WATER SCARCITY MANAGEMENT IN NARANG CANAL

A Study in Narang District, Kunar Province, Afghanistan

By

Said Hafeezullah Syedy

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Postbus 411
Tel: +31 31 7486230
Fax: +31 31 7484884
Email: research@larenstein.nl

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Said Hafeezullah (syedy)

September 2011,

DEDICATION

This thesis is dedicated to my respectable parents and to millions of innocent Afghans martyred, the widows and the Orphans during the last three decade war in Afghanistan.

ABBREVIATIONS

NGO	Non Governmental Organization
GDP	Gross Domestic Product
MoEW	Ministry of Energy and Water
WUA	Water User Association
DAIL	Department of Agricultural irrigation & Livestock
MAIL	Ministry of Agriculture Irrigation & Livestock
MRRD	Ministry of Rural Rehabilitation and Development
NGO	Non-Governmental Organisation
O &M	On farm management
FAO	Food Agriculture Organization
USGS	United States Geological Survey
IMD	Irrigation Management Deportment

Glossary of Afghan expression	
Syllabi	Flooding
Abi	Irrigated land
Malik	A senior elder of a village community, representing the interests of his community his community to district and provincial government.
Jerib	Unit of land Measurement (1jerib = 0.2 hectares or 5 Jerib = 1 ha
Mirab	water master
Shura	Traditional gathering party of Afghan local people to solve issues Within Afghan community.
Karez	Karez Underground canals connecting well) underground canal system that taps aquifers by gravity through a series.
Arhat	Ground water is lifted from shallow wells with the help of Persian wheel (Arhad) Supplying irrigation water to the fields of an individual farmer.
Water right	The allocation of water among the different users according to formal or informal mutual agreement of all water users.
Kakhai	Assistant of the Mirab (water master)

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Abstract

The main theme of this research was to investigate the main causes of water scarcity in Narang canal in autumn season and find possible measure to contribute in the reduction of water scarcity. The Narang district is the one of the well known districts of Kunar province for agriculture. The Narang canal is the vital source of irrigation water for agriculture which irrigates 1600 ha of land. Unfortunately, the farmers of this canal face water scarcity in the autumn season. The study was conducted in three villages of the Narang district belonging from upstream (Bar Narang village), midstream (Char Qala village) and downstream (Kotkai village) area of the canal. The Narang canal has a traditional water management system known as Mirab. The Mirab system has one Mirab (water master) with assistants from each big village. This assistant is known as Kakhai (Assistant of the Mirab).

The research investigated the causes of the scarcity of water in Narang district in autumn season and highlighted the possible ways to reduce the water scarcity in the area. The research focused on three main aspects to achieve the objectives. Theses aspects were traditional water management system, physical structure of the canal and on-farm water management practice of the farmers. The data collected from survey of 30 farmers (10 per village), group discussion with the community elders, Mirab and extension department. The data collected from the survey was analysed in Excel and the causes of the scarcity was concluded.

The result of the survey indicated that the water scarcity in the Narang districts has different reasons ranging from the improper water distribution, poor maintenance and improper on farm water management practices. The result showed that the water distribution among the water users is not equitable. The upstream people use more water as compared to the downstream water users. The upstream water users do not care for downstream water users much. One of the reasons is the change of cropping pattern in the upstream area. The upstream user started cultivation of more water consuming crops like rice and vegetables which has affected the downstream users. The physical structure of the canal is poor and has lot of water losses.

The canal intake is made of local materials and is very weak. The intake is washed away by the flood waters in autumn and spring season and is rehabilitated by the water users again and again. It takes several weeks to rehabilitate the intake. In contrast, the water level in the river falls down and the intake receive less water which causes water shortages. The canal is subjected to occasional floods in the spring and in autumn seasons. Many parts of the canal are destroyed by these floods and take several days to rehabilitate it. The control structures like turnouts are made of local materials and are not good in water diverting and distribution. Moreover, the canal embankments are weak in some parts of the canal where overtopping occurs.

The leakages in the canal were also observed which are caused by rodents. At the farm level, the water use was not efficient. The farmers do not know the crop water requirements and determination of irrigation time was based on their own perceptions. Soil dryness and crop wilting were the two main indicators for crop water requirements. The farmers especially the upstream uses over irrigate their crops believing that it will contribute in increase of crop yield. The levelling of the land was not good and there were high spots in the fields.

It can be concluded that the causes of the water scarcity in the Narang canal has various reasons which belong to the poor maintenance of the canal, weak traditional irrigation water management system and poor on-farm water management practices. In order to manage the scarcity a multi-dimensional approach will be need both on long and short term.

CHAPTER ONE

1. INTRODUCTION

1.1 Back ground information

Afghanistan is located in the south – central Asia. It is a landlocked and mountainous country. In terms of area it constitutes about 652,230 km2 with 5,529 km land boundaries, 3 percent is forest, 46 percent is pasture and 39 percents covers mountains. On the southeast part, Afghanistan is bordered with Pakistan, whereas Iran is on the west, Tajikistan, Uzbekistan and Turkmenistan on the north and China is located towards the north-eastern Afghanistan 'see figure 1. It is characterized by its rugged terrain and an average elevation of 1100 meters above sea level, ranging from 150 to 8,000 meters. The cultivable area has been estimated at 8 million ha, which is 12% of the total area. In1991, the area cultivated with annual crops was estimated at 3.2 million hectares, which is only 82% of the area cultivated in 1978. In addition, about 144 000 ha were estimated to consist of permanent crops in 1990 the table1, shows the general information about Afghanistan. (FAO country profile Afghanistan)

Table 1: General information of Afghanistan

Area:	652,230 km²
Administration:	34 provinces
Population:	30 M cap [estimated 2005]
Capital:	Kabul (ca. 3.5 M cap, estimated
Further big cities:	Kandahar (460,000 cap), Herat (450,000 cap), Mazar-i Sharif (180,000 cap), Jalalabad (180,000 cap) [2002]
Urban Population:	23 % [2003]
Population density:	44 cap/km²
Population growth:	3.88 %
Agricultural area:	12.3 %, 33.8 % of cultivable land is irrigated Products: wheat, fruits, nuts, vegetables, cotton, poppy seed, sheep
Wooded area:	14,000 km²
Commodities:	natural gas, salt, copper, petroleum, iron ore
Important industries:	carpet weaving mills, production of foods, fertilizer, leather goods
Use of drinking water:	Agriculture 98 %, Industry 0 %, Domestic 2 %

Source: water- asar 2006-2011

Figure 1: Map of Afghanistan

Source: World Map 2001,

1.2 Climate

Precipitation

Afghanistan is characterized by a continental climate, although the presence of mountains causes many local variations. The typical climate varies from arid in the South and Southwest to semi-arid in most other parts of the country. The high mountain ranges of Hindu Kush and Pamir are moderate humid and covered by permanent snow and glaciers at altitudes above 5,000 m. With a few exceptions of some locations receiving sufficient rainfall in spring (Northern slopes of Hindu Kush above 1,000m altitude), the climate is not favourable for rain fed agriculture. During winter, temperatures are low and precipitation occurs in form of snow whereas during summer, temperatures are high and rainfall is virtually zero. Without irrigation supplies, these arid to semi arid areas cannot support any irrigation. In Afghanistan, the water availability for irrigation purposes is mainly a function of effective rainfall and surface as well as groundwater resources - which depend in turn on the amount and distribution (time and space) of precipitation. The annual distribution of precipitation with more than half of the area receiving 100 mm to 300 mm of precipitation. The remaining 50% of the country (having altitude of more 2000 m ASL) receives 300 mm to 800 mm of precipitation. About 50% of the precipitation

occurs in winter (January to March), much of which falls in the form of snow. A further 30% falls in spring (April to June) and the remaining 20% during summer and autumn. (Qureshi, 2002)

Temperatures

The daily (20°-30°C) and the seasonal (35°-40°C) variations of temperatures prevailing all over the country lead to different lengths of growing seasons, and require a careful selection of the most suitable crop for an area. This is reflected in many regions well known for their particular agricultural products (e.g. grapes, melons, and rain fed wheat) or their natural forest cover (pistachio trees, pines). In the South-western desert plains, frost can occur in any month of the year even when temperatures reach a daily maximum of up to 40° C. Daily 4minimum temperatures in the Northern (Turkestan) plains can be as low as -20° C in winter and as high as +50° C in summer at one and the same location. (Qureshi, 2002)

Evapotranspiration

Annual evapotranspiration rates are relatively low in the Hindu Kush (1,000-1,300 mm) because of severe and long winters. They vary between 1,300 mm and 1,500 mm in the Northern plains and reach up to 1,800 mm in the Southern and South western plains. However, summer evapotranspiration rates are high everywhere showing a daily peak of 6-8 mm in July/August. Due to strong winds occurring particularly in Mazar-i Sharif and Herat (bad-e sad-o bist ruz); maximum daily evapotranspiration rates are 9 mm and 10 mm, respectively. (Qureshi, 2002)

Study area (Kunar province, Narang district)

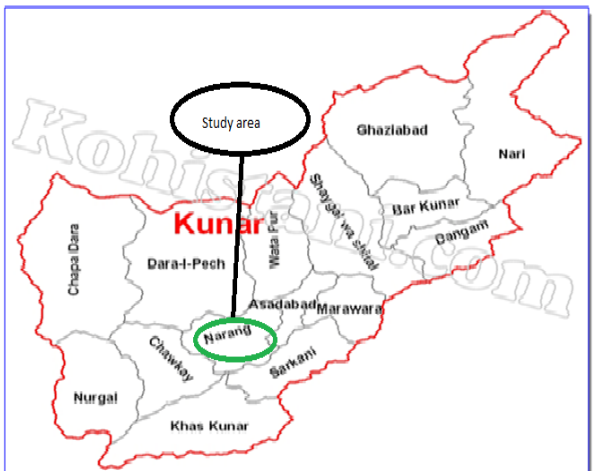
Kunar province is located in the East of Afghanistan. It borders with Ningrahar province to the South, Nuristan to the North, and Laghman to the West and has a border with Pakistan in the East. The province covers an area of 4339 km^2. Nearly nine tenths (86%) of the province is mountainous or semi mountainous terrain while one eighth (12%) of the area is made up of flat land. The province is divided into 15 Districts. The provincial capital is Asad Abad which has a population of about 29177 inhabitants. Kunar has a total population of 413008. There are 64588 households in the province, and households on average have 8 members, See Kunar province map in figure 2. (Kunar provincial profile)

The climate of Kunar province is generally classified as being rainy and cold throughout the year however with four distinct seasons in most parts and two seasons in upper parts that remains covered almost six months under snow. Kunar River, which originates from overflow for the period of almost 5 months between March and August, brings large quantities of soil cause sedimentation and close irrigation channels. Sometimes sweep across agriculture land and wash away rice and corn crops and make destruction to residential areas on its banks. (Kunar provincial profile)

Narang is one of the districts of the Kunar province. Narang District located in the Southern side of Asadabad. It borders Chawki District and Asadabad, and is surrounded by high mountains and the Kunar River .This district is an agricultural district. The total population of this district is

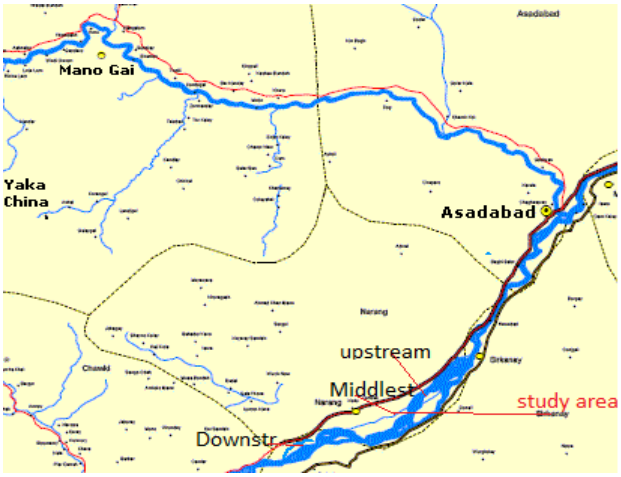
27937 where 80% of the population is engaged in agriculture. (Kunar provincial profile)This district has 2200 ha of cultivated land, 1500 ha out of 2200 ha of land is irrigated by the Narang canal. The Narang canal is an old canal dug by farmers in the beginning of the era of king Zahir Shah. This canal is 14 km long and 3 m wide. Figure 2 and 3 show the location of the study area in the province. (Kunar extension department annual report 2010)

Figure 3: Map of Kunar Province



Source: Kohistani, Kunar province,

Figure 2: Map of Narang District



Source: AIMS District Map

Afghanistan's one of the main priority to secure access to water for all and protection against water related shortage is one of the human development challenges confronting with it. Does it mean that Afghanistan faces with shortage of water for drinking and irrigation needs of course, the situation is not that much concern of but the critical situation that is facing is lack of adequate distribution of water though a few river basins and sub-basins are facing shortage in water but it does not mean that Afghanistan face with shortage of it. Parts of Afghanistan suffers with scarcity of water it does not mean that there is not enough water but most people lack to access water is due to inadequate water distribution and poor infrastructure and management which leave the community in scarcity of water.

However, Afghanistan as general has started to take effective measure to mitigate the scarcity of water but, its only efforts would not bring productive results unless the water users are brought in decision making process on shared resources. Thus, effective water management of the water supply is required to not only improve the socio-economic life of people but also reducing the overall vulnerability in Afghanistan. So emphasis is required to enhance water management efforts to eliminate and or reduce the deficiencies in providing of available water resources. Vis-a-Vis the rapid growth of population in the country increases the demand for water in non agriculture section which is also a matter concern and we cannot neglect regional dimensions in water management as some of the Afghanistan river water is shared with neighbouring countries flowing down the stream. (Thomas and Eqrar 2011)

Planners need to think over major water development projects with close consideration and need of the neighbouring countries. Hence to overcome the challenges of scarcity of water governments, donors and other stakeholders are required to come together to manage the scarcity of water and reduce the uncertainty over the water resources. In fact the water scarcity is not because of lack of water but due to mismanagement and this must be highlighted as top Priority in the management of water and cannot be deal properly unless the locals are not included for finding and working on the solutions. (Thomas and Eqrar 2011)

1.3 Definition water scarcity

In popular usage, “scarcity” is a situation where there is insufficient water to satisfy normal requirements. Water Scarcity Management in the Context of WFD June 2006)defining water scarcity is a complex phenomena according Afghanistan Human Development Report if some individuals could not able to get enough water for drinking and livelihood support activities for some definite duration then the individuals are considered in secured in similar lines if a larger segment of population in a given region could not able to have access to drinking water or for agriculture purpose for some time then the region is regarded water scarce.

From the mentioned definition the water scarcity seems very simple but it is not so to indicate an area of residing a pocket of population water scarce in Afghanistan Human Development report mentioned that water scarce is depended on the demand and the needs of the individuals as well as taking consideration of environmental concerns and its suitability of ecosystem in the area Furthermore, the share of the water that can satisfy need of all shareholders without compromising one another and the availability of water in agricultural seasons. Indicators suggest that Afghanistan is not a water-scarce country. It possesses an estimated overall surface water availability of 2,775 cubic metres per capita per year. Experts consider 1,700 cubic metres per capita per year sufficient to satisfy the water demand of a given population for domestic, food production, industrial, energy and environment. (Thomas and Eqrar 2011)

Does Afghanistan face with scarcity of water?

Afghanistan annual renewable and surface water resources are 57 billion cubic meters which flows and managed within five main basins and 34 sub-basins across Afghanistan the five basins are Panj Amu, Northern, Kabul, Harriod Murghab and Helmand the distribution of water varies as shown in the below table 2.

