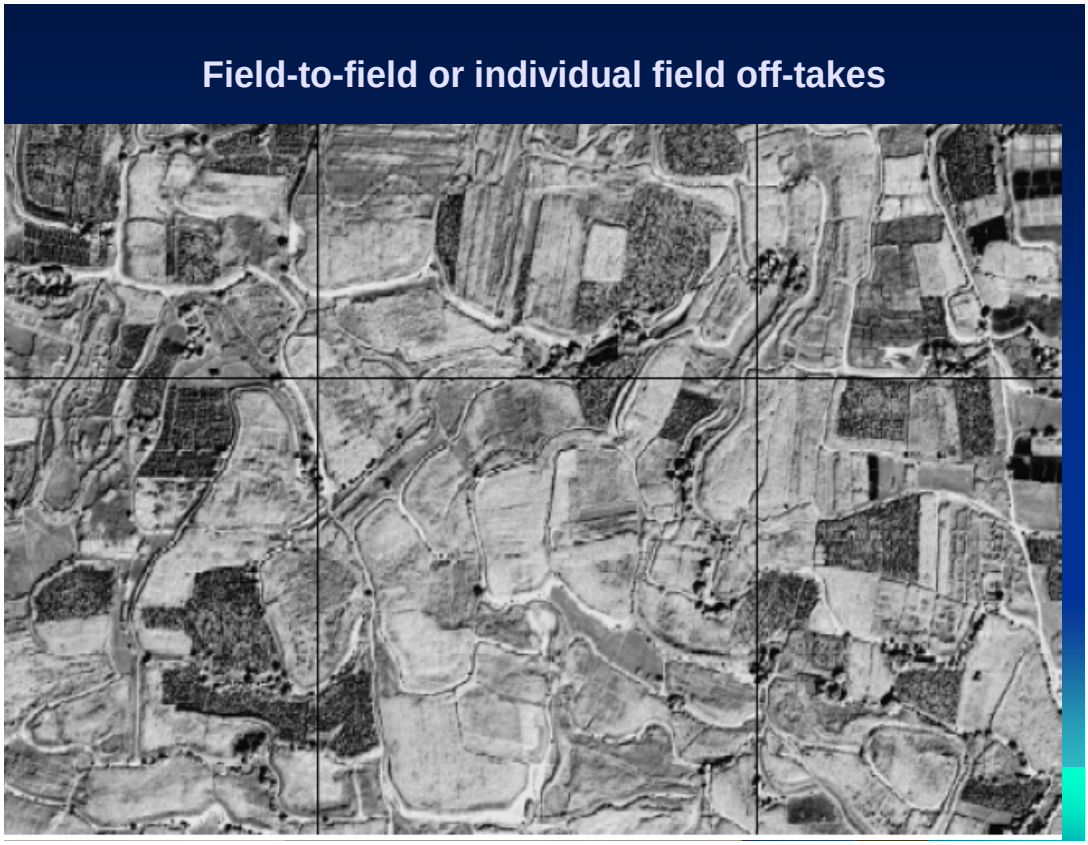
The Wadi characteristic is unic in the world . In all wet or dry water courses the size of the wadi course at the bigining of the wadi is narrow and enlarged to the maximum size at the end which is not the case in wadi Hadhramout

A long the wadi course there are many tributries / branches counted more than fifty just down stream of Tarim Town.

4 - a - 2 – Floods

The rain source is mostly the isolated comulative clouds , this phenomina coused the floods in some branches of wadi Hadhramout while the others are dry . If it happened the clouds and then the rain spread over different branches the floods from different branhes accomulate and caused sever damage as it happened in the seveties .

Spate irrigation is an ancient form of water management, involving the diversion of flashy spate floods running off from mountainous catchments, using simple deflectors of bunds constructed from sand, stones and brushwood on the beds of normally dry wadis. Flood flows, usually flowing for only a few hours with appreciable discharges, and with recession flows lasting for only one day to a few days, are channeled through short steep canals to bonded basins, which are flooded to depths of 0.5 m or more.



Subsistence crops, often cereals, are planted only after irrigation has occurred. Crops are grown from one or more irrigations using residual moisture stored in the deep alluvial soils formed from the sediments deposited from previous irrigations.

This type of agriculture is very risk-prone and requires high levels of co-operation between farmers to divert and manage the distribution of flood flows .

The Hadhramis community had ran the system, until the period 1970 - 1990 of the Communist Regime in the Southern Governorate , the agricultural land was taken from its owners and distributed to others , thus participated in the negligence of the traditional system since then spate irrigation system in Hadhramout is started degradation, **the damage to the irrigation infrastructure are from absent of maintenances** and poverty has increased. Most households in spate-irrigated areas are

poor, with a per capita income generally less and in some cases far less, than US$1 per day. Estimated net household revenues derived for some spate-irrigated systems [1] Traditional intakes are constructed from locally available materials. Large embankments (diversion bunds) are constructed with animal powered scraper boards, but this type of equipment cannot easily handle coarse gravel and cobbles. Diversion bunds are found on lower reaches of wadis, where the bed slopes, bed material sediment sizes and the flood peak discharges, are all lower than at the mountain fronts.

