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INDIGENOUS SURFACE IRRIGATION AND WATER MANAGEMENT: CASE STUDIES OF GAWALDAI AND SHYOK VALLEYS-PAKISTAN

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Abstract

In the mountainous north of Pakistan, areas where arid and semi-arid climate prevails, farmers have developed their own irrigation system in which water of streams and springs is utilized for irrigation through man-made water channels called diversion channels. During pre-winter and pre- summer, the flow of water in streams and springs reduces due to low temperature in mountains. Eventually, discharge of water in diversion channels is also affected. Due to the scarcity of water, farmers have developed a community oriented water management system based upon rationing of water. This paper is an attempt to probe the method of this irrigation system and role of social organizations in irrigation practice and water management in two areas; the Gawaldai Valley, located in the Khyber Pukhtunkhwa region and the Shyok Valley, located in Gilgit Baltistan region of Pakitan.

Introduction

Irrigated farming in the mountainous regions of Khyber Pukhtunkhwa and Gilgit Baltistan has gained attention of researchers, particularly for their indigenous method of irrigation called diversion channels and community oriented water distribution and management system being practiced in these two regions for centuries (Israruddin, 1967, Kreutzmann, 1988, and others). In this method, cultivated lands of mountainous terrain and elevated valleys are irrigated through diversion channels (Khan, 2005). The whole system works on the basis of indigenous method of constructing channels and tanks for maintaining gravity for the flow of water in diversion channels. Some water channels are several kilometres long passing through difficult terrains. To maintain gravity for the flow of water wooden pillars and wooden channels are used to supply water to croplands. The social organizations of villagers like conciliatory body called *"Punchait'* and judicial body called *"Jirga"* are responsible for construction of water channels, their maintenance, water distribution and resolving conflicts of water sharing and water theft among villagers. In early summer(March to May), when melting of snow on mountains does not fully start and early winter (October to November) when freezing and snowfall begins, natural flow of water in streams and springs reduces. Farmers get low amount of water to irrigate their croplands through these diversion channels. Due to the scarcity of water in these months village communities operate indigenous systems of water rationing and management

developed by their elders centuries ago.

The role of social organizations in the development of indigenous irrigation system and water management technique has remained an important field of research in social geography. Many studies were conducted on the indigenous and traditional methods of irrigation and water management systems in different regions of the world like Karez in Pakistan, Qantas in Iran and Saudi Arabia, Foggaras in Oman etc. (Cressey, 1958, Beaumont,1971,Rehman,1981 and Khan,1998). Despite the importance of this social perspective of irrigation system and water management, little attention has been given by the researchers to bring out facts of the old indigenous irrigation and water management system of diversion channels being practiced in the northern parts of Pakistan. One of the pioneer studies in this regard was carried out by Israruddin (1967). He investigated the techniques of constructing diversion channels and their distribution system in Khot Valley of Chitral district, Khyber Pukhtunkhwa. German geographers Staley (1969) and Kreutzmann (1988) brought out some facts of irrigation system in the Hunza valley of Gilgit Baltistan. Similarly, Khan (1994) pointed out the development of modern irrigation system in the Attabad area of Hunza. Due to dearth of studies the present study is worthwhile to bring out facts about this indigenous irrigation and water sharing system in two different areas; the Gawaldai valley of Khyber Pukhtunkhwa and the Shyok Valley of Gilgit Baltistan (Fig.1).

Database and Methodology

The present study is primarily, a description of methods of indigenous surface irrigation system of diversion channels and role of community in the development of sustainable water management system being practiced in the regions of Gilgit Baltistan and Khyber Pukhtunkhwa. Two large villages, Bishu Bala located in the Gawaldai and Kiris located in the Shyok Valley were selected as case studies, because these are relatively large settlements and administratively and culturally belong to, two different regions of Gilgit-Baltistan and Khyber Pukhtunkhwa. The study is based upon extensive field surveys conducted in 2012 in these two villages. Following methods were applied to carry out this study and for collection of information from villagers:

i) Reconnaissance surveys of these two villages were conducted to acquire general understanding about the study areas.

ii) Survey research method was used for conducting detailed study comprising field investigation through observation and interviews of villagers for recording information about the area, construction of diversion channels and methods of water sharing and water management .