Table 2: Afghanistan main Basins for Irrigation water

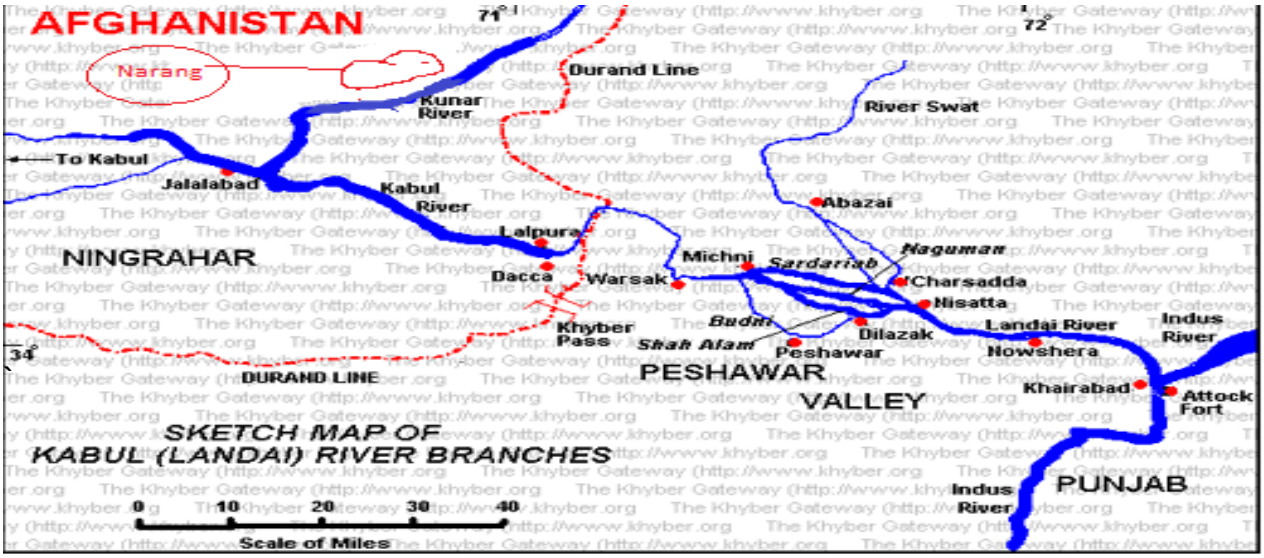
The river basins of Afghanistan	
River basins	Annual discharge (billion cubic meters)
Panj Amu	22.00
Northern	1.88
Helmand	9.30
Harriod Murghab	3.06
Kabul (Kunar river)	20.76

Source: Thomas and Eqrar 2011,

The farmers in upstream which are close to have access to canal water enjoy the utmost and unlimited availability of water while hundreds of agriculture farmers in downstream are often deprived of their rights to water access many of them are unable to irrigate their field as result every year the farm field remain fallow missing out agriculture opportunities because of unequal and fair management of water.

In Afghanistan living people, land and water across river basins are not at balanced size; the basins that contains the maximum of water like Panj Amu or Kabul rivers basin do not irrigate the land with the highest share on the contrary the Northern or Helmand rivers basins which irrigate the highest proportion of land in Afghanistan do not benefit from the highest share of water; for instance Kabul river is supposed to irrigate the maximum but the proportion of people living and agriculture land are not much moreover, seventy percent of Kabul river water flow comes from Kunar river which is located in the downstream of the basin very near to Pakistan border areas figure 4 ,clearly indicate a large portion of the water flows to Pakistan without being used in lower stream because of limited irrigation field and in the upstream much of irrigation land remains untouched. (Thomas and Eqrar 2011*)*

Figure 4: Map of water flow Direction



Source: Afghanistan river map

1.4 At National level storage of water and seasonal variations

Water is not a static resource, in fact its availability is depended on year season and the weather conditions in Afghanistan where the one of the main water source is snow melting therefore, depends on the level of snow, sometimes the abundance of water creates disaster in terms of flood hazards at times come where it is hard to meet the need and demand in the region. In Afghanistan there is overall absence of water storage facilities one of the core reason is war and insecurity in the country could not provide environment for physical infrastructure even the available ones were either destroyed or damaged this has left Afghanistan in volatile condition for not having water storage facilities. (Thomas and Eqrar 2011)

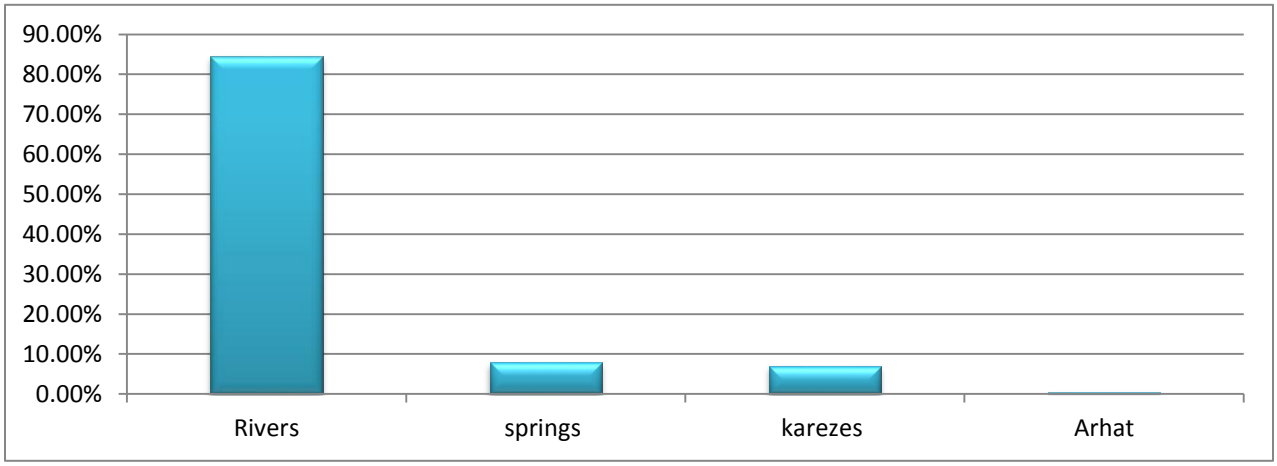
According World Bank (2005) Afghanistan is among the lowest nations in world for lacking water storage capacity which accounts for 140 cubic meters per capita. There is also worrisome as the country population is in rapid growth so does the demand for water and food production and agriculture also increase thus, it will lead to decrease the water in the availability of water per capita would raise concerns in the region. The last four decades of war and insecurity the irrigation infrastructure is damaged which resulted lack of storage and inefficiency to control and manage equitable distribution of water particularly between upstream and downstream this has created an atmosphere of despair and conflict among communities. Furthermore, Government's lack of conflict resolution yielded seeds of tension and irrational claim of upstream villager over the rights of water neglecting the need of downstream. (Aini, 2007)

The country's basic irrigation infrastructure has been badly damaged by a quarter century of war and political upheavals. Only about a third of the farmland that was irrigated before the conflict now receives the irrigation water it needs. As a result, agricultural productivity remains low. In

recent years, the situation has been further exacerbated by frequent droughts. Revival of irrigation systems is a key to reduce poverty. (World Bank, 2006)

The ministry of water and power under the Government of Afghanistan divided the sources of irrigation water into four classes: rivers 84.6%, spring7.9%, Karezes 7%and Arhad 0.5, figure 5, show the main resources of irrigation water in Afghanistan.

Figure 5: irrigation water sources in Afghanistan



Source: Aini, 2007.

In Afghanistan particularly in eastern Afghanistan river is the main source irrigation which goes through canals for field and drinking to villages to manage the water and its distribution there is a traditional system which is run by Mirab (water master system).It is an old system which prevail in much part of eastern Afghanistan .The main duties of Mirab is to manage the distribution of water and its structure maintenance. Usually Mirab is selected through traditional gathering of village farmers and local leaders. The Mirab must (should) have knowledge and experience to bear the responsibilities. There is mutual cooperation and understanding between farmer and Mirab.

So the load of pressure is always on the shoulder of Mirab usually there are differences with regard to water access between downstream and upstream the water distribution runs smoothly however, in dry season the existing Mirab system and its management are not adequately managed or planned to avoid proclaim from the downstream communities moreover, the researcher observed that Mirab criteria and understanding is limited to traditional practices and use of water which does not seem to be well equipped to face the challenges of lack of water, new irrigation and economic challenges and the need of downstream people so as to obtain proper production and income. (Water scarcity management, 2006)

1.5 Research problem:/Background

Water is the lifeblood for the people of Afghanistan, not just for living but also for the economy. The economy has traditionally been dominated by agriculture, which now accounts for over half the GDP (Gross Domestic Product) and employs 66% of Afghanistan's workforce. Decades of

war have destroyed much of Afghanistan's irrigation and other water supply systems, which are vital for the agricultural economy (FAO 2011, water development and management)

Narang is one of the well known district of Kunar province in agriculture production. The district has 2200 ha land for agriculture. The Narang canal is the main water supply canal and the vital source of the irrigation for the agriculture of Narang district. About 80% of the total cultivated land of the Narang district is irrigated by this canal.

The farmers especially at the downstream area face severe scarcity in the season of autumn which result in reduction of yield and sometimes complete failure of the crops. The pressure on water increases in this season and sometimes resulting in the severe social conflicts. It is therefore necessary to investigate the main causes of the water scarcity and find the possible ways through which the water scarcity could be managed through some extent.

1.6 Research objective:

To investigate the main causes of water scarcity in Narang canal in autumn season and find the possible measures to contribute in the reduction of water scarcity.

1.7 Research questions:

Main Questions

Q1. What are the causes of water scarcity in Narang canal?

- How is the physical condition of the canal and watercourses?
- What are the conveyance losses of the canal?
- What are the current on farm water management practices of farmers?
- What is the cropping pattern in fall season?
- How effective is the current water distribution and O&M of irrigation infrastructure?
- Why the autumn season is more sensitive than the other season?

Q2. What are the possible ways for the reduction of the water scarcity?

- What are the short terms measures for scarcity reductions?
- What are the long term measures for the scarcity reductions?

1.8 Expected output:

This research focuses on the water scarcity management in Narang canal downstream area which are always in the fall season crops have facing to the water shortage .it is expected that the research have find out the way of solution for to reduced the problem and also contribute to managed the scarcity of water in the whole canal.

1.9 Research conceptual frame work:

The research has investigated the three main parts to achieve the objective of the research. These aspects are as follow;

1. Studying the Water Management System
2. Studying the on-farm water management practices
3. Physical Structure of the canal

1.10 Limitation of the study:

Three decades of war and destruction have destroyed the agriculture infrastructure and production. Lack of technology, illiteracy, extension working, nonexistence of correct documents and data, security condition and limited sources are the main challenges for the researchers and reliable data is hard to obtain in almost all sectors of agriculture. Therefore the current situation forces the study to rely on limited sources. The provided information of this report is through observation of the physical structure of the canal (control structure, turnouts and intake), on-farm water management practices (land levelling, cropping pattern, and irrigation method). The group discussion with community elders including Mirab and the extension department was another source of data and information. The full description of current circumstances needs broader investigation. However the primary collected information of this study can be used for future study and planning.

1.11 Report structure:

This report is structured into 6 main chapters. Chapter 1 offers the background of the study and describes the problem statement. Its further includes the formulated research questions that guided the study. Chapter 2 consists of literature related to the challenges in water scarcity, canal infrastructure, water distribution system, and other related issue about irrigation water in the canal area. Chapter 3 includes research methodology, study area, research strategy, tools used. Chapter 4 presents the empirical findings of the research Results, Chapter 5 discussion and Chapter 6 includes conclusion and recommendations.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Introduction

This chapter deals with the review of different relevant reports, publications and books about the scarcity management. The literature review was done for the validation of the research findings.

2.2. Importance of Water

Water is the lifeblood for the people of Afghanistan, not just for living but also for the economy. The economy has traditionally been dominated by agriculture, which now accounts for over half the GDP (Gross Domestic Product) and employs 66% of Afghanistan's workforce. Decades of war have destroyed much of Afghanistan's irrigation and other water supply systems, which are vital for the agricultural economy. (FAO2011, water development and management)

The United States Geological Survey (USGS) states that the availability of water is vital to the social and economic development of Afghanistan. Historically, the mountains of Afghanistan have served as a natural storage facility and source of water for the Afghan people. USGS reports that snowmelt from the mountains, in addition to the melting of glaciers, accounts for the majority of Afghanistan's freshwater. Over 80% of Afghanistan's water is sourced from the Hindu Kush Mountains. (Water scarcity in Afghanistan 2011)

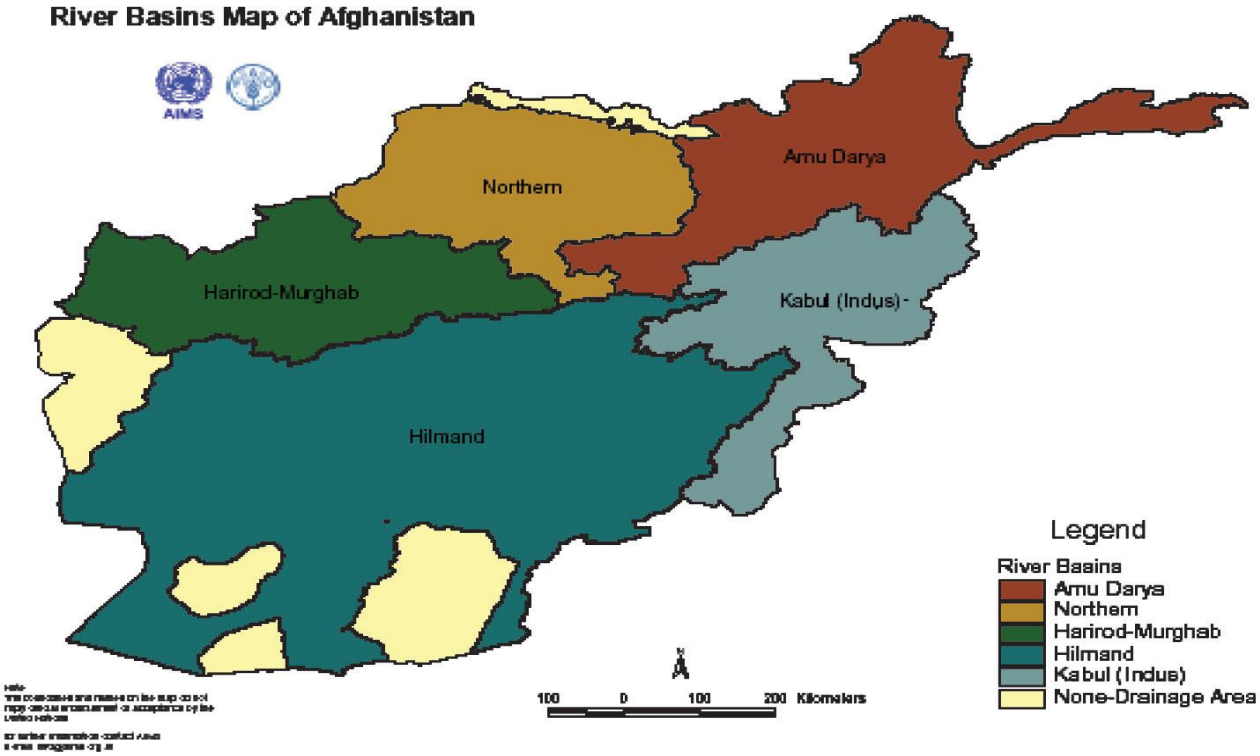
Water scarcity issues are becoming emergency issues and are going to play a key role in the near future for the definition of both environmental and development policies at a global scale. Regarding Europe, the 2003 and 2005 drought events especially in Spain and France confirm definitely this trend and the urgent need of the implementation of common strategies facing the problem which involves the whole European Community and not only Mediterranean countries (water scarcity management, 2006).

Water is used for various purposes such as irrigation, mining and other industrialises, and servicing rural and urban communities for growing crops and drinking purposes. It is the best source of agriculture inputs with the aim for whole world food production and healthy functioning of the natural resources, beside water is causing a severe combating among the communities especially in rural areas (Chartres and Williams. 2006)

Water scarcity discussions have brought to the front deeper "issues" such as the importance of irrigation for food security and public health as well as its contribution to the development of agriculture-dependent developing economies. Irrigation consumes from 50 percent (Rosegrant et. al. 2002) to 70 percent (Molle, 2002; WRI et. al. 2000) of global water resources. This share may even be as high as 90 percent in developing countries (Postel, 2001) As per Hydrology Department of Water and Power ministry the Afghanistan rivers are divided by the following five basins; Amu Rivers in the north flowing from east towards west, HariRud basin flowing that is flowing towards west and then north which leads to enter in Turkmenistan country; The Kabul

river basin flows towards east which later enters in Pakistan joining Indus river, and the Helmand river basin flows towards south-west the mentioned river basins are shown in the figure 6.