[1] Al- Hebshi Mohamed Abdul-Rahman Hashm**,** THE CYCLE OF POVERTY IN YEMEN**,** Sana'a , 2004

The Average annual surface flow in Wadi Hadhramout is shown in the following table :-

Catchment Area (km2)	Mean Annual precipitation (mm/year)[a]	Average Annual surface flow (Mm3)[3]	Rechareg (Mm3)/year[3]	Net Abstraction (Mm3)/year[3]
46075	54	161	180	144

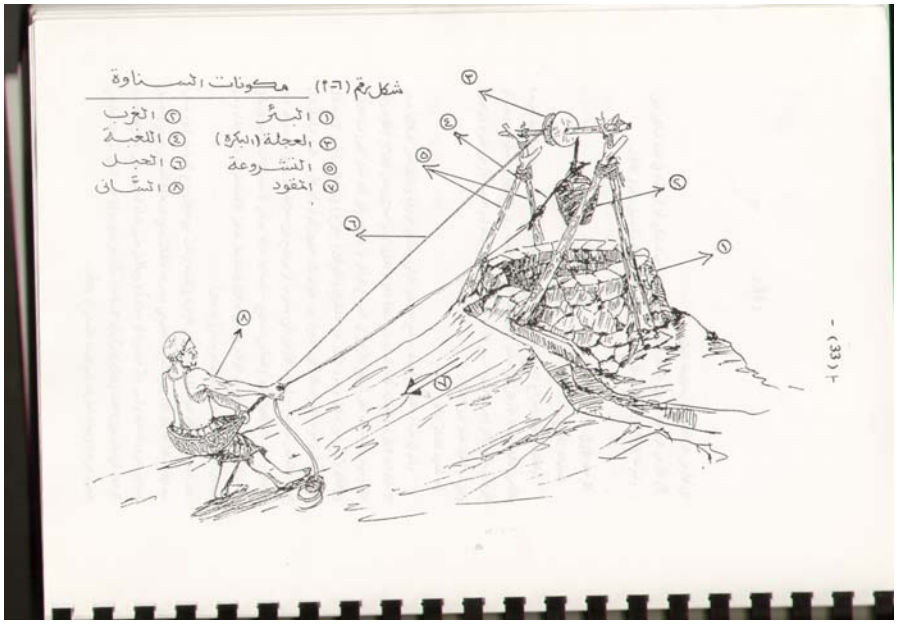
In Wadi Hadhramout branchs the wadi flood is intercepted to divert the flood water for irrigation using various types of diversion structures

Farmer improved spate irrigation structures in the Hadramawt in Yemen
Diversion Weir with a stepped downstream face

through canals to the fields . Some structures such as drop structures , wiers ,controle structures

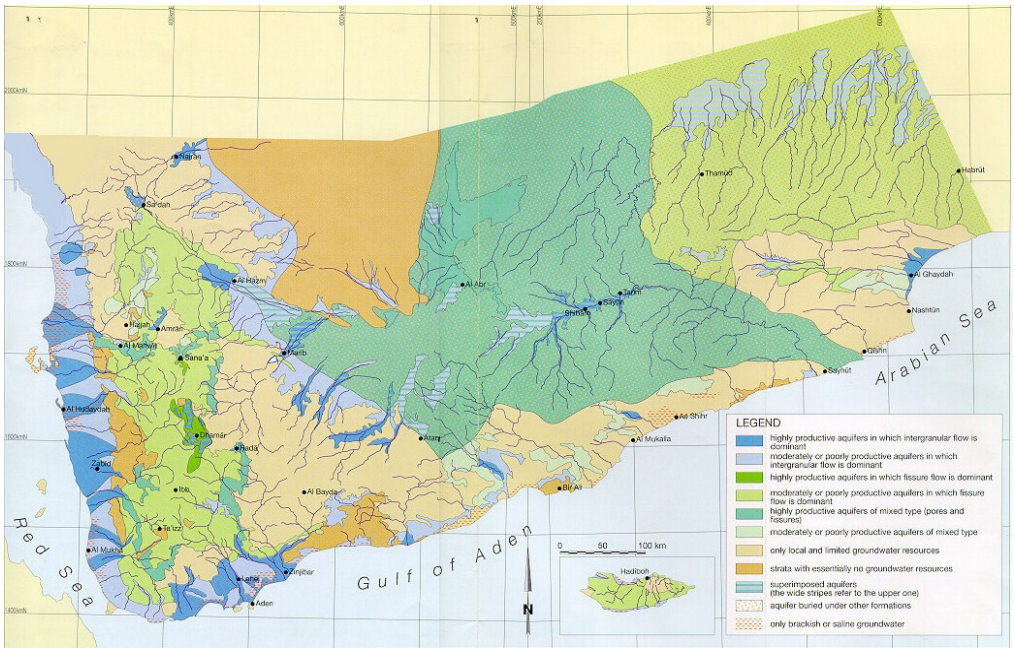
4 – a - 3 – **GROUND WATER**

since early times the farmers in wadi Hadhramout used to draw the ground water using labours and animals



Since early 50 s the mechanical engins started in wadi Hadhramout to be used to drow ground water for irrigation and for drinking purposes

Groundwater Map -Yemen



A major groundwater aquifer was recently discovered in the eastern part of the country with an estimated storage of 360 billion m3[2].