Results and Discussion

1. The Gawaldai Valley

The Gawaldai River valley is located in District Upper Dir of the Khyber Pukhtunkhwa province (North West Frontier Province).The Gawaldai river is a tributary of Panjkora river which is a tributary of Swat river (Fig 1). The Panjkora river valley is comprised of several valleys drained by different small tributaries of Panjkora river like Gawaldai valley, Siri valley, Kalkart valley etc. These valleys are located at the heights ranging from 2500 metres to 35000 metres above sea level (Rehmat, 1990). These are the valleys where transhumant communities live. Most of them belong to different Pathan tribes who

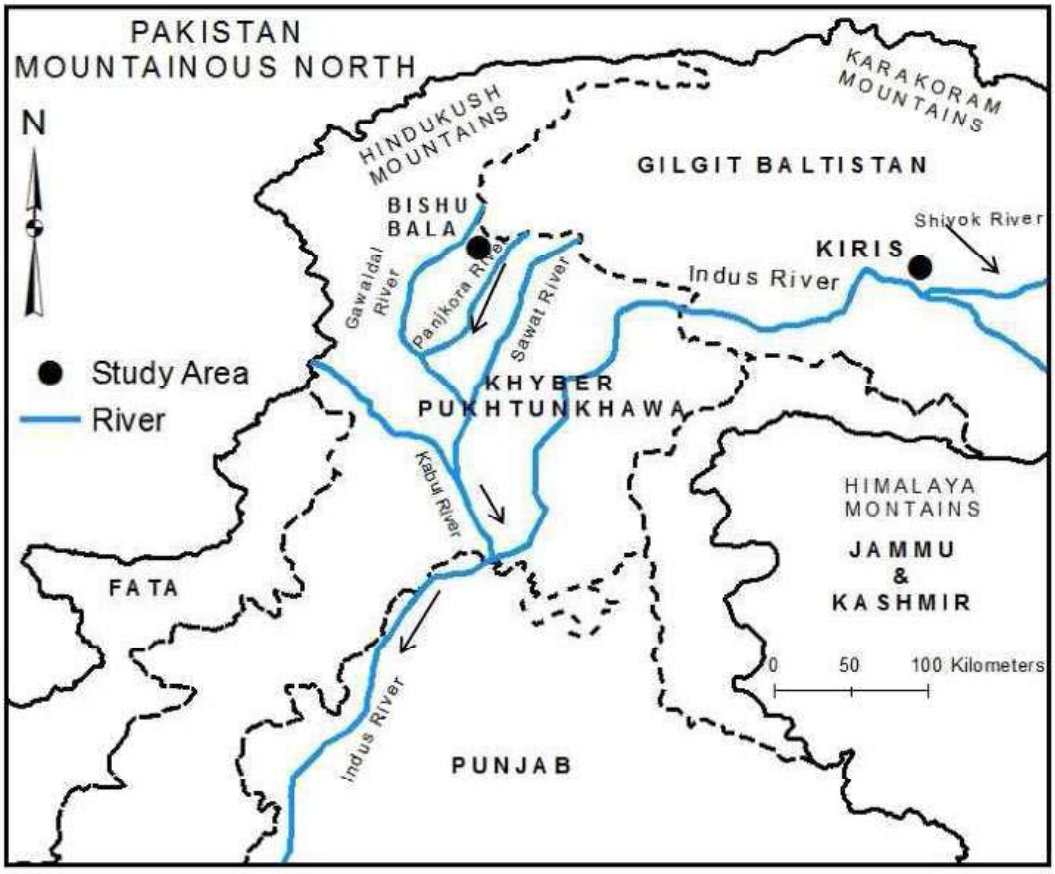

Fig. 1

came from Afghanistan centuries ago and settled here (Ahmed, 1991).