Figure 6: : River Basins Map of Afghanistan



Source: SCA, 2007

the country entirely depended on annual rain and snow particularly in the highland which is 2000 meters in elevation which represents 80 % of water irrespective of ground water of the country an estimated 150,000 million m3 annual water is received from snow melting and only 30,000 million m3 rainfall is received by the country and only 15 % contribute to recharge ground water in the country from the 180,000 million m^3. (SCA, 2007)

2.3. Water Scarcity Afghanistan

Water is a basic human right and necessity; water scarcity can also be a potential source of conflict. Scarcity often means that there is increased competition for resources with increased economic value. Competition can potentially lead to conflict among countries and within countries especially when it faces the upstream downstream dilemma. (Afghanistan human development report 2011) Water is a basic human right and necessity; water scarcity can also be a potential source of conflict. Scarcity often means that there is increased competition for resources with increased economic value. Competition can potentially lead to conflict among

countries and within countries especially when it faces the upstream downstream dilemma. (Thomas and Eqrar 2011)

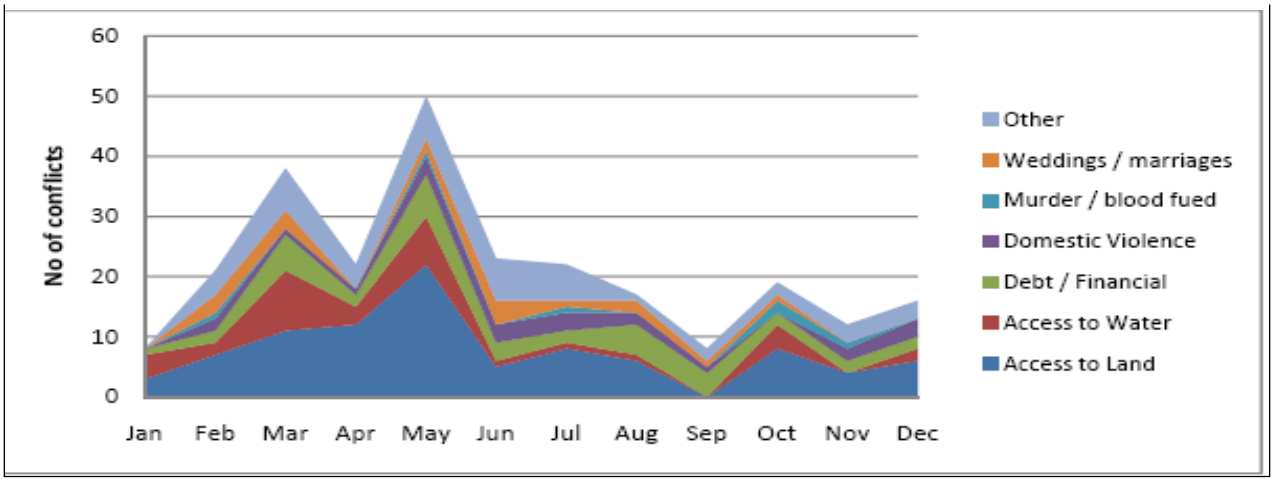
"Water shortages and needs are increasing, and the competition for water among urban, industrial, and agricultural sectors, as well as other resources users, is growing more intensive". (Hamdy, et al., 2003)

Afghanistan is facing a serious problem of natural resource scarcity, especially that of water in view of population growth and economic development. Water being a prime natural resource, a basic human need and a precious national asset, its use needs appropriate planning, development and management to cover water scarcity and proper need for agricultural production. (Garg and Hassan OCTOBER 2007)

Water is a basic human necessity and it is a key resource in most forms of livelihood strategies especially in Afghanistan. The scarcity of water and the competition created as a result can naturally lead to conflict and violence. There continue to be conflicts over water between states internationally, between countries regionally, between communities within a country and between and within families. The scarcity of water is without doubt a source of conflict. (Thomas and Eqrar 2011)

The people who lives in downstream, are having conflicts over water, for instance most local conflicts, are largely determined by the seasonal phase and peaks in March and May, with smaller spike in January and October. The March to May period are having highest water levels and the highest water related conflict levels because farmers are trying to get enough water for their fields (See figure 7).During this period a significant amount of time is needed for repairing and maintaining water systems, thus labour needs must be coordinated and fairly distributed among the various communities. The March to May period is also a planting season which requires additional irrigation; the October month is also related to additional irrigation required at planting for winter crops. (Kakar, 2001)

Figure 7: Different cause of conflicts during the year



Source: Kakar, 2001

2.4. Causes of Water Scarcity

According to (WFD.2006) mentioned in its book that for long time water is a non limited resources because water availability was enough to cover the requirements for the various sectors and the environment. Gradually due to increased water use, misuse of water resources, increased pollution and other natural and human encourage changes, water has become scarce resource not only in arid and drought areas but also in humid or sub humid zones of the world. (WFD.2006)

A report from the Christian Science Monitor indicated that 30 years of war have left Afghanistan's irrigation canals and water management system in a state of disrepair, thus creating obstacles for the agriculturally-reliant nation. The Christian Science Monitor indicated that, in order to develop, Afghanistan must renovate and develop its water infrastructure but that doing so could spark tension with neighbouring nations which have come to rely on Afghanistan's mismanagement of water – and the excess water flowing from Afghanistan to their region for their own development needs .(Water scarcity in Afghanistan 2011)

Despite apparent signs of resilience in the Mirab system, local intuition has managed to adapt to the new challenges during a period of conflict and a rapidly changing political and institutional environment. The following are the most serious challenges faced by local intuition in recent decades.

- A fivefold increase in population has led to more competition for decreased irrigable land and resources. This has meant greater problems for Mirab as and other actors involved in controlling water distribution. Because of more competition among more numerous water users, the chance that local agreements may be bypassed are heightened if negotiation become more difficult.
- Combined with a collapse o local government capacity to support Mirab and local institution, the erosion of social capital has led to an increase in illegal practices. these include and expansion in the cultivation of water – intensive crops ,such as rice or cotton ,in the head reaches of canals " the unregulated construction of new off takes, which allows upstream farmers to siphoned off more water , As result , farmers in the tail each are suffering the consequences of reduced access to water .
- Collective maintenance has decreased partly because the erosion in social capital has contributed to reduction in the conveyance capacity canal and poor infrastructure performance. The low irrigation efficiency subsequently contributes to limiting the access to water in downstream areas. Source.(Thomas and Eqrar 2011)

2.5. Possible Ways to reduce Water Scarcity

In order to prevent major problems such as leakages and destruction of embankments, the canal system need to be regularly inspected throughout the irrigation season. Rat holes in canal banks, small leakages, erosion of canals and cracks in linings can cause severe problems. They need to be noticed and repaired as soon as possible. Such quick responses will only occur if the system is properly inspected. This means that the canal banks should have good pathways, and need not be cover with plants. (Van den Bosch, Hoevenaars and Broawer, 1992)

Irrigation infrastructure rehabilitation, including low-cost technologies. The rehabilitation of canal infrastructure is a priority if irrigation is to become more efficient. One good example of this is the World Bank–funded Emergency Irrigation Rehabilitation Project being implemented by the Ministry of Energy and Water with the support of the Food and Agriculture Organization of the United Nations. If rehabilitation is to be successful, it is crucial that communities participate in the design and implementation phases. This could be undertaken through newly formed water user associations and irrigation associations and with the support of sub-river basin agencies and councils. (Thomas and Eqrar 2011)

2.6. Water Management in Afghanistan

The main problem facing rural parts of Afghanistan is the management of irrigation system. The availability of water is not a problem, but there are problems in the management of irrigation system. (Thakkar, H, 1999)

While the general principles of water management are similar across Afghanistan, there exists considerable regional variation in practices, reflecting specific cultures and resources conditions. Large and complex lower-catchment irrigation systems appear most susceptible to structural and social inequalities in water allocation. The Mirab water management system, found widely in these lower catchments, is not always sufficiently resourced to redress inequities of irrigation water; it may indeed be needed simply institutionalize local power relations as well to control both head and tail end of canal (Thomas, 2009)

Unequal irrigation distribution is arisen in many reasons such as people who are very dominant in area like leaders or elites include Malik, Khan, community elders and so on are still having power in allocation of the water, growing more water consumptive crops and usage of illegal water could major factors to cause unequal distribution of water. There is also widespread theft of water from irrigation channels; however unfair water distribution is creating enormous social tension. (Riemann, C. 2005)

Living things are depending on production, distribution and its supply system and it is assumed that if a macro level production such as vegetables and cereal crops is ensured through by equal distribution of water and management and it is supplied to consumption points so food security will be ensured and has linked with local people s' employments. (Murray, H. Lashari, B and Memon, Y, 2000)

Increasing scarcity of water makes the issue of efficient allocation more important. On the other hand, since water is crucial for human life, equity is also a central concern in allocation. Economic efficiency is concerned with the amount of wealth that can be generated by a given resource base. Equity on the other hand is concerned with the distribution of the total wealth among the sectors and members of society. Equity objectives are particularly concerned with fairness of allocation across economically disparate groups. Hence these two criteria may or may not be consistent. (Dinar et. al., 1997)

2.7. On-Farm Water Management Practices in Afghanistan

On farm water managements a broad as agriculture itself, and there for mast be studied as an entire system including physical, organizational, economic, and legal; factors. Farmers do not have one or more discrete problem but they are concerned with the management of a complex system. For example, poor physical farm delivery systems resulting in high losses of water might be related to legal factors, social organizational factors, design factors and lack of knowledge. Likewise, farmers, low irrigation application efficiencies and under irrigation or over irrigation may be related to water availability, un-level fields, lack of information regarding actual crops water requirements and inadequate extension services. Such factors likely have a high degree of interdependence and interaction any farm system. ICARDA 2002)

2.8. Method of Irrigation

Irrigation is the controlled application of water for agricultural purposes through manmade systems to supply water requirements not satisfied by rainfall. The field observation and the survey showed that the most common method of irrigation used by farmers is the basin irrigation method which has less efficiency as compared to the furrow irrigation method. More over the farmers especially at the upstream over irrigate their fields with the view that more irrigation gives more yields. The following figure shows a farmer with a spade irrigating his fields with basin method of irrigation. (ICARDA 2002)

More efforts are needed to improve on – farm water management. The farmer's knowledge of crop water requirements is based on the dry appearance of soil surface or remembrance of the time of last irrigation. Basin irrigation is practiced widely which results in wastage of water at the expense of the lower end farmers. (ICARDA 2002)

2.9. Field levelling

Levelling of irrigation field result in improved crop and water use efficiency. On an average, fifty percent of farmers surveyed responded that their farms are levelled. This is indication of wide spread inefficiency in irrigation to overcome unevenness of their fields, farmers divide their fields into smaller plots. ICARDA 2002)

2.10. Determination of irrigation time

Farmers do not know exact crop water requirements or what stages of crop growth require more critical demands of water. Their decisions are based on visual crop and soil stress indicators and the amount of water applied for each individual irrigation is based on the estimates derived from trial and error practices. Farmers, knowledge about water management practices at the farm level is impressive under the given physical, legal social and economical constraints. The problem lies not so much with the farmer as with the lack of institutional services and incentives. The major problems are organizational and structural. For example, neither extension workers nor irrigation engineers have been trained in the water management problems and their solution the farm level. (ICARDA 2002)

Therefore present irrigation practices of farmers include a tendency to over-irrigation whereas opposite should be accomplished. Irrigation practices witnessed in the field are based on the maximum amount of water a farmer can capture. In traditional as well as in modern irrigation schemes the dominant irrigation method is basin/border irrigation for cereals and furrow irrigation for vegetables. The lack of this information could be a reason for farmers to apply more or less water than is required for optimum crop growth. (ICARDA 2002)

2.11. Cropping pattern

Owing to both the hydraulic attributes of irrigation structures and the way in which water resources are managed, farmers in the lower catchment irrigation systems face systemic inequities in the availability of water. Water scarcity at the tail end of canals limits the possibilities for high crop diversity and cash crops and results in reduced yields for other types of crops. Consequently, agricultural opportunity and livelihood security generally decreases along the length of irrigation systems and river basins, with downstream farmers severely disadvantaged. Water scarcity is exacerbated by the state of irrigation infrastructure in Afghanistan, which is estimated by MAIL to operate at roughly half its potential efficiency (on average) due to lack of maintenance and improper design, (Lorene Flaming and Alan Roe June 2009)

In many parts of the Kundoz valley, only one crop per year is possible because of water shortages that relate more to issues of getting water the long distances to the field rather than too little water in the river. Full water requirements are achieved from May–July, provided that the intakes survive the high flood flows. At this time of year river water levels are high enough to enable full supply to enter the canals .From August onwards, levels in the river are much lower and it is far more difficult for farmers to ensure that full supply levels are achieved in the canals.

Crops cultivated include wheat and barley, clover and some Lucerne. If there is enough water for a second crop, farmers will cultivate some vegetables: carrots, turnips, cotton, flax, sesame, maize, green maize for fodder and melons. Some farmers have fruit trees but many were lost during the drought. Some farmers cultivate poppy, but this is not a common crop at present. Farms with good water supplies grow cotton and rice but these water-demanding crops are discouraged to enable the limited summer water supplies to go further. (Anderson 2006)

2.12. Irrigation Systems used in Afghanistan

About 85 percent of the total crops in Afghanistan are grown under irrigation. Canal irrigation is by far the most commonly used method of irrigation in Afghanistan. Canals in Afghanistan irrigate nearly 75% or 1.9 million ha of land.

Water use has become very important particularly with the increase of population growth and domestic consumption the increase in the use of vegetables therefore, United Nation had declared the 1980s as the water decade in the world to spread the message with regard to the water and its proper use and preservation therefore, it is considers the importance of water management and any steps towards effective management of water use will ensure the sustainability for the future generation. In Afghanistan the large portion of agriculture is dependent on irrigation system both on traditional and modern ways which is tapped from rivers

and streams for about 85 percent of all the type crops are produced under irrigation system (Swedish Committee Afghanistan, 2007) the irrigation system is carried out by various means and process it is done through large , medium and small scale irrigation pattern for in the large system the water is either directly diverted river water or through building of storage water (dam) this type of system has not in major parts of Afghanistan except some provinces like Helmand, Ningrahar.

At medium level there are locally built irrigation structures from river or large stream by constructing canals to irrigate land beside, the irrigation is also done through the storage of water from Karez (the water is stored in a large pond so as to get use for irrigation-it is one of oldest traditional system of agriculture in southern and eastern parts of the country it is still followed; there is also the irrigation through digging deep well in local word terminology it is called Arahat which is one of the old traditional mechanism for extracting ground water not only for irrigation but for drinking purpose too.

Nevertheless ministry of Water and Power, the government of Afghanistan divided the irrigation water system into four distinctive classes they are as follows; Rivers 84.6 %, Spring 7.9%, Karezes 7% and Arahat 0.5% (SCA,2007) you can clearly observe that Afghanistan's irrigation is hugely dependent on river water. Here, it is necessary to notice that the water distribution for agriculture field across Afghanistan is not uniformed particularly between upstream and downstream for instance upstream has maximum access to water so it uses much of the available which jeopardize the rights and equitable of use of water as result downstream does not get enough for cultivation. (SCA, 2007)

CHAPTER THREE

3. RESEARCH METHODOLOGY

This study is based both on quantitative and qualitative data. The data for this research was collected through interviews, survey, observations and literature review. The primary data was collected through interviews, survey and observation. Keeping in view the specific objective of the research and the analysis of the water scarcity and management in wider context an in-depth study of canal was carried out in order to understand the situation of the irrigation water scarcity in the region and the context of the problems stated in chapter two.

Discussion with key informants

Discussions with key informants were useful to collect key insights about the research area and the governance of the district. These key informants were basically, The Head of the extension department at the district level, l Mirab and Kotiki downstream village elders, Charqula middle stream village and the upstream elders in the Narang district. Information was collected through prior managed checklists in order to have their views on the Narang canal and response to the research questions.

Survey

The survey was conducted in three differentiation villages covering the upstream, midstream and downstream area of the canal (Upstream- Bar Narang, Midstream- Charqula and Downstream -Kotki). From each village 10 farmers were selected from 10 different parts covering almost the whole village.

During data collection each respondent was interviewed individually. Most of these questions were asked in close and open forms. The second part was the open questions for the discussion these kinds of questions asked from the elders, Mirab and extension staff of the district.

Observation

Through observation, the researcher noticed the interest of farmers with the different villages, and most importantly visual observation of three parts of the canal (upstream, middle stream and downstream). He also visited the farmer fields to observe there on-farm water management practices and different infrastructures of the canal.

Selection of Sample

Considering the time range of the data collection (July 20 to Aug 15), availability of farmers and the security situation; the researcher was in close consultation with the Head of extension of the district and elder of villages. A survey was conducted in Narang district which covered three different villages. Kotiki, Charqula and Bar Narang village's community .The three selected

villages covered the upstream, middle and the downstream farmers of the Narang canal. Ten farmers were selected from each village. The following Table 3 provide the complete information about different people interviewed.

Table 3: Reason for selection the different categories of respondents

Respondent	No	Purpose	Reason for selection
Mirab	1	Discussion	Mirab is the most experienced person in water management and is involved directly in water related issues of the community.
Community Elders	6	Discussion	Community elders are involved in the conflict resolutions, have knowledge of the community, Have influence and are involved in decision making.
Extension officers	2	Discussion	They are involved in provision of technical extension services to the farmers.
Farmers	30	Survey	To collect the data through the survey questionnaire

Data processing and interpretation

The data collected was analyzed with the help of Ms-Excel. These analyses were made in frequency counting, pie charts, bar charts and tables.

The secondary data Have consist of documents related to Water Scarcity Management sector; these documents include different reports, documents produced by concern departments at regional and district level, the region and district socio economic profile journals, books as well as different website .

Literature review

The relevant data about on irrigation water scarcity and management practices have collected through desk study which includes reviewing books, reports, and journals.