Ground water resources have not been adequately quantified (Porf. Bamatraf, 1996).[3]

Table 1 explains deferent aquifers of Hadramout area, Aquifers Depth, Water by Millions Barrel In square mile and Water Quality .

2 LAHLOU ABDELHADI, WATER RESOURCES OF 11 WATERSHEDS IN NORTH YEMEN, 3rd International Conference on Wadi Hydrology,12-15 December 2005, Sanaa, Yemen, lahlouhadi2004@Yahoo.fr

[3] د / عبد الرحمن محمد با مطرف ، تقرير نتائج زيارة اللجنة الفنية من جمعية حضرموت الخيرية الاجتماعية - صنعاء والمركز الدولي للبحوث الكندا ،اوتاوا كندا ، الى حقل المسيلة . يوليو ١٩٩٦ م

Typical Rock Formations In Masila Block Hadramout 4

No.	Aquifers	Aquifers Depth Meters	Water by Millions Barrel In a squire Mile	Water Quality
1	Jeza	0 – 120		
2	Umm Eradhuma	180 – 270	Un-Know	Potable
3	Sharwayn	25 –50		
4	Mukalla	300 – 600	640	Potable
5	Fartaq	40 – 55		
6	Harshiyat	700 – 900	742	Potable
7	Qishn		96	Water & Oil

4 – a – 4 – DISPOSAL OF THE WATER ACCOMPANYING MASILAA OIL

Canadian Occidental Petroleum Ltd. (Canoxy), major operators in the Hadhramout-Masila block region of Yemen in 1992, retain Komex International Ltd (Komex) to provide an assessment of the ground water resources in the area. Komex year long study determine the existence of two previously unexplored major deep aquifers. Data from this study suggest that these aquifers, which exist at over 800 m depth in most of the study area, offer excellent potential for good quality groundwater for potable supply and industrial or agricultural purposes. Initial estimates suggest that annual potential safe yields from the aquifer could exceed several hundreds of millions of cubic meters, if properly developed.

[4] CANADIAN OCCIDENTAL PETROLEUM , Hydrological Assessment of Produced Water Disposal Yemen Masila Project (April 1994)

Canoxy has retained Stanley International Consultants Ltd (Stanley) to conduct a study on the potential impacts of disposing of the produced Qishn water into the Harshiyat formation in the N.W Masila Block, Yemen. The study should, in particular, address the concern that disposal operations may impact the overlying Mukalla aquifer, which contains potable water.

5 – THE WATER RESOURSES DEVELOPMENT

Before the unity in 1990 , the water resourse development in the tow parts was runing in two opposite directions , In the north part of the country the government implement developing project concentrating on the wadi and flood control project and the exploitation of the ground water was left to the privet sector , while in the south the Government concentrate on the ground water exploitation neglecting the floods and the wadi development although land reclamation projects were implemented depending on ground water. The privet sector was out of the equation in this field . In early 1990 after the unity the situation was in the north part the ground water was exploited and in many regions it reached grave situation . and in the south the land ownership started and all the the gained developed land became graduly deseret. And the the wadis flood structures need heavy rehabilitation and maintenance while most of the people did not know how such structres used to be maintained

6 – CONJUNCTIVE USE OF FLOOD AND GROUND WATER

The conjungtive use of flood and ground water was not experianced widly in wadi Hadhramout. There is an old saying farmers used to say if the rain does not come we will draw water from the ground using the humans and the animals . (**ا ن مطرت والا سنينا**)

The practise of using ground water and flood is widely experienced in Tihama region West of Yemen as the wadis flood is controled by modern permenent structures which is not the case in Wadi Hadhramout .

7 – CONCLUSIONS

Twenty years of comunist rigim establish farming pratices in place of old succesfull systems and practises which was not realized till the agricultural activities reached the bottom. The present situation is neither the old practise excists nor the new system succeeded . It is very important to record the historic practise of water wrights and public irrigation systems maintenance , with the different farming traditons .

As the irrigation systems and the agricultural activities in this regions is very old the agricultural lands became widely distributed and rarely one land owner own (0.2) hectare in one place , more over due to cultural complication , it is very difficult to give up the land . The lands are spate irrigated of excellent soil . The ground water is available and the mean activities of the people is cultivation . It is required to test an unprecedented relationship for irrigation with ground water in scattered land ownership taking into consideration the passibility of flood irrigation as conjunctive use of ground and flood water.