Irrigation

Annual rainfall in Gawaldai valley is erratic and low (about 125 mm). It occurs mostly in winter when cropping season ends, because of below freezing temperature. Therefore, the whole area depends on irrigation by means of water channels taken out from streams and springs. Water of streams and springs is diverted in diversion channels locally called *'Valle'*. Water channels, taken out from springs and streams are called *'Chena Valle'* and *'San Valle'* respectively. Construction of these water channels on a difficult terrain is a traditional skill of villagers which is being passed on generation to generation. It is community oriented irrigation system. Its construction, maintenance, water management and distribution is done by farmers themselves through their traditional methods set by their forefathers.

Construction of *Chena Valle*

Most of the agricultural land in Gawaldai valley is located at highlands. In summer when snow of mountains melts, a number of natural springs locally called *'Chena'* start functioning. Water of these springs' flows in natural water channels called *'Khores'* which finally join Gawaldai river. Water of these *'Khores'* is diverted towards *'Chena valles'* (Photo 1).

Selection of sites on *'Khores'* for diversion of water is considered on two

Photo 1

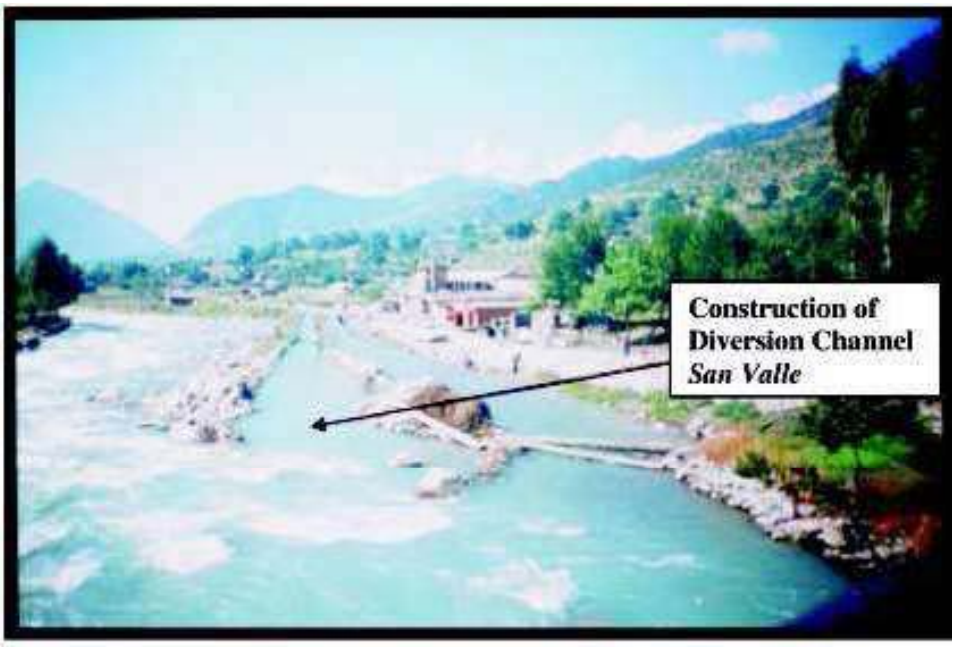

Photo 2

basis; i) where channel is relatively smooth and quantity of water is sufficient and ii) to develop gravity for smooth flow of water in diversion channels, sites of diversion must be higher than the agricultural fields. The width of channel generally ranges from 0.25 to 0.5 metre, while its depth varies from 0.25 metre to 1.0 metre. Diversion channels are generally unlined, constructed either by digging ground surface or by making channels with stones and mud on the ground surface. In areas where cultivated lands and water channels have

different heights, wooden channels called *'Tarnao'*, are constructed to maintain gravity (Photo 1).

Long size logs are commonly used for constructing *'Tarnaos'* which are used to cross depressions and streams to maintain gravity and save amount of water to percolate in ground particularly where amount of spring water is low.