Study area description

In this chapter, the Kunar River, Kunar province and Narang canal is introduced. The climatology of the study area is also discussed.

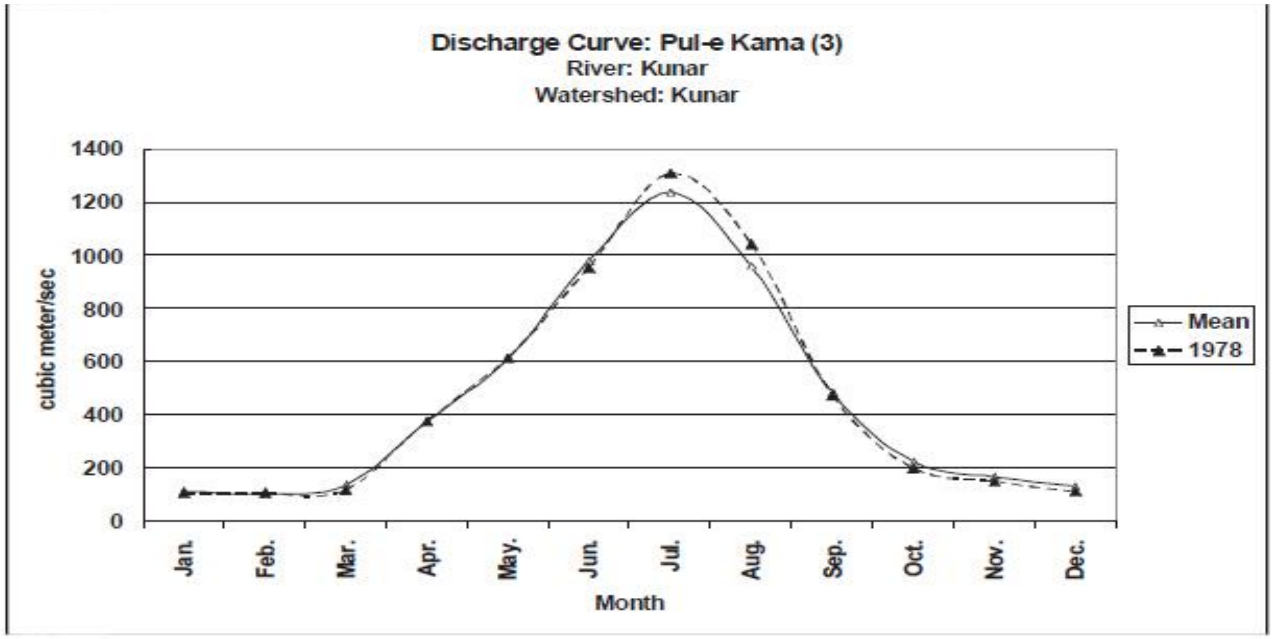
3.1. Description of the region of Narang district

The Kunar River rises in the Hindu Kush Mountains and flows generally south – west wards to its confluence with the Kabul River near Jalalabad in eastern Afghanistan. The total catchment area of the Kunar River is 26000km2, 12100Km2areas located within Afghanistan.

3.1.1. Hydrology

The regime of the Kunar is characterised by a high flow period from May to September during which, in an average year, about 75%of the annual discharge is passed, and minimum flow period during the months of December, January and February. The summer high flow period results from the combined effect of snow –melt and rainfall in the higher parts of the catchment. See figure 7 However, due to the large catchment area, pronounced peak flood discharges of short duration do not occur during this period .on the basis of the stream flow records for 1961to 1965, the average annual flow in the Kunar river was 325 m3 /s, and during this period the maximum instantaneous discharge recorded was 1180 m3/s. (Kunar river basin development Master plan report 1977)

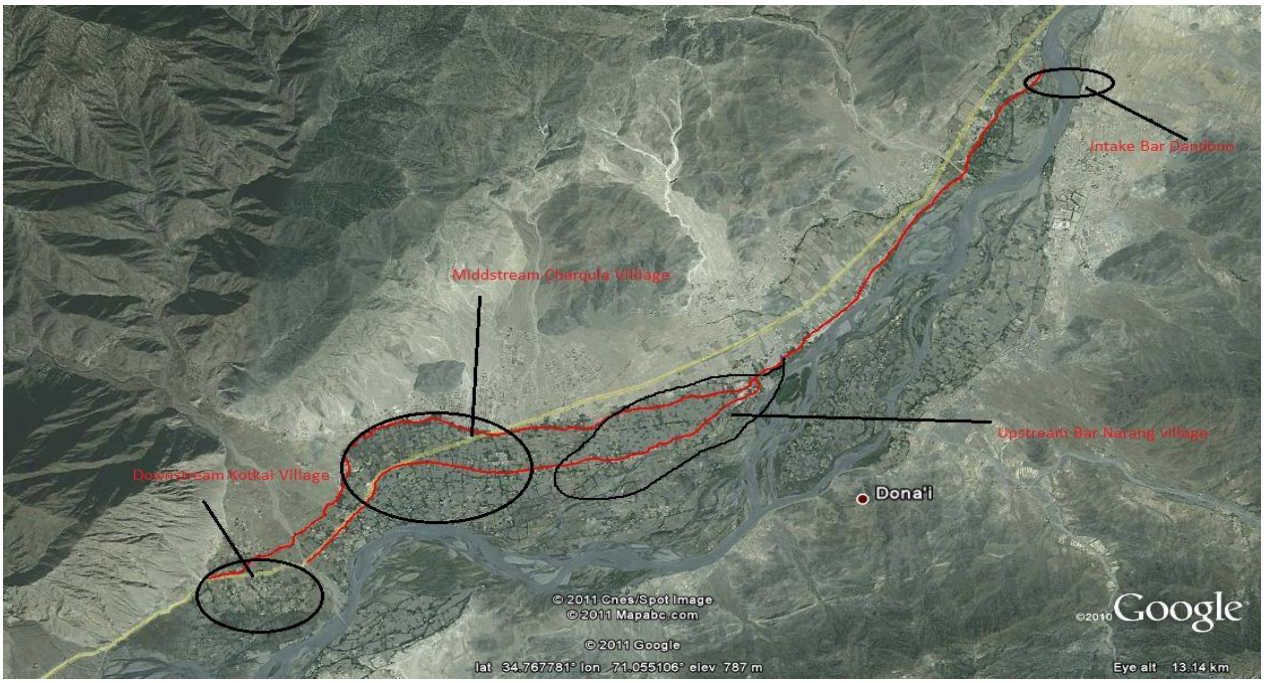
Figure 8: Discharge curve pul e- Kama of Kunar River



Source: Favre 2004,

Narang district is one of 15 districts in Kunar Province, Afghanistan. It is situated in the central part of the province and borders Chawki district to the south, Khas Kunar and Sarkani districts to the east and Asadabad district to the south. The total land for agriculture 2200 ha .from this figure the (1500/ha) is irrigated from the Narang canal. See the study area in figure 7, (Kunar profile)

Figure 9: Study Area Map



Source: Google Earth Map Website

The Narang region is surrounded by large ranges of high altitude volcanoes emerge above the plateaus. Deep canyons such as Badil valley and lachak valley contrast with the landscape. The total population of this district is 27937, mainly lives on the plane area of the district. The main crops for agriculture is wheat, rice, maize and different types of the vegetables. The poverty rate of the entire regions around 65%. Their Narang canal is 14 kilometres long and 3 meters wide. The source of water of the Narang canal is Kunar River. (Kunar Extension Department Annual Report 2010 and Kunar profile)

3.1.2. Climatology

Kunar province climate is arid to semiarid. It has cold winters and dry, hot summers, depending on altitude. In district summer occurs in the months of April to august and winter from October to March. In the region of Narang, climatology is defined by two seasons fall season and spring seasons. The data recorded include temperature, sunshine, wind speed, humidity and rain fall. The mention data come from the FAO climate website. There is no other station nearby appropriate for the Narang district.

3.1.3. Temperature

In the Narang district the temperature are estimated to vary between 0.4 c^{o} in January and 36.3c in June, with an annual average of 12c^{o}. These variations are changing upper and lower area in the district level.

3.1.4. Sunshine time

There is much sunshine, the sunshine in the Narang district is estimated to vary between 48%in March and 70.9 and the air is usually clear and dry. The average per month sunshine is 62%.

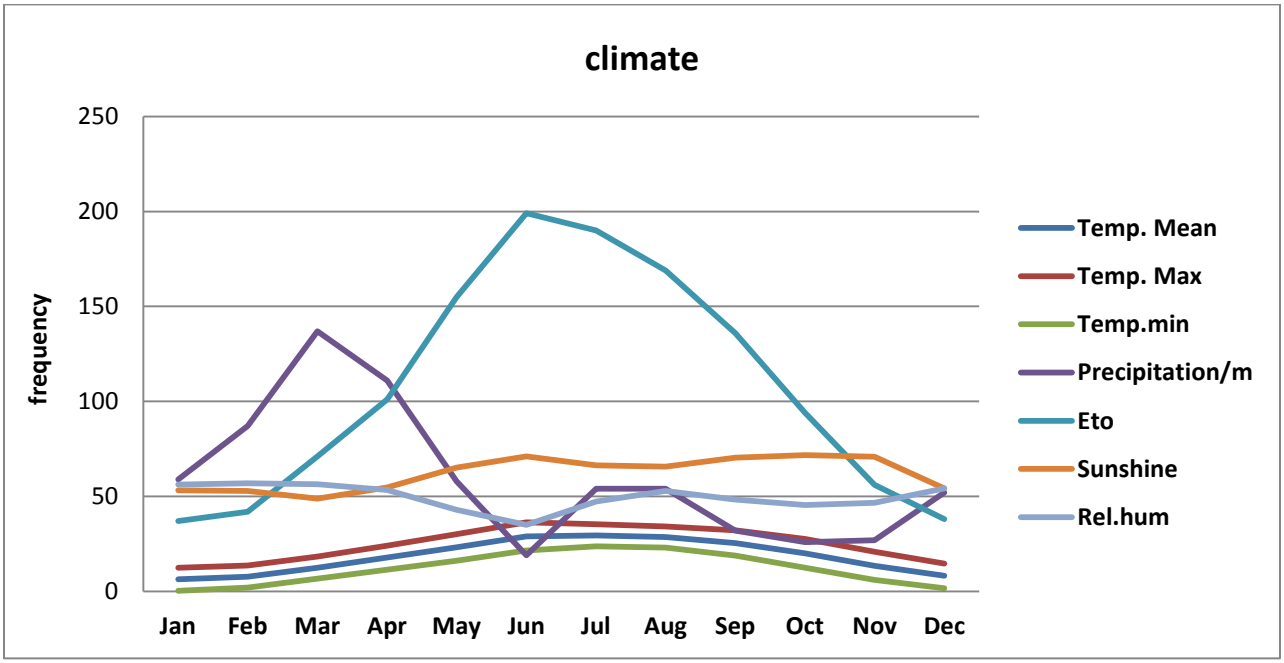
3.1.5. Relative humidity:

The annual average relative humidity is around 49.63 %, with the lowest values between June and November. And maximum values in the month of February.

3.1.6. Precipitation:

The most of the precipitation occurs between December and April the precipitation records were obtained from the AFO website. The average precipitation rate in the month is 60 mm/month the more information showing in the figure 8.

Figure 10: Narang climate data



Source: FAO Website

CHAPTER FOUR

4. RESULT

This chapter is proceeding to present the result of survey which was obtained from primary data collection through survey, group discussion and observation.

4.1 Group discussion

The group discussion was carried out with Mirab, community elders and extension department staff which is described separately as follow:

4.1.1 Discussion-Mirab

The Mirab was asked about the distribution of water among the water users. According to the Mirab the water distribution among the users is done according to land size. There is no turn system in our Mirab system and the water is diverted first by the upstream people and then middle and then the downstream people. Whenever there is a serious necessity of water to a village then the water is allowed to go to that village. In the past, all water users received water equitably because of the implementation of the water rights. Currently, the upstream people have changed their cropping pattern and they are sowing rice and vegetables which consume comparatively more water.

This resulted in the shortage of water at the downstream area. Usually, one Jerib of land needs 30 minutes of irrigation but it is dependent upon the water discharge. The community elders and the Mirab are involved in the temporary water distribution among the users. These people can allocate water for village in the time of necessity. Currently, the upstream farmers grow vegetables, rice and maize in the autumn season. The middle farmers grow maize, rice and few farmers also grow vegetables while the downstream people grow only maize. See the figure 1,

Photo 1: Photos of the Rice, Mize and Vegetables

Ridge Gourd Mize Rice

The farmers use their local knowledge for the determination of irrigation time. They look to the soiling dryness and wilting of plants and then decide for irrigation. One of the main reasons for the scarcity of the water in the autumn season is the poor condition of the intake. The level of the water in the river falls down and the intake receives little water. In this case all the farmers are asked to contribute in rebuilding of the intake. Second reasonable for the water scarcity is the flood problem in the autumn season. The flood washes away the intake and some parts of the canal causing water shortage for weeks. It takes few weeks to rehabilitate the canal and the intake. The crops face water stresses resulting in low yield and sometimes complete crop failure.

Mirab was asked about the conveyance losses of the canal. He replied that it is difficult to determine the actual conveyance losses of the canal but from my general observation and experience the canal has great losses because it is not lined and have poor conditioned. The control structures are not modern and are made of local materials.

The operation and maintenance of the canal is done by the Mirab, farmers and community elders. The Mirab system is composed of one Mirab with assistant from every main village locally known as (kakhai). Although we have the irrigation management department but it is not active and has no activities. They pass the time in their offices by drinking tea, Photo 2 shows meeting with Mirab.

Mirab gave the following suggestion for the management of the scarcity;

1. Make the intakes paved and improved
2. Make the turnout paved and improved
3. Protection against flood water at some parts of the canal.

Photo 2:Discussion with Mirab

4.1.2 Discussion- Extension Department Staff

They group discussion within the extension department staff gave the following information:

The water distribution among the users is done according to land size. There is no turn system in our Mirab system and the water is diverted first by the upstream people and then middle and then the downstream people. The community elders and the Mirab are involved in the temporary water distribution among the users. These people can allocate water for village in the time of necessity. There is no turn system in our Mirab system and the water is diverted first by the upstream people and then middle and then the downstream people. Whenever there is a serious necessity of water to a village then the water is allowed to go to that village. Usually, one Jerib of land needs 30 minutes of irrigation but it is dependent upon the water discharge.

In the Narang districts, the farmers grow vegetables, rice, maize and wheat. There is great variation in the cropping pattern between the upstream and downstream people. The upstream farmers grow vegetables, rice and maize in the autumn season. The middle farmers grow maize, rice and few farmers also grow vegetables while the downstream people grow only maize. Most of the farmers are illiterate and do not have technical information about the water requirements. The farmers use their local knowledge for the determination of irrigation time. They look to the soiling dryness and wilting of plants and then decide for irrigation. Most of the farmers over irrigate their fields and have wrong concept that over irrigation will increase their yield. They do not know the importance of the correct time of irrigation and correct amount of water.

There are various reasons behind the water scarcity in autumn seasons. Technically, in this season the evapo -transpiration is more. The farmers cultivate vegetables and rice in this season which required more water. There are other non agronomic reasons behind water scarcity. One of the main reasons for the scarcity of the water in the autumn season is the poor condition of the intake. The level of the water in the river falls down and the intake receives little water. In this case all the farmers are asked to contribute in rebuilding of the intake. Second reasonable for the water scarcity is the flood problem in the autumn season. The flood washes away the intake and some parts of the canal causing water shortage for weeks. It takes few weeks to rehabilitate the canal and the intake. The photos 3 show the weak infrastructure of the canal.

The crops face water stresses resulting in low yield and sometimes complete crop failure. Unfortunately, we have not measured the conveyance losses of the canal but from observing the general condition of the canals estimation could be made. The physical condition of the canal is too poor leading to considerable losses of the irrigation water. The operation and maintenance of the canal

Photo 3: Overview of Canal infrastructure

Stone made turnout

General view of the canal discharge

Canal intake local material made

Canal intake

is done by the Mirab, farmers and community elders. The extension department sometimes is also involved in the maintenance of irrigation infrastructure through projects. Cash for work projects are sometimes implement through our department.

My suggestions for managing the scarcity in the Narang district are as follow;

The extension department needs assistance from NGOs to implement projects of trainings for the farmers in on-farm water management, irrigation scheduling and determination of crop water requirements. Establishment of demonstration plots to show the farmers about the improved methods of irrigations. The following issues related to canal are also important:

- Make the intakes paved and improved
- Make the turnout paved and improved
- Protection against flood water at some parts of the canal.

4.1.3 Discussion with Community Elders

The group discussion with community elders was done which is summarized as follow:

The water distribution of irrigation water among the users is done according to land size. The land was registered in the directorate of agriculture, irrigation and livestock and according to that land water was allocated to the canals. In our case, we also distribute water according to the land size. There is no turn system in our Mirab system and the water is diverted first by the upstream people and then middle and then the downstream people. Whenever there is a serious necessity of water to a village then the water is allowed to go to that village. In the past, all water users received water equitably because of the implementation of the water rights.

Photo 4:Meeting with elder

Currently, the upstream people have changed their cropping pattern and they are sowing rice and vegetables which consume comparatively more water. This resulted in the shortage of water at the downstream area. Usually, one Jerib of land needs 30 minutes of irrigation but it is dependent upon the water discharge. The community elders and the Mirab are involved in the temporary water distribution among the users. These people can allocate water for village in the time of necessity. Photo 4 shows meeting with elder.

The cropping pattern of the upstream people has changed and currently, the upstream farmers grow vegetables, rice and maize in the autumn season. The middle farmers grow maize, rice and few farmers also grow vegetables while the downstream people grow only maize. The farmers have their own indicators for the determination of irrigation time. They look to the soiling dryness

and wilting of plants and then decide for irrigation. The intake of the canal is not good and the canal is poorly maintained which leads to water losses. The level of the water in the river falls down and the intake receives little water. In this case all the farmers are asked to contribute in rebuilding of the intake. Second reasonable for the water scarcity is the flood problem in the autumn season.

The flood washes away the intake and some parts of the canal causing water shortage for weeks. It takes few weeks to rehabilitate the canal and the intake. The crops face water stresses resulting in low yield and sometimes complete crop failure. We have wastage of waters in the canal but we do not have any idea about the quantity of water lasted. The operation and maintenance of the canal is done by the Mirab, farmers and community elders. The Mirab system is composed of one Mirab with assistant from every main village locally known as (kakhai). In order to manage water scarcity the intakes and turnout need improvement.

The canal also needs protection against flood in some parts of the canal. Overtopping of a canal section is one of the big problem in the upstream area it caused by an excessive discharge in that section in relation to the actual canal capacity. Canal banks which are frequently overtopped are very probably eroded and lowered, and thus the actual capacity will be less than the original capacity for which the canal has been designed. The canal capacity needs incensement in some parts. Rules and regulations on change in the cropping pattern must be made.

4.1.4 Survey

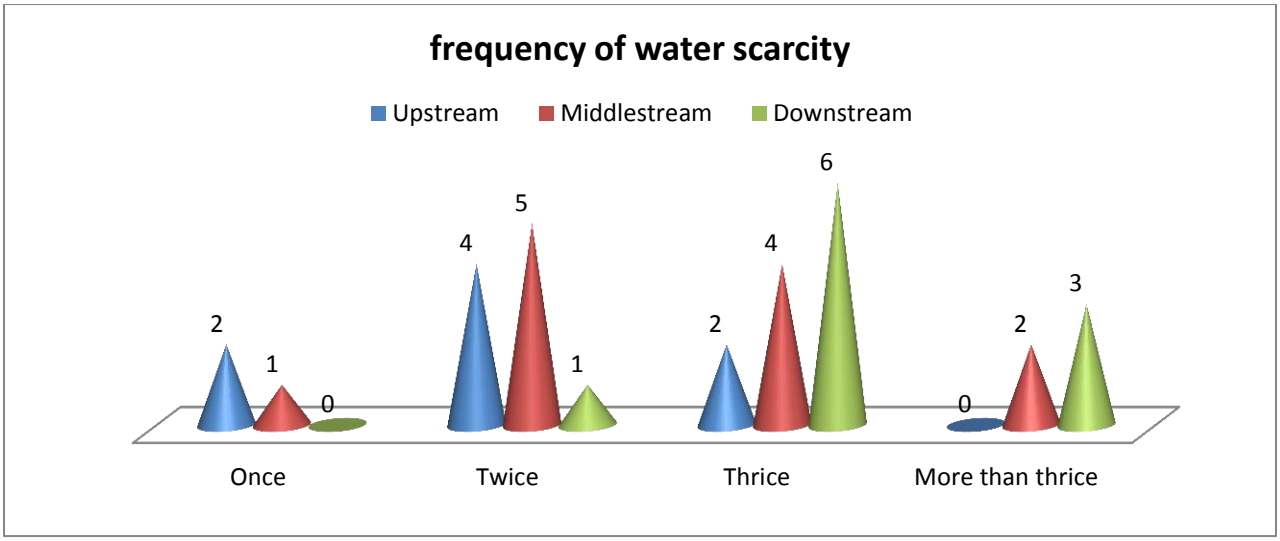
Thirty farmers from three different villages were interviewed and the result of the interview is given below: photo 5 shows the meeting with farmers of downstream.

4.1. Frequency of Water Scarcity

The figure shows that the downstream water users are mostly affected by the water scarcity. The middle stream is the second most affected people. In general all the water users are facing there water scarcity problems at least twice year.

Photo 5:Interview with Kotkai village farmers

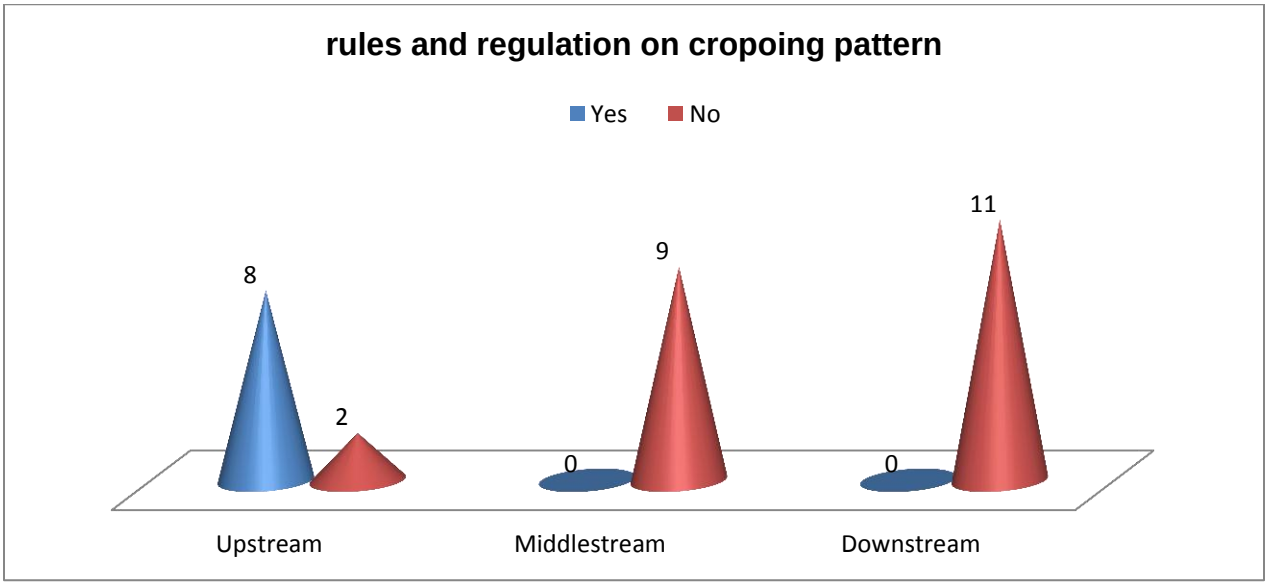
Figure 11: Frequency of water Scarcity



4.2. Rules and Regulations on Cropping Pattern

The figure below shows that there are no rules and regulations which governing the change in the cropping pattern by farmers. Therefore the upstream people have changed the cropping pattern and started cultivating more water consuming crops like rice and vegetables which has adversely affected the downstream people.

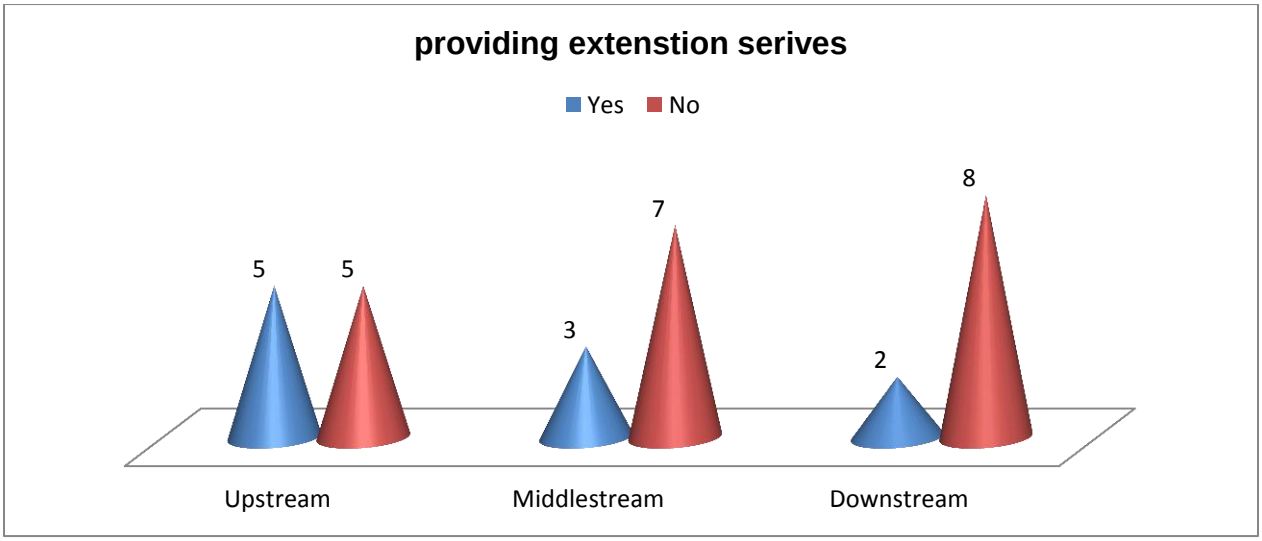
Figure 12: Rules and Regulation on cropping pattern



4.3. Provision of Extension Service by government or NGOs

The figure below indicates that the all the water users including upstream, middle and downstream do not receive extension services by government or NGOs.

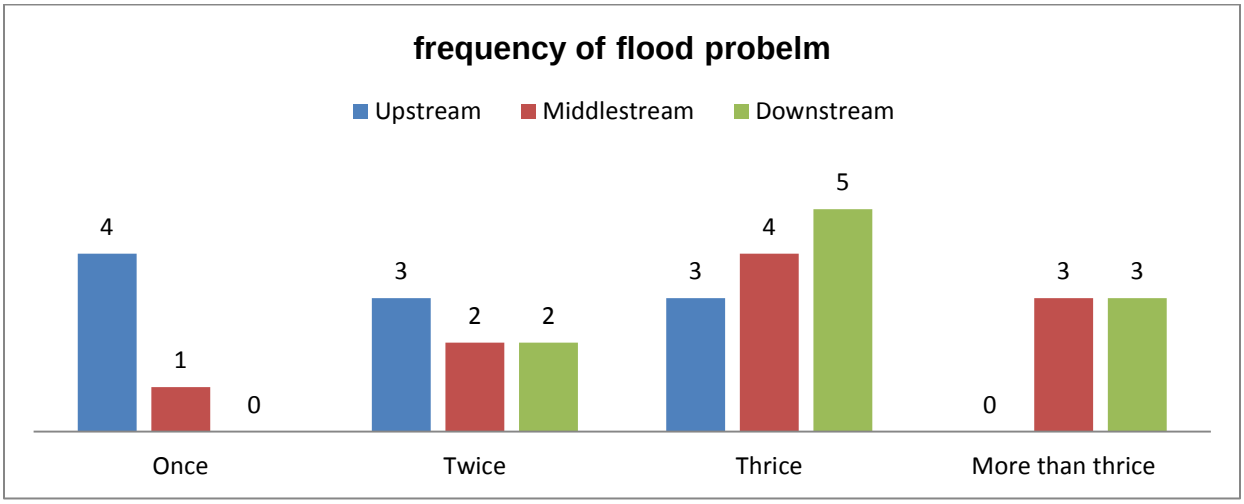
Figure 13: Provision of Extension Services by government or NGOs



4.4. Frequency of Flood problem faced by farmers

The figure below shows that the farmers of downstream area are facing flood problems more than the middle and upstream. It is clear from the figure the downstream people face at least three times flood problem per year.

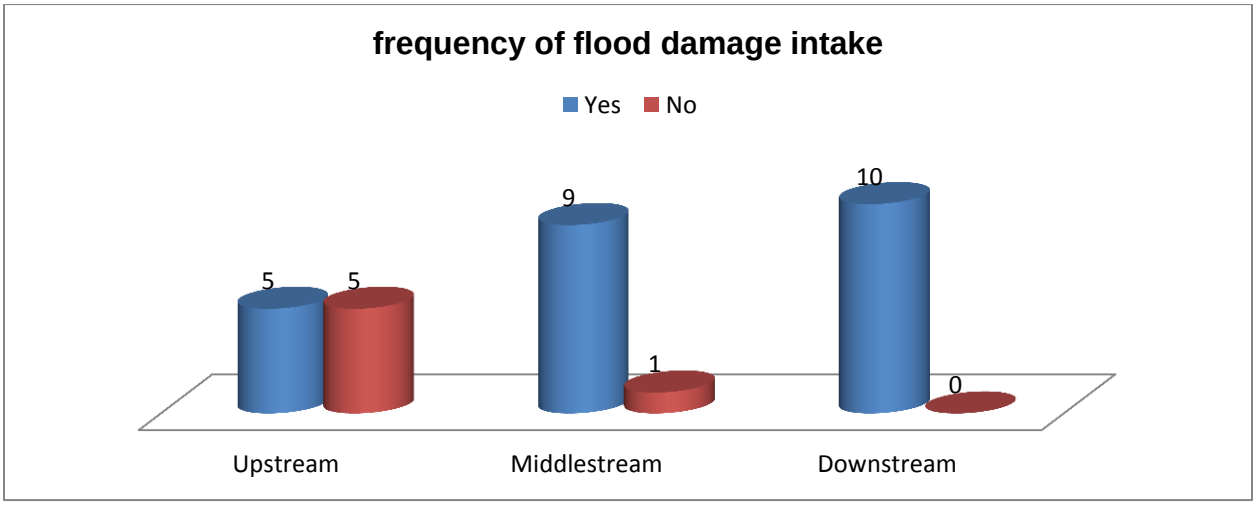
Figure 14: Number of floods faced by farmers per Year



4.5. Damage caused by the flood

It is clear from the figure below that the flood is causing damage to the intake of the irrigation canal which is one of the reasons of the scarcity. The canal cannot receive enough water from the river.

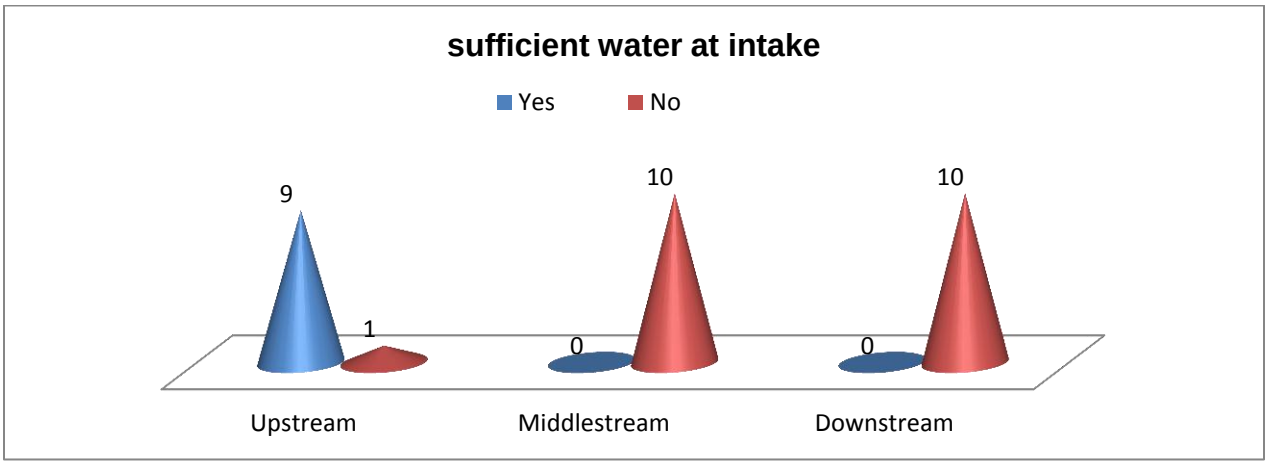
Figure 15: Damage caused by the flood to the intake of canal



4.6. Amount of water received by the intake

The figure below shows that there is problem with the intake of the canal. The intake of the canal does not receive sufficient water especially when destroyed by flood and when the level of the river falls down.