Water flows in *'valles'* under gravity. Therefore keeping gravity for water flow in diversion channels is an important aspect of water management. At such points where water flow declines small tanks are built locally called *'Dari'* where water coming from *'valles'* accumulates slowly. *'Daris'* are square, semi-circular or rectangular in shape, small in size i.e. about 10 to 40 sq. metres and mostly unlined. Some are built on the surface with stones and mud or cement while others are built by digging ground 1 to 3 metre depth. *'Dari'* works like barrage to raise the water level and develop gravity for water flow in *'valles'*. There are two holes, the first hole is used to receive water in the reservoir through *'valle'* and other is through which water is discharged in *'valle'*. The inlet and the outlet holes are operated through small wooden gates called *'Warkh'*. Water in the tank comes according to the set schedule, allocated to respective farmers whose fields are irrigated by that tank. Water accumulates in the tank slowly when level of tank rises up to the level of outer diversion channel, the outer gate is pulled up to discharge water with speed. There are several water tanks, constructed to maintain gravity and flow of water with speed.

Construction of *'San Valle'*

Rainfall in the Gawaldai valley is also low and erratic. Although spring fed diversion channels *(chena valles)* exist in large number in the area but due to their dependence on melting of snow, they operate only in summer for four to five months while amount of water flow depends upon quantity of snowfall in the catchment areas of these springs. In case of drought they become dry. Under these circumstances, it is essential for farmers to utilize stream water for irrigation. The diversion canals, taken out from stream are called *'san valle'* (Photo 2).

Construction of water channels to divert water of a stream is not easy because agriculture lands in the mountain terrain are quite high than channel of stream. Supply of water to mountain terraces through *san valles* is extremely difficult. Their construction and maintenance are expensive and need skill, courage and large number of workers. However, despite such difficulties *san valles* are constructed because of their importance for crop cultivation and operating small hydro-electric units and water mills.

Water in the *'san valles'* comes from upstream because of the higher level of farming fields. Selection of higher site for diversion of stream water into channel is very important for maintaining gravity and sufficient water flow in the *valles*. Therefore, in order to maintain gravity of flow of water in diversion channels, *valles* are taken out from long distance at a point where stream's channel is located at higher level. Some *valles* are 10 km long. At the starting point of diversion channels, barriers of boulders and cobbles are built to divert water of stream into man made channels. Wooden channels *(tarnaos)* are used where surface is irregular and deep and not suitable for constructing *valles* on ground surface. The height of *tarnao* from the ground surface varies from 1metre to 20 metres (Photo 3). *Tarnaos* are supported by wooden pillars which often break up whenever heavy snowfall occurs. In

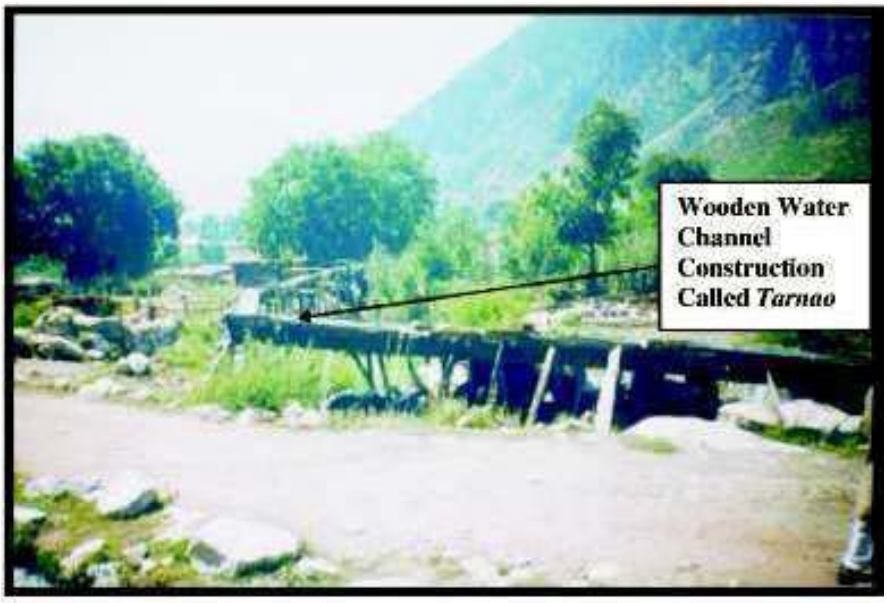

Photo 3

Photo 4

case of narrow valleys and gorges *tarnaos* are fixed with steel clips on cliffs which are 30 to 60 metres above the stream.