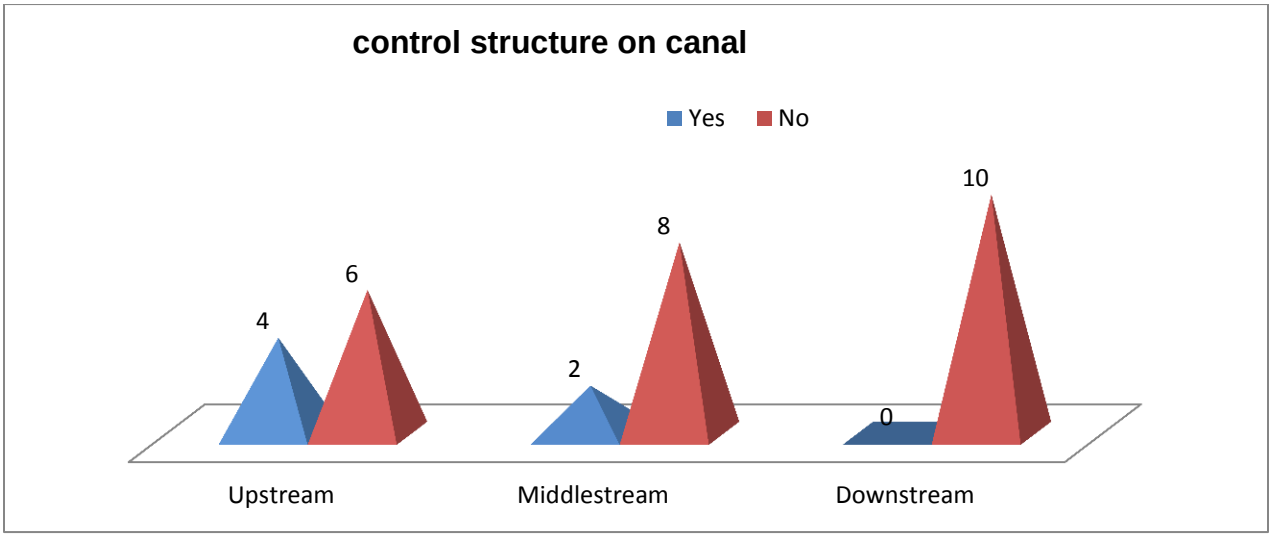
Figure 16: Amount of water received by intake of the canal



4.7. Improved water Control structure on canal and water courses

It is clear from the figure below that there are no improved water controls structures on the canal and the farmers usually use local materials i.e. stone, branches and so on for controlling or diverting water. The turnouts are also made of local materials wood, stone and bushes.

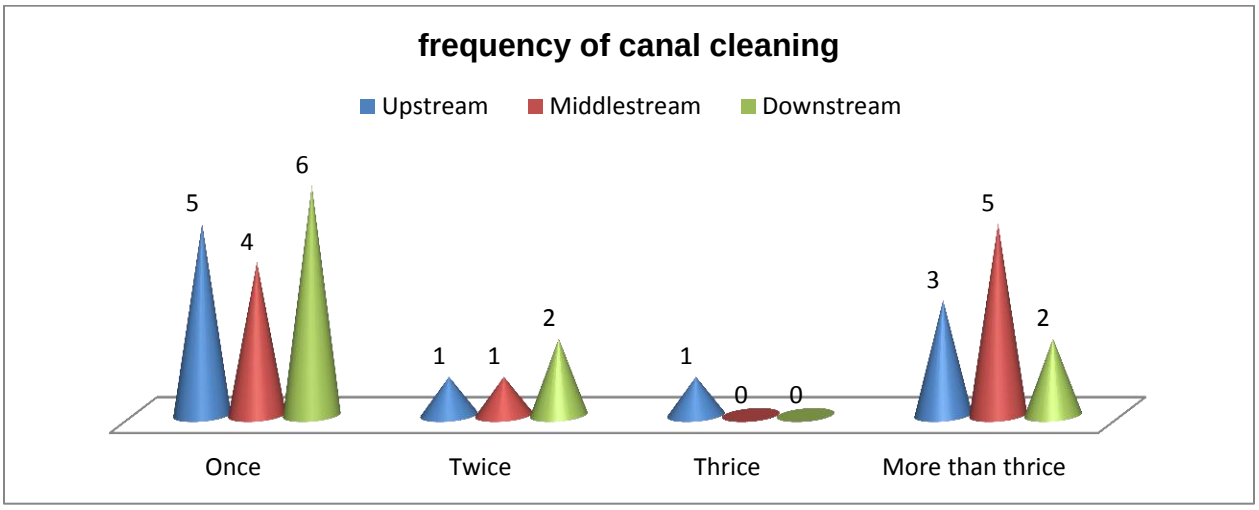
Figure 17: Improved water control structures on the canal



4. 8. Cleaning of Canal per year

It is clear from the figure below that the canal cleaning by the farmers is done only once a year. The clean is de-silted. The weeds and bushes are removed in the cleaning of the canal.

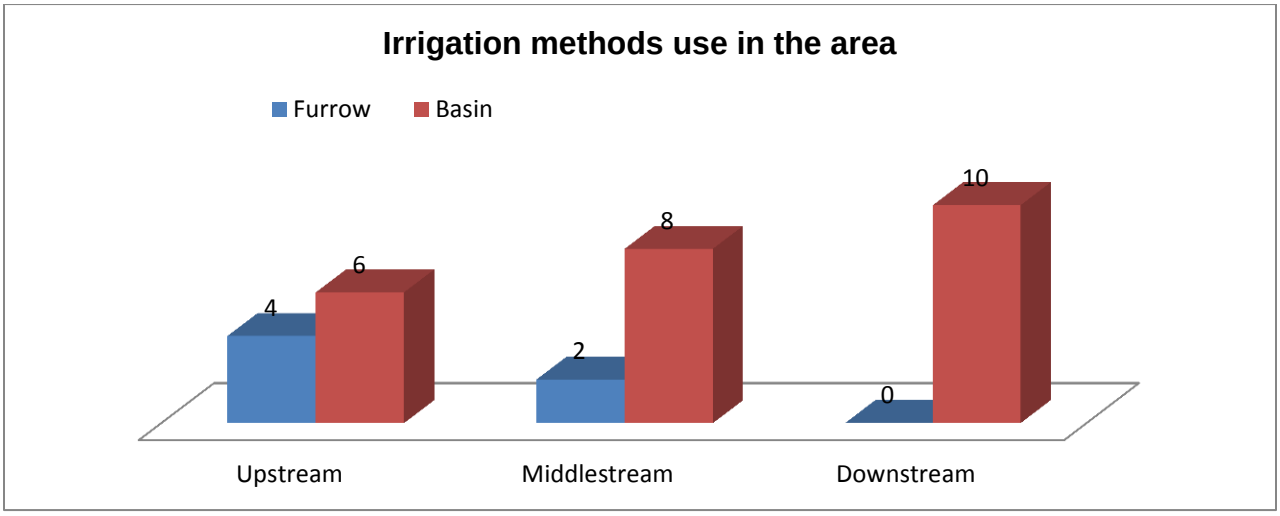
Figure 18: Frequency of canal cleaning per year



4. 9. Method of irrigation used by farmers

The figure below shows that the most of the farmers use basin irrigation method which has less efficiency as compared to the furrow irrigation method.

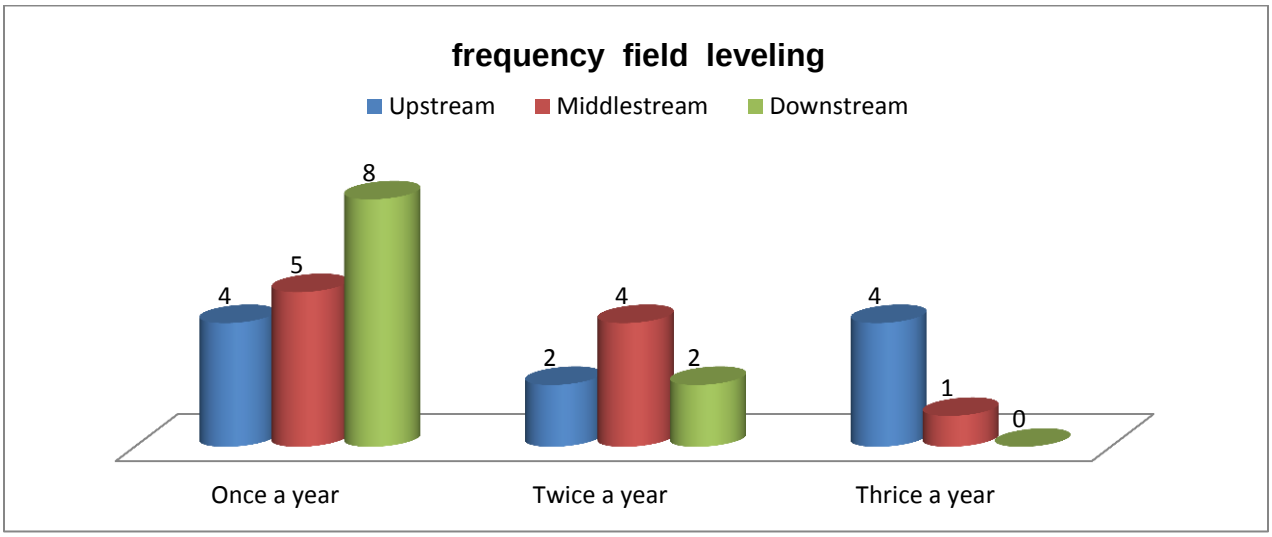
Figure 19: Method of Irrigation used by farmers



4.10. Frequency of land levelling by farmers

It is clear from the figure below that mostly of the farmers of upstream, midstream and downstream level their fields only once per year. However, the farmers who grow vegetables were levelling their fields twice and even thrice per year.

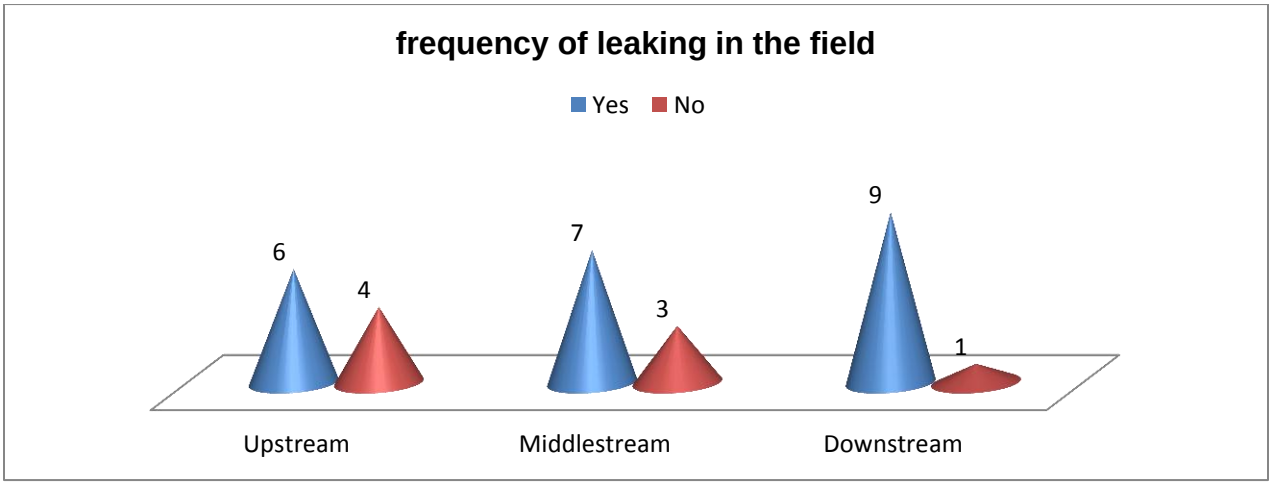
Figure 20: Frequency of land Leveling per year



4.11. Leaking of water in the field

The figure below shows that majority of the farmers have leakages in their fields caused by the rodents which lead to the losses of water.

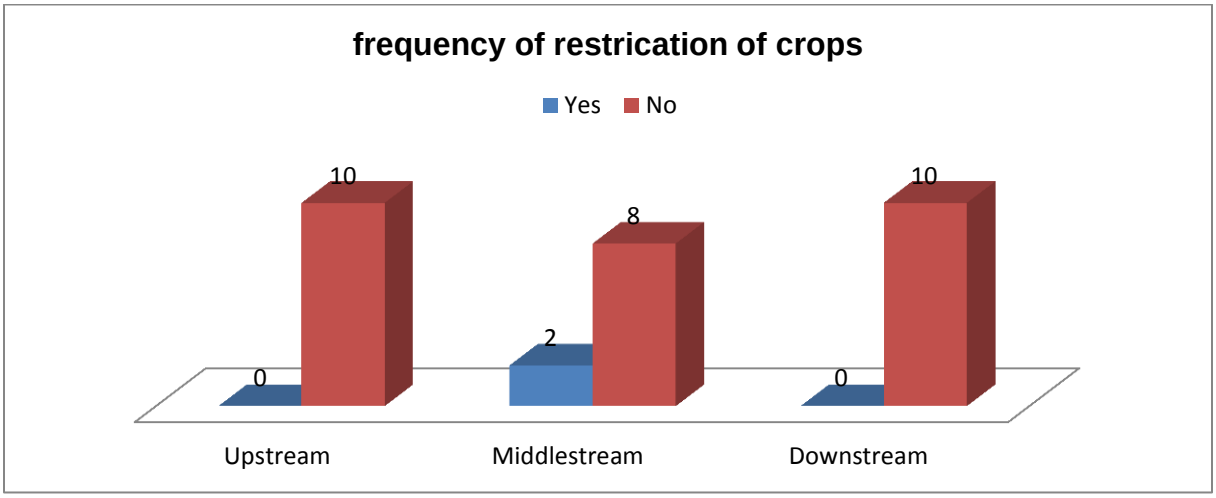
Figure 21: Leakages in the fields



4.12. Restrictions on the choice of crops

It is clear from the figure below that there is no restriction on choice of crops among the farmers. The people having more water are growing rice and vegetables which consume more water especially the upstream people.

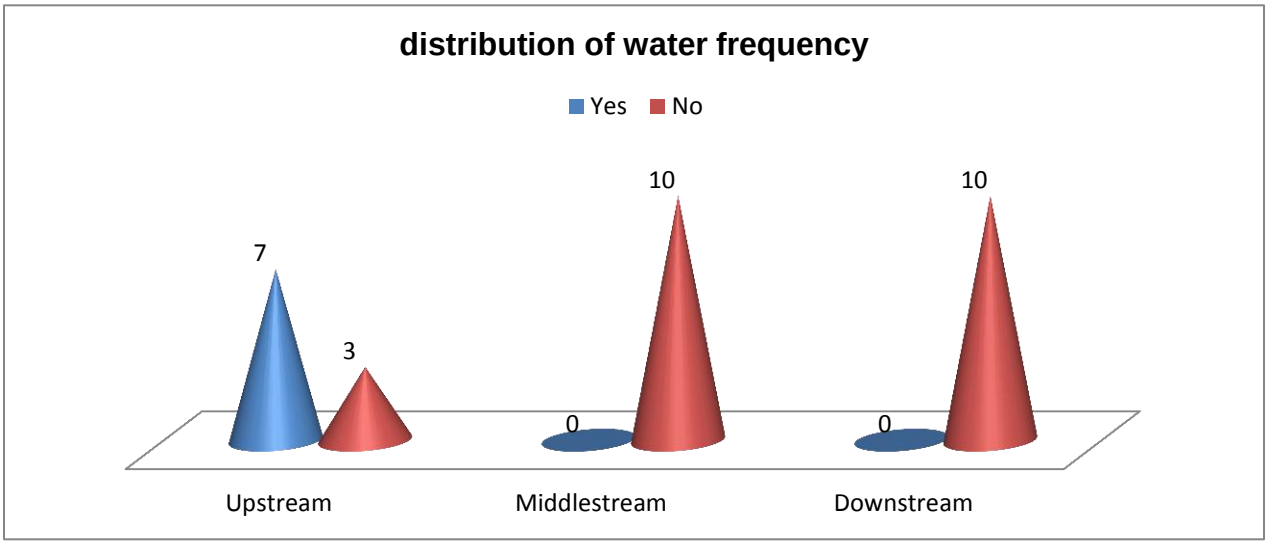
Figure 22: Restrictions on Choice of crops



4. 13. Equity in distribution of water

The figure below shows that the water distribution is not equitable and usually the downstream farmers receive less water as compared to the upstream people.

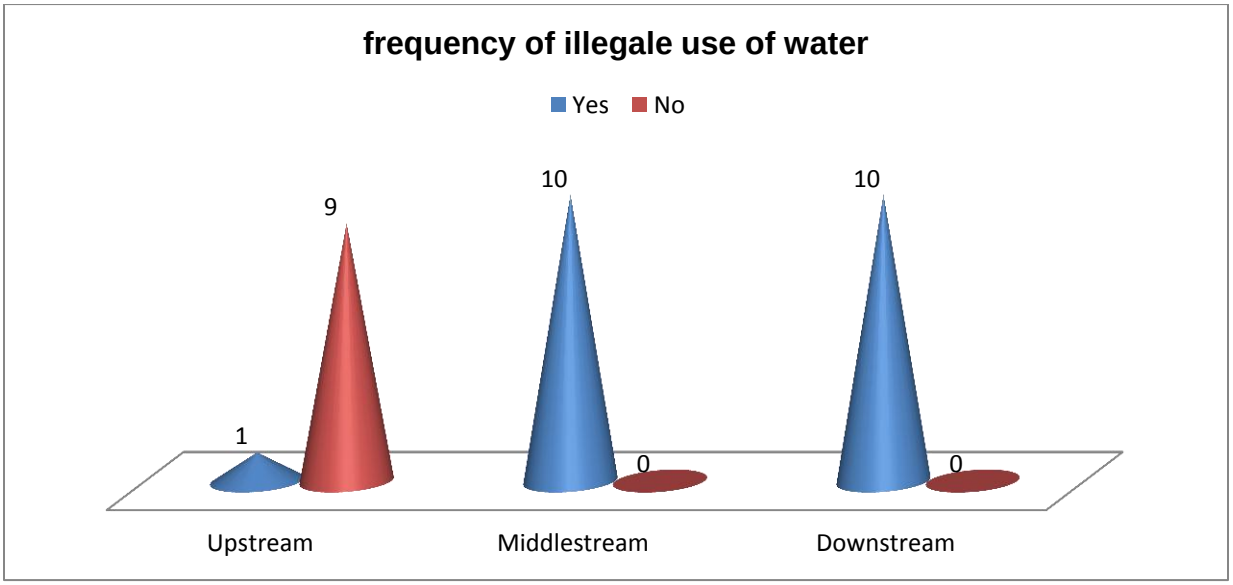
Figure 23: Equity in water distribution among the farmers



4.14. Illegal water use

The figure below shows that the farmers use water illegal especially when there is water scarcity. The practice of illegal water use is very common.

Figure 24: Illegal water uses



4.15. Personal Observations

The field observation was done for inspection of the canal infrastructures and farmers fields to observe the on-farm water management practices.

4.15.1. Canal Infrastructure

Intake

During the field work it was observed that the intake of the canal was made of local materials like stones, bushes, branches and bags filled with sand. The water was diverted to these traditional structures at the intake. The intake of the canal not powerful and resistant to flood water and was easily washed away by flood.

Culvert

The canal is passed through ups and downs area especially in the upstream area and is subjected to floods. There are culverts in some area which though which flood water is passed without damaging the canal. There were also certain areas where siphons were not installed which caused the damage of the canal and filling of the canal with silt by the flood water.

Turnouts

The turnouts on the canal and its branches were poor and were made of local materials like buses and stones.

Retaining Walls

Some parts of the canal are passing along the big river of Kunar and are subjected to damage of the river. There were no retaining walls and sometimes those parts of the canal were damaged by the river at the time of flood.

Leakage

There were leakage losses of water in some parts of the canal. There were larger openings in the canal bed and especially at sides. The main roots and causes of leakage of the canal are noticed are; rat or termite holes in a canal bed and sides the residents try to close the holes but after some days they are reopened by the rats; Moreover, the canal gates are not tightly sealed becomes more difficult to control the loss of water. Leakage often starts on a small scale, but the moment that water has found a way through a canal embankment a hole develops through which water leak.

Overtopping

It was observed in the upstream area of the canal that the embankment of the canal were weak and the water overtopped resulting in the water losses.

4.16. On-Farm Water Management

The observation of few on-farm water management practices were made during the field study which are described below:

Irrigation Methods

Majority of the farmers used the basin irrigation method which has more losses as compared to the furrow irrigation. The farmers who were growing vegetables were using the furrow irrigation method.

Over Irrigation

The upstream water users usually over irrigate their fields because they were thinking that more water will lead to more yields.

Land levelling

The majority of farmers level their land with tractors. The levelling of the fields was not good as majority of the fields observed had high spots. However, the levelling was good in vegetable fields as compared to other crops.

Cropping pattern

The upstream people were sowing vegetables, rice and wheat while the downstream cultivated only wheat and maize.

Summary of the Results

The result of the various group discussion, observations and survey is summarized as follow;

The irrigation water was managed by a community based, traditional system known as Mirab. The irrigation water was distributed among the users according to land size. There was no turn system in Mirab system and the water was diverted first by the upstream people and then middle and then the downstream people. Whenever there is a serious necessity of water to a village then the water is allowed to go to that village. In the past, all water users received water equitably because of the implementation of the water rights. Currently, the water rights are not implemented.

The majority of the water users are facing the problem of the water scarcity in autumn season. However, the downstream water users are mostly affected by water scarcity. There are several reasons which contribute in water scarcity ranging from the canal intake to the farmer fields: the intake of the canal is made of local materials and is often washed or damaged by the seasonal flooding. Moreover, the intake of the canal does not receive sufficient water especially in the autumn season. There are no improved water control structures in the canal which causes losses of water. Moreover, the canal cleaning is done only once a year. At the farm level, one of the reasons of the scarcity is the change in the cropping pattern especially at the upstream area where high water consuming crops have been cultivated. There is no restriction over the choice of the crops which have adversely affected the downstream people. The most common method of irrigation used by the farmers is the basin method which has less efficiency as compared to the furrow method. The fields of the farmers are not well leveled. There are leakages of water

which is caused by the hole dug by the rodents. However, the farmers who are growing vegetables have well leveled fields. The water distribution among the users is also not equitable. The upstream users use more water which affects the downstream water users. The illegal water use is also a common practice of the farmers. All these factors have contributed to the water scarcity especially in the autumn season.

The canal also needs protection against flood in some parts of the canal. Overtopping of a canal section is one of the big problem in the upstream area it caused by an excessive discharge in that section in relation to the actual canal capacity. Canal banks which are frequently overtopped are very probably eroded and lowered, and thus the actual capacity will be less than the original capacity for which the canal has been designed. The canal capacity needs incensement in some parts. Rules and regulations on change in the cropping pattern must be made.

From the observations at the canal level it is clear that the canal was poorly maintained. The intake was not good and made of local materials. The control structures such as turnouts were in bad condition. The canal embankments were week at certain parts of the canal and there was overtopping. At the farm level, the fields were not properly levelled. There were leakages in fields caused by holes of rodents. The farmers were over irrigating their fields. The most common method of irrigation was the basin irrigation. There was variation in the cropping pattern at upstream and downstream level.

The following suggestions were given to address the water scarcity in the autumn season.

Provision of trainings for the farmers in on-farm water management, irrigation scheduling and determination of crop water requirements. Establishment of demonstration plots to show the farmers about the improved methods of irrigations. Improvement and pavement of intakes, turnouts and protection against flood water at some parts of the canal is very important in order manage water scarcity in the autumn season.

CHAPTER FIVE

5. Discussion

5.1. Canal Infrastructure

The performance of an irrigation canal system depends not only on how the system is operated, but also on the condition of the canals. Irrigation canals function well so long as they are kept clean and if they are not leaking. If no attention is paid to the canal system, plants may grow and the problem of siltation may arise. Even worse, the canals may suffer from leakages. Plant growth and sedimentation not only impedes the flow in a canal, they also diminish the area of the cross-section.

5.1.1. Flood problems

From the survey results and field observation it clear that the Narang district is facing the seasonal flood problems. These floods destroy the intake and some parts of the canal causing water shortage for weeks. Although the flood problems occur mostly in upstream area but all the water users are affected from the floods because it destroy the parts of the canal and the intake. The intake is then rehabilitated with mutual labour contribution of the all the water users. This intake is made from the local materials and is easily washed away again by the floods. The intake of the canal does not receive sufficient water especially when destroyed by flood and when the level of the river falls down. The direction of the flow of the Kunar River is also changing each year to some extent causing water.

Various authors have considered the floods as a serious problem in Afghanistan. According to Kakar 2011 the significant dependence on agriculture, the lack of water storage infrastructure and ongoing land degradation render Afghanistan particularly sensitive to the effects of floods and drought.

According to Thomas and Eqrar 2011, Floods can severely damage water supply and irrigation infrastructure, representing important setback in the development of a community. in Badakhashan province ,for example the 2009 spring floods damaged six water supply networks and 83 wells, while in Baghlan province ,at least 430for example, the 2009 spring foods damaged six water supply networks and 83 wells, while, in Baghlan Province, at least 420 canal hydraulic structures were destroyed. This contributed to the inefficient and inequitable distribution of water for irrigation resource

According to the disaster Management information system the mountainous north – eastern region of the county is at particular risk. This is partly because of the higher spring precipitation levels, which can induce flash floods, and the grater snow accumulation at higher altitudes.

Thomas and Eqrar 2011 have discussed the period and floods in Afghanistan. Flash floods generally occur from February to June. The Kabul river basin is a notable exception because it

is influenced by the monsoon and often suffers from flash floods in august and September. In the area not influenced by the monsoon, heavier rain and snowfall during the early part of the year are reflected in high – intensity flash floods. River floods occur during the snow-melt period, primarily in June and July.

5.1.2. Control structure

From the survey and field observation it is clear that there are no improved water controls structures on the canal and the farmers usually use local materials i.e. stone, branches and so on for controlling or diverting water. The turnouts are also made of local materials wood, stone and bushes .The canal is also not lined and therefore there are a lot of conveyance losses. According to Anderson 2006, intakes are used for all canals in the lower Kundoz, with river water being abstracted by means of traditional temporary diversion weirs built from soil, stones, timber and grass that extend at a flat angle into the river .These weirs are remade every year or when they are damaged or destroyed by floods. No diversion weir supplies more than one canal, and suitable intake sites can be utilised by a number of canals with their intakes running parallel to each other.

According to Anderson 2006, the floods destroy diversion weirs and when the floods have passed, river levels are too low for canal to obtain water without rebuilding of weir.

5.1.3. Canal cleaning

The result of the survey showed that the farmers clean their canals only once a year. The canal is de-silted. The weeds and bushes are removed in the cleaning of the canal. That part of the canal is cleaned with mutual contribution which passes along a common area. The farmers clean the parts of the canal passing along their land individually. Each farmer is responsible to clean that part of canal which is passing along his land. However, the cleaning of canal only once a year is not sufficient. If the canal is cleaned at least twice a year then it will add in saving of more water.

According to Anderson 2006, the general cleaning is done annually at the beginning of the new year (21st March). This is before the first irrigation of the season, and is intended to rectify damage and siltation resulting from the winter rains. Maintenance is planned by the Mirab, but supervised by an appointed person from each village, and all canals are cleaned at the same time. This takes two three days on average. All farms that benefit from the irrigation water are required to contribute one labourer per holding or water right, depending on size and duration of flow. There is need to develop and maintain a good maintenance programme would help in lengthening the life of canal as it is mentioned in the following lines. Maintenance of an irrigation canal system is usually carried out in between two irrigation seasons, or at times of low water demand. It consists of cleaning, weeding, de-silting and re-shaping.

Bushes or trees on canal embankments should be removed. They may obstruct the water flow and their roots will open the compacted soil in the banks and cause the development of leakages. Plants silt and debris in the canal should be removed. While cleaning the canal bed, care must be taken that the original shape of the cross-section is kept. For this, a wooden

frame, or template, with the exact dimensions of the designed cross-section of the canal being cleaned, can be of great help. Breaches and rat holes in the embankments should be filled with compacted soil, inside as well as outside of the embankment. For compacting, the soil should be wetted. Weak sections and sections of canal embankments where people or animals cross the canal should be strengthened with compacted soil or with bricks.

For long lasting and effective results there is high recommendation that for maintenance operations it is important to develop and set up farmers' committees/association so as to be involved for active participation.

5.2. On farm Water Management Practices

5.2.1. Cropping Pattern

The result of the survey and group discussion showed that currently, there are no rules and regulations which governing the change in the cropping pattern by farmers. In past, there were also no rules and regulation on cropping but at that time water was abundant. The absence of rules and regulation on cropping patter allow the upstream people to change their cropping pattern and started cultivating more water consuming crops like rice and vegetables which has adversely affected the downstream people. At current water scarce time, there is a need to establish rules and regulations on cropping pattern which has a balance of benefits between upstream and downstream. According to Lorene Flaming and Alan Roe June 2009 Water scarcity at the tail end of canals limits the possibilities for high crop diversity and cash crops and results in reduced yields for other types of crops.

According to Riemann 2005, one of the causes of inequity in irrigation water distribution is the growing of more water consumptive crops by dominant people.

Anderson 2006, in his study in Kundoz province stated that farmers cultivate wheat, barley, clover and some Lucerne. If there is enough water for a second crop, farmers will cultivate some vegetables: carrots, turnips, cotton, beans, flax, sesame, maize, green maize for fodder and melons. Some farmers have fruit trees but many were lost during the drought. Some farmers cultivate poppy, but this is not a common crop at present. Farms with good water supplies grow cotton and rice but these water-demanding crops are discouraged to enable the limited summer water supplies.

5.2.2. Irrigation Method and Irrigation Time Determination

The field observation and the survey showed that the most common method of irrigation used by farmers is the basin irrigation method which has less efficiency as compared to the furrow irrigation method. More over the farmers especially at the upstream over irrigate their fields with the view that more irrigation gives more yields. The photo 6 shows a farmer with a spade irrigating his fields with basin method of irrigation.

According to ICARDA 2002, Major effort is needed to improve on – farm water management. The farmer's knowledge of crop water requirements is based on the dry appearance of soil surface or remembrance of the time of last irrigation. Basin irrigation is practiced widely which results in wastage of water at the expense of the lower end farmers.

Photo 6: Photo of basin irrigation method

5.2.3. Land levelling

The result of the survey showed that the farmers of upstream, midstream and downstream level their fields only once per year. However, the farmers who grow vegetables were levelling their fields twice and even thrice per year. Some farmers reflected on the land levelling that the currently the land levelling is done by the hired tractors. However, the skills of the tractor operators are not good which results in poor land levelling. Moreover, the rent cost of the tractor is high therefore farmers do no pay much attention to land levelling. In past, we used to level our land by oxen and we had good results.

According to ICARDA 2002, Levelling of irrigation field results in improved crop and water use efficiency. On an average, fifty percent of farmers surveyed responded that their farms are levelled. This is indication of widespread inefficiency in irrigation, to overcome unevenness of their fields, farmers divide their fields into smaller plots.

5.2.4. Water Leaking

From the field observation and survey it was clear that majority of the farmers have leakages in their fields caused by the rodents which lead to the losses of water. The canal and watercourses are not lined and are good living places at certain sites for rodents like rates. These rodents make holes in the canals, watercourses and even in fields resulting in water losses. More attention is needed to solve this problem both at farm level and at canal or watercourse level to save the losses of water.

5.3. Traditional Water Management System (Mirab System)

The irrigation water management in the Narang district is carried by the traditional water management system known as Mirab. According to Anderson 2006, the tradition of Mirab in Afghanistan shows that farmers have been able to maintain their own systems without outside interference for hundreds o years. Collectively they have constructed, managed and maintained traditional irrigation system, said to cover 90 percent of all irrigated area in Afghanistan, solving conflicts in water use and land in the process. Those communities now look for outside funding to solve problems first, before looking within their own community .This system is too weak and

its efficiency is declined in term of equitable water distribution and O&M of irrigation infrastructure.

The water distribution is done basically, according to the land size. However, there is a great gap between the actual water distribution and the water rights. The upstream water users receive more water as compared to the downstream. The upstream water users usually over irrigate their fields because of having more water and believing that more irrigation will result in more yields. If the water is properly distributed and managed the water scarcity could be reduced to some extent.

According to the Kakar 2011, in most parts of Afghanistan, de facto inequitable water sharing is practiced within and between canals. in many cases , including during periods of drought , upstream farmers use more water than necessary to grow lucrative , water –intensive crops such as rice or cotton ,while downstream farmers are obliged to use far less water merely to grow subsistence crops . The inequity in water sharing is well captured by local proverbs noting that access to irrigation water mainly based on the location o fields within a canal system. Better to be servant in the upstream area than a king in the downstream area.

According to Anderson 2006, many of the problems of water management and inequalities of water distribution between villages stem from inefficient abstraction and significant conveyance losses at times of peak demand and relatively low flows. There is clear evidence of flexibility at the local level, with farmers sharing water on an as-needs basis with their neighbors, whether on the same canal or on other systems.

5.3.1. Water right

Water right issue is an important factor if irrigation is to improve substantially. The survey showed that farmers are not using local practice and traditional laws in water distribution. There is need to for the implementation of the water rights through the support of government.

5.3.2. Possible ways Scarcity reduction

Environment may prove difficult. But unless the water law is updated and enforced, agricultural improvement will be difficult to achieve. (ICARDA 2002)

In the group discussion with community elders and government extension staff it was mentioned that the current infrastructure needs improvement in order to redress the water scarcity in the Narang district.