Water Distribution and Management

Water supplied by *valles* is limited. Therefore, distribution of this limited source of water among the farmers for irrigation needs proper water management. The water distribution is based upon the communal system of sharing water and maintenance of diversion channels. The principle of water distribution is an important part of this irrigation system which was developed by their elders centuries ago. Each land holder strictly follows this principle of sharing water

and satisfies himself with this water distribution system.

The farming fields of village Bishu Bala are irrigated by eight water channels. Only one is *san valle* which provides water for the whole cropping season. While the remaining seven are *chena valles* which provide water only for one cropping season. These water channels also provide water to other villages through which they pass. Therefore, a time table of days and duration has been made by *Punchait*. This is strictly followed by the villagers. For example, Monday is allocated to farmers of Bishu Bala for receiving water from *san valle*. Only those lands are irrigated through which that *valle* passes. The first located land has first right of receiving water. Lands of second, third and other farmers receive water turn by turn. Generally, one hour is given to each farmer for watering his fields. If flow of water is sufficient, then one hour is enough to irrigate farming field. In case of water crisis, when water flow is slow, extra time is given till the field is irrigated. This is because, the next turn for watering the field will come after a weak and if required water is not provided then it will seriously affect the crop production.

Water of the channel is diverted in fields through *'warkh'*, made up by stones and mud. The first farmer receives water from 6 a.m. to 7 a.m. Farmer of the second field reach at his field just before its due time and at 7 a. m. *warkh* of first field is closed to stop flow of water into the field while, *warkh* of the fields of second farmer is open up to 8 a.m. Thus, farmers receive water from *valle* turn by turn. Normally, lands of farmers located at the tale of *valle* receive relatively less amount of water due to declining gravity and amount of water. Therefore, to compensate this shortage, next week the first turn starts from fields of that farmer which are located at the tail end. The second turn will be given to farmer whose land is located next to it. Therefore, farmer whose turn of receiving water was first in the first week will receive water in the end in the second week. In case of any conflict among farmers on watering of crops it is resolved by tribal heads called *'Mashar'* in *Jirga*. During drought period when flow of water in *valles* is low and each farmer demands extra time for watering crops the problem is resolved by *Mashar* by providing extra time in the next turn to complainant for watering his crops.

Maintenance of Diversion Channels

Diversion channels are unlined. Silts and pebbles derived by water accumulate in water channels and slow down the flow of water. *Tarnaos* are damaged by heavy snowfall. The wooden pillars supporting *tarnaos* may fall down during floods. Therefore, repairing of *tarnaos* and removal of sediments from *valles* is essential and collective responsibility of villagers. Cleaning and repairing works start in the month of March just one or two weeks before the start of cropping season when *valles* are dry. *Chena valles* are generally inactive by the end of September up to March when melting of snow starts while *san valle* is also inactive by the end of November to early March, because level of stream water declines from the level of *valles*. However, these start re-functioning by the end of March when melting of glaciers starts and flow of water in the stream increases. Whenever elders of village decide to clean *valles* it is announced in the village. From each house one male member participates in it along with their tools like spade and mattock. Those families who do not have male members or they are out of village have to provide tea and meal to villagers who are engaged in cleaning work. In the maintenance of *tarnaos* each family participates in cutting of trees and making of new *tarnaos*. During the cropping season

also whenever *valles* are damaged by rock sliding, earth sliding, rain or flood, the villagers gather and repair them with their collective efforts.

2. The Shyok Valley

The Shyok river valley is located in the Himalayan region of Baltistan. The Shyok River is a tributary of the River Indus (Sherat, 1980). Kiris is an important area of the Shyok Valley, administratively located in the Ghanche district of Gilgit Baltistan (Fig. 1). The total population of Kiris is about 12000 persons. Kiris is located at the lowest part of the Shyok river valley at a height of about 2800 metre above sea level (Roster, 1997). The upper part of the valley is occupied by glaciers. Various water channels which come from glaciers join Shyok river. Among them *'Chogho Harka'* is a water channel, along which several villages are located, inhabited by transhumant communities.

Irrigation

Annual rainfall (about 125 mm) in the region is low (Uhlig, 1995). Therefore, farming is practiced through a traditional irrigation system. In this system, villagers obtain water from diversion canals locally called *'Harkong'*. These canals were built by villagers themselves centuries ago. These canals are taken off from the main water channel known as *'Chogho Harka'* (Photo 4). The diversion channels run parallel to each other on both side of the *Chogho Harka*. The diversion channels which are taken off right side of the *chogho harka* are *khanan harkong (asmani nahar), jahil harkong, malong harkong, mirpi harkong* and *shikhar harkong* while diversion channels which are taken off left side of the *chogho harka* are *surfa harkong (nia nahar), chamma harkong, yolgo harkong, chogho harkong* and *mona harkong*.

Water Distribution

Amount of water in the natural stream called *chogho harka* depends on the melting of snow. In June, July and August water is sufficient in the *chogho harka* while in other months water is insufficient and flow is nearly stopped in winter. Therefore, during shortage of water in *chogho harka*, an excellent collective system of water sharing exist among different villages. The system of water sharing is strictly practiced, particularly in two months of April and May. A schedule of whole week of taking water from different diversion channels *(harkongs)* is prepared by the *punchait*. According to this schedule each village has been given right to irrigate its lands located along that diversion channel. Water from *khanam harkong, surfa harkong, chamma harkong* and *jahil harkong* is not taken during shortage of water. While from other *harkongs* water is taken according to schedule. For example on Thursday *malong khor* village takes water from *malong khor* channel during day time. Similarly the *malong khor* village obtains water from *takhor harkong* channel on Sunday during night and on Monday night from *mirpi khor* channel. Water is released into channels according to their turn by making small embankments made up of mud and stones on the *chogha harka* to stop water entering into other channels. Each diversion channel provides water to nearby fields of more than one village. For example *thikor khor* channel provides water to nearby fields of five villages. The village whose fields are located at the tail of diversion channel has the responsibility of cleaning grass and silt. In case of any large damage in channel due to land sliding, etc. villagers of all villages which receive water from that channel repair damages collectively. The villagers appoint a person from village to monitor the schedule of water sharing and theft of water. He is called *'choraba'*. For this work

villagers give barley and ghee to *'Choraba'* as remuneration.

Impacts of modern Development

During the last two decades many changes have taken place in the study areas. Government has announced several small hydro-electricity generating projects and modern sprinkles, pipes and drip irrigation system in the areas (Uhlig,1995). As a result, on one hand discharge of water in diversion channels has reduced significantly and on the other hand due to Government funded irrigation projects villagers are more interested to irrigate their croplands through the modern pipe and drip irrigation system. Young people of the areas are migrating to big cities for higher education and employment to improve their socio-economic conditions. As a result, due to shortage of workers for the maintenance of diversion channels, proper flow of water is difficult to ensure.

Conclusions

Problem of fresh water resources and their management is a serious concern all over the world. This problem is extremely serious in the arid and semi-arid regions of Less Developed Countries of the World. In this context, community based irrigation systems and water managements have gained much attention and importance for sustainable use of water. In the Gawaldai Valley of Upper Dir district, Khyber Pukhtunkhwa and the Shyok river valley of Baltistan are two examples in Pakistan where the systems of diversion channels have been working for centuries. The construction, maintenance, water distribution and water management of this irrigation system are indigenous and community oriented. With the introduction of modern irrigation techniques like drip and sprinkle methods of irrigation, the traditional system of irrigation is being ignored. It is an important responsibility of Government and local community to sustain and improve the indigenous community oriented irrigation system which is not only economical but also ecologically sustainable.

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