Van den Bosch, Hoevenaars and Broawer, 1992. Emphasise of on the inspection and regular rehabilitation of the irrigation canals to prevent major problems of leakages, destruction of embankments and erosion in the canal. Rat holes in canal banks, small leakages and erosion in the canal are leading to the water losses. These problems should be addressed properly.

5.3.3. Extension Service

Extension services in field of water management play great role in water management and its efficient use. The survey results showed that there are no extension services in the study area

and all the water users including upstream, middle and downstream do not receive extension services by government or NGOs. Addressing the current water scarcity in the Narang district needs an integrated approach from water management, distribution and improvement of physical infrastructure. According to ICARDA 2002, extension workers are not trained in problem conceptualization, diagnoses or solution.

As a first step, extension workers should learn about measurement of water and estimation of losses, identification of moisture stress and soil fertility, estimation of the need for land levelling, and communication skills. Once the field workers have been trained in theses problem identification skills, they will need to learn about problem solving skills. These should include, estimating crop water requirements water conservation techniques, irrigation schedules for different crops, organizing farmers for maintenance of canals and watercourses improved irrigation and cultural practices and crop planning.

CHAPTER SIX

6. CONCLUSION AND RECOMMENDATIONS

6. 1 CONCLUSION

Narang is one of the important agricultural districts of Kunar province. Canal is the main source of irrigation water for the district. The water distribution and O&M of irrigation infrastructure is carried out by community based irrigation management system known as Mirab. The people of Narang district face problem of water scarcity especially in autumn season. The causes of the water scarcity are summarized below.

The result of the survey indicated that the water scarcity in the Narang districts has different reasons ranging from the improper water distribution, poor maintenance and improper on farm water management practices. The result showed that the water distribution among the water users is not equitable. The upstream people use more water as compared to the downstream water users. The upstream water users do not care for downstream water users much. One of the reasons is the change of cropping pattern in the upstream area.

The upstream user started cultivation of more water consuming crops like rice and vegetables which has affected the downstream users. The physical structure of the canal is poor and has lot of water losses. The canal intake is made of local materials and is very weak. The intake is washed away by the flood waters in spring season and is rehabilitated by the water users again and again. It takes several weeks to rehabilitate the intake. In contrast, the water level in the river falls down and the intake receive less water which causes water shortages.

The canal is subjected to occasional floods in the spring and in autumn seasons. Many parts of the canal are destroyed by these floods and take several days to rehabilitate it. The control structures like turnouts are made of local materials and are not good in water diverting and distribution. Moreover, the canal embankments are weak in some parts of the canal where overtopping occurs. The leakages in the canal were also observed which are caused by rodents.

At the farm level, the water use was not efficient. The farmers do not know the crop water requirements and determination of irrigation time was based on their own perceptions. Soil dryness and crop wilting were the two main indicators for crop water requirements. The farmers especially the upstream uses over irrigate their crops believing that it will contribute in increase of crop yield. The levelling of the land was not good and there were high spots in the fields.

In general, the Mirab system is liked by the people and they have great respect for the Mirab. In reality, the current Mirab system is not effective in the equitable water distribution and O&M of irrigation infrastructure. The weak Mirab system is also one the reason of the scarcity.

In order address the water scarcity in Narang district two kinds of approaches i.e. short term measures and long term measure are needed. The short term approach should focus on the improvement of the on-farm water management practices of the farmers through trainings and seminars. Improvement of the embankments, closer of the leakages and killing of the rodents could is also important. On the long run, the strengthening and improvement of the traditional water management system is needed. The system needs to be authorized in making important decision making in water distribution, determination of cropping pattern and implementation of water rights.

The physical infrastructure of the anal also needs rehabilitation and improvement. The intakes, turnouts and the embankment of the canal need rehabilitation and improvements. It can be concluded that the causes of the water scarcity in the Narang canal has various reasons which belong to the poor maintenance of the canal, weak traditional irrigation water management system and poor on-farm water management practices. In order to manage the scarcity a multi-dimensional approach will be need both on long and short run.

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6.2 RECOMMENDATIONS

In order to contribute in the scarcity reduction in the Narang district two kinds of recommendations are given:

Short term Measures

- In order to control the overtopping problem the width of the canal needs to be increased. The area of the canal where the overtopping occurs is very narrow. The width of the canal should be brought the original size i.e. 3 meters. The community elders with Mirab could play great role in this regards.
- The Irrigation Management Department (IMD) has started supporting Mirab and registered some Mirab of other canals. The IMD should also register and support the Narang Mirab.
- The Agriculture Irrigation and livestock Department of DAIL should provide the farmers trainings in improved on farm water management practices like land leveling, determination of crop water requirements and proper irrigation methods. The farmers should be made aware of the disadvantages of over irrigation.
- The farmers' community should make bridges from local materials in area where animals crossed the canal and causing damage to the canal.
- The community elders and Mirab should ask farmers to improve their turnouts on their own efforts. The farmers should clean the canal at least twice a year with common contribution of fund or labour.
- The farmers should raise common fund for the operation and maintenance of irrigation infrastructure.
- The MAIL should provide the cross visit to farmers and Mirabs to share they own experience.

Long Term Measures

The Kunar River is flowing freely with zigzag pattern. This river needs protection walls at certain places to make it straight. This will protect hundreds Jerib of land from being washed away. The intakes of various canals will also be protected from the flood waters of this river.

- Government (MAIL) should take responsibility to protect the forests and provide there law to avoid the deforestation of the province.
- The canal intake should be made on sound basis.
- The canal should be rehabilitated and should make resistant enough to the flood water.
- The Mirab system needs improvement and strengthening to ensure the implementation of water rights, rules and regulation over cropping pattern and operation and maintenance of the canal.

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Annexes:

Annex 1.Plan of approach:

S.N	Activities	Months															
		June, 11				July, 11				August,11				September, 11			
1	Preparation of research proposal																
2	Literature review																
3	Field work/ Data collection																
4	Data analysis																
5	Report writing																
6	Submission of draft report																
7	Working on report																
8	Submission of final report																
9	Thesis defence																

Annex 2. Assessment questionnaire

Questionnaire on managing water scarcity in the Narang canal Kunar province Afghanistan.

Name of the respondent: Ph No:

Address:

Education: □Primary □Secondary/Diploma □University □Illiterate

General

1. How often do you face water scarcity?

a) Once a year b) twice a year c) thrice a year d) more

2. Is there any rule and regulations on cropping pattern?

a) Yes b) No

3. is there any NGO or government official providing extension services?

a) Yes b) No

Physical Infrastructure

4. How often do you face flood problem?

a) Once a year b) twice a year c) thrice a year d) more

5. Does the flood damage your intake?

a) Yes b) No

6. Do you have sufficient water at the intake?

a) Yes b) No

7. How is the canal?

a) Lined b) Semi-lined c) not lined

8. Do you have control structure on your canal and watercourses?

a) Yes b) No

9. How often do you clean your canal?

a) Once a year b) twice a year c) thrice a year d) in two year one time

On-Farm Water Management Practices

10. Which method of irrigation do you use?

a) Furrow irrigation b) drip irrigation c) basin irrigation d) other

11. How often do you level your field?

a) Once a year b) twice a year c) thrice a year d) not at all

12. Do you have leaking in your field?

a) Yes b) No

13. Is there any restriction on types of crop?

a) Yes b) No

Water Distribution

14. Is the distribution of water equitable?

a) Yes b) no

15. Is there and water course ending in marshy land or back to river?

a) Yes b) No

16. Is there any illegal use of irrigation water?

a) Yes b) No

Annex 3. Checklist for discussion

Mirab

1. How is the water distributed among the farmers?
2. Who are involved in the distribution of water?
3. How much hour of water do you use per Jerib?
4. What do you grow?
5. How do you determine water requirement?
6. According you what are the major reasons for water scarcity?
7. Which cropping season is the most affected by water scarcity?
8. How much is the conveyance loss of water?
9. Do you know whose responsibility is to maintain the canal? Please explain
10. Is there any traditional managing practice to avoid the water scarcity? If yes, please describe.
11. What are your suggestions for managing the water scarcity?

Annex 4. Checklist for discussion

Extension staff

1. How is the water distributed among the farmers?
2. Who are involved in the distribution of water?
3. How much hour of water do you use per Jerib?
4. What do you grow?
5. How do you determine water requirement?
6. According you what are the major reasons for water scarcity?
7. Which cropping season is the most affected by water scarcity?
8. How much is the conveyance loss of water?
9. Do you know whose responsibility is to maintain the canal? Please explain
10. Is there any traditional managing practice to avoid the water scarcity? If yes, please describe.
11. What are your suggestions for managing the water scarcity?

Annex 5. Checklist for discussion

Community elders

1. How is the water distributed among the farmers?
2. Who are involved in the distribution of water?
3. How much hour of water do you use per Jerib?
4. What do you grow?

5. How do you determine water requirement?
6. According you what are the major reasons for water scarcity?
7. Which cropping season is the most affected by water scarcity?
8. How much is the conveyance loss of water?
9. Do you know whose responsibility is to maintain the canal? Please explain
10. Is there any traditional managing practice to avoid the water scarcity? If yes, please describe.
11. What are your suggestions for managing the water scarcity?

Annex 6.Narang district climate information table

Latitude: 34.753° **Longitude:** 71.048° **Elevation:** 1 227m

Month	Prc.	Prc.	Prc. cv	Wet days	Tmp. mean	Tmp. max.	Tmp. min.	Grand Frost	Rel. hums.	Sun shine	Wind (2m)	ETo	ETo
	mm/m	mm/d	%	days	°C	°C	°C	days	%	%	m/s	mm/m	mm/d
Jan	59	1.9	88.2	4.2	6.4	12.5	0.4	17.9	56.2	53.2	0.9	37	1.2
Feb	87	3.1	53.7	6.4	7.8	13.6	2.0	13.8	56.9	52.8	0.9	42	1.5
Mar	137	4.4	52.7	11.2	12.5	18.3	6.7	7.0	56.5	48.9	1.0	71	2.3
Apr	111	3.7	59.9	11.3	17.8	24.1	11.5	1.5	53.4	54.7	1.0	101	3.4
May	58	1.9	89.9	8.4	23.2	30.2	16.2	0.2	42.9	65.1	1.3	155	5.0
Jun	19	0.6	119.0	5.0	28.9	36.3	21.5	0.0	35.1	71.1	1.6	199	6.6
Jul	54	1.7	97.0	7.1	29.5	35.4	23.7	0.0	47.3	66.4	1.5	190	6.1
Aug	54	1.7	122.2	7.8	28.6	34.2	23.0	0.0	52.8	65.7	1.4	169	5.4
Sep	32	1.1	110.1	5.2	25.5	32.2	18.8	0.1	48.3	70.4	1.2	136	4.5
Oct	26	0.8	90.8	4.0	20.0	27.6	12.5	1.2	45.4	71.7	0.9	94	3.0
Nov	27	0.9	128.2	3.0	13.4	20.9	6.0	6.7	46.6	70.9	0.8	56	1.9

Dec	52	1.7	127.6	4.4	8.2	14.7	1.7	14.8	54.2	54.2	0.8	38	1.2
Total	714											1 287	

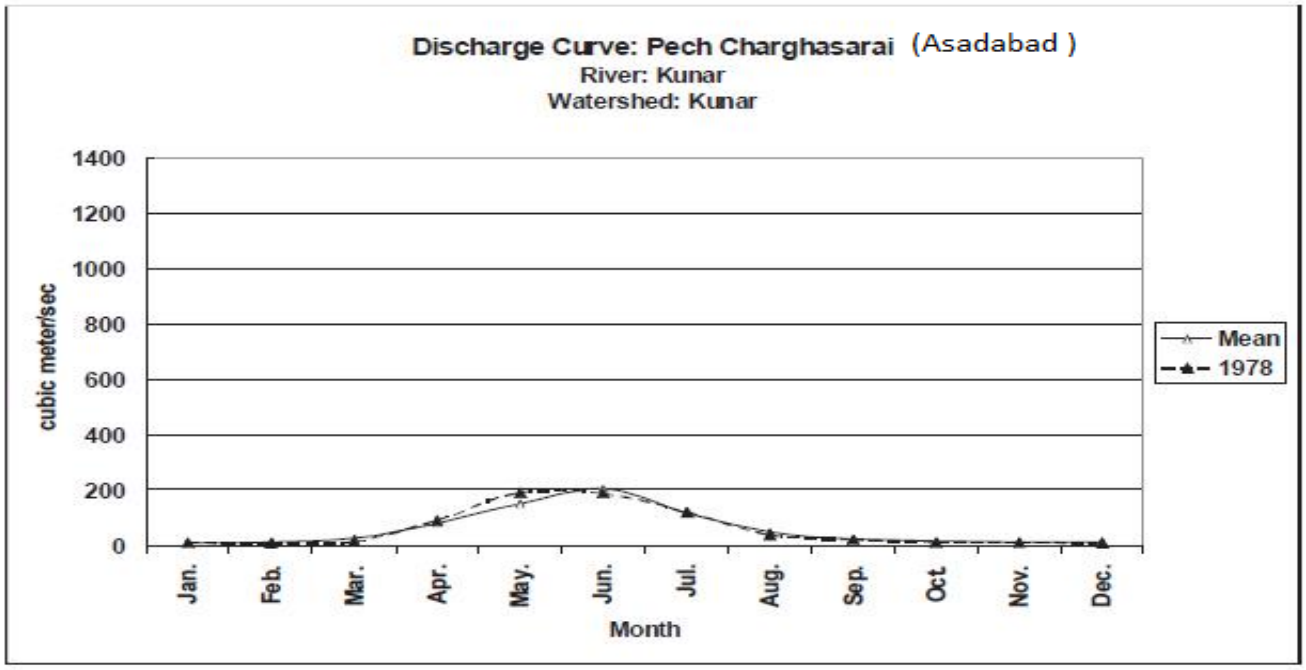
Source: FAO climate website

Annex 7. List of the different respondent from the command area

No	Respondent name	Age/year	Village	Job
1	Sher Malang	39	Upstream (Bar Narang)	Farmer
2	Asmat ullah	42	Upstream (Bar Narang)	Farmer
3	Mohamad sadiq	60	Upstream (Bar Narang)	Farmer
4	Gul Mohammad (kapile)	62	Upstream (Bar Narang)	Farmer
5	Mohammad Asif	33	Upstream (Bar Narang)	Farmer
6	Ibrahim	30	Upstream (Bar Narang)	Farmer
7	Malang pacha	52	Upstream (Bar Narang)	Farmer
8	Waheedullah	35	Upstream (Bar Narang)	Farmer
9	Mohammad Nadir	48	Upstream (Bar Narang)	Farmer
10	Merza	40	Upstream (Bar Narang)	Farmer
11	Malim Amanullah	48	Upstream (Bar Narang)	Elder (member of local council or shoura)
12	Abdul Zahir khan	55	Upstream (Bar Narang)	Elder (member of local council or shoura)
13	Abdul Akabar	50	Middle stream (Charqula)	Farmer
14	Abdul jamil	45	Middle stream (Charqula)	Farmer
15	Gulam rasole	55	Middle stream (Charqula)	Farmer
16	Gul Bahar	55	Middle stream (Charqula)	Farmer
17	Sher wali	35	Middle stream (Charqula)	Farmer
18	Khanzada	37	Middle stream (Charqula)	Farmer
19	Ajmal	32	Middle stream (Charqula)	Farmer
20	Momin khan	31	Middle stream (Charqula)	Farmer
21	Sher zada	28	Middle stream (Charqula)	Farmer
22	Anwer khan	37	Middle stream (Charqula)	Farmer
23	Mamoor Mohamad said	60	Middle stream (Charqula)	Elder (member of local council or shoura
24	Haji Mamtaz	53	Middle stream (Charqula)	Elder (member of local council or shoura
25	Gulam Ali	50	Downstream (Kotki)	Farmer
26	Laqat khan	31	Downstream (Kotki)	Farmer
27	Saidullah	30	Downstream (Kotki)	Farmer
28	Ajamal khan	45	Downstream (Kotki)	Farmer
29	Mehbatdin	28	Downstream (Kotki)	Farmer
30	M sadin	54	Downstream (Kotki)	Farmer

31	Haji Dawood	63	Downstream (Kotki)	Farmer
32	Azat ullah	58	Downstream (Kotki)	Farmer
33	Salim	27	Downstream (Kotki)	Farmer
34	Masafar khan	37	Downstream (Kotki)	Farmer
35	Haji Ataullah	54	Downstream (Kotki)	Elder (member of local council or shoura
36	Malim khalilullah	52	Downstream (Kotki)	Elder (member of local council or shoura
37	Sher Azam khan	41	Kotki	Head of extension
38	Mohamad Rahim	62	Kotki	Mirab

Annex: 8 Discharge curve pech charghasarai or Asadabad



Source: Favre 2004,