

# Community-Based Irrigation Water Management in Ladakh: A High Altitude Cold Arid Region

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## Abstract

Ladakh constitutes the easternmost trans-Himalayan part of India, bordering Pakistan and China. Truly described as cold arid desert, is one of the coldest and most elevated inhabited regions of the world. Because of diverse environment and lower population density there is greater need for social networking, which is clearly evident from the local institutions, the role they play in sustainably managing the meager and unpredictable resources available with the people of Ladakh, in designing strategies to deal with the inhospitable and tough environmental conditions.

The present case study explores the management of irrigation water (inter and intra village level) by local institutions in Ladakh. Local people are involved at every step of study. The study describes how irrigation water is managed by the local people of Phyang (upstream) and Phey (downstream) villages. Crop raising depends on irrigation water, originating from snowmelt and glaciers. The availability of this water is not easily predictable because it depends on the amount of snowfall in preceding winters and the prevailing weather condition. There exist local institutional arrangements for equitable and timely distribution of this water. The system of water distribution is certainly complex but exploitation is rare. The *chhur-pon* (water supervisor) is the most important functionary related to water distribution. The distribution system is pegged to the household or the channel according to the nature of resource availability. There exist proper rules regarding who, when, and how to access the resource, with provision of sanctions (different degree) on defaulters.

**Key words:** Ladakh, irrigation, local institution

## 1. Ladakh an Introduction

Ladakh constitutes the easternmost trans-Himalayan part of Jammu and Kashmir State of India, bordering Pakistan and China (see Figure 1). Truly described as cold arid desert, it covers an area of 59146 Sq. km. situated along the valleys of the Indus river, with an estimated population of 1,70,541<sup>1</sup>. Intensive sunlight, high evaporation rate, strong winds and fluctuating temperature (30 to -40°C) characterize the general climate. It is generally said that a man sitting in the sun with his feet in the shade can have sunstroke and frostbite at the same time. With sparse vegetation there is little moisture in the atmosphere. Most of the land is a mountainous desert of rocks, sand and dust. Only small parts are used for cultivation and animal husbandry. By means of a system of terraces and irrigation canals, patches of land are made arable wherever possible. Because of high mountains all round and heavy

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snowfall during winter, the area remains inaccessible (through road) to the outside world for nearly six months in a year.

Adventurous spirit, strength and stamina is required to inhabit such a region lying at an elevation varying between 8520 to 16500 ft. above sea level. The most important measure to raise production to support an increasing population is the improvement of irrigation facilities. Irrigation technology in Ladakh was transferred from neighbouring regions<sup>2</sup>. The farmers have made use of the barren alleviated semi desert conditions by cultivation through skillful irrigation; a practice which goes back to at least the tenth century (for detail on irrigation source, see table 1) when it said to have been introduced by the scholar saint *Atisa*<sup>3</sup>.

**Table 1: Source of Irrigation (Area in Hectares)**

Year	Net Area Irrigated				Gross Area Irrigated			
	Canals / Khuls	Wells & Tube Wells	Tanks	Total	Canals/ Khuls	Wells & Tube Wells	Tanks	Total
1991-92	10309	0	0	10309	10623	0	0	10623
1992-93	10196	0	0	10196	10257	0	0	10257
1993-94	9985	0	0	9985	10360	0	0	10360
1994-95	9942	0	0	9942	10430	0	0	10430
1995-96	10414	0	0	10414	10789	0	0	10789
1996-97	9920	0	0	9920	10475	0	0	10475
1997-98	9940	0	0	9940	11000	0	0	11000
1998-99	9012	0	0	9012	9224	0	0	9224
1999-2K	8476	0	0	8476	9162	0	0	9162
2000-01	8476	0	0	8476	10493	0	0	10493
2001-02	8496	0	0	8496	10523	0	0	10523
2002-03	8460	0	0	8460	10478	0	0	10478

Source: Deputy Commissioner's Office Leh

The melted snow water from various rivulets called *kangs-chhu* (ice water) which at some point merges and forms a *togpo* (stream) that flows through a valley touching many villages connected by a main channel called *ma-yur* (mother channel). It is built along a mountainside that forms its retaining wall, and is lined with clay to hold the water. This may be termed the Ladakhi version of a dyke. At some places rocks are broken to allow the passage of water. Elsewhere, where the hills are precipitous or rocks are too hard, a hollow poplar or willow trunk is cut into two equal halves to allow the water easy passage. The hollow trunks are called *va-to* and are supported on both sides by wooden pegs and very occasionally with iron ones that are fixed in an upright position close to the trunks on both sides like pillars below which the trunks are firmly held. Water from the *ma-yur* is further diverted into *yu-ra* (small canals), which irrigates the fields. The point from where *togpo* water is diverted into *ma-yur*, and *ma-yur* water into a *yu-ra* is called *yurgo*; and *ska* is the point from where *yu-ra* water is diverted to the field. Water in the *ska* is further guided through channels known as *snang*, which carry the water throughout the field (Fig. 2).

The water distribution through a system of channels is quite complex with different sizes of channels distinguished by various names. There may be some regional differences in the phonetics of the names; moreover it is similar in whole of Ladakh<sup>4</sup>.

## 2. Social Organisation (in context of irrigation)

Irrigation water is a critical source of food and wealth in Ladakh. One might expect to find a complex politics of distribution and exploitation. Distribution is

certainly complicated, but exploitation is rare<sup>5</sup>. Of course there are inevitable abuses and conflicts in the distribution of water. Villagers are continually being watched at the same time that they are watching out for their neighbours, thus creating a reciprocal check on activities. It is difficult to evade signs of cheating- a moist field when all the surrounding fields are dry.

It would be very difficult to arrange distribution of a fair share of water every day to every farmer. Nor do crops need irrigation daily. The farmers in big villages like Hunder, sNimo, and Leh are divided into groups commonly known as *Schhu-cho*, and each group gets right to water according to the traditional distribution system. The groups and the distribution pattern of water are recorded in the land records, stored at the patwari's office in Leh, whose duty includes maintenance of an official register of these water rights or on a silk document in the village itself, generally referred to as *bandabas* by local people. The documentation suggests that these disputes could be taken to the court in Leh. While this is beginning to be the case in Leh, mostly villagers still prefer to negotiate their disputes at the village level itself.

Distribution of water for irrigation is in accordance with the rotational system. The rotational system is largely determined by the village topography, total village acreage, relative exposure to sun, average temperature, size of glacier, soil type and seepage in the irrigation channel, among other factors<sup>5</sup>. The amount of acreage and the number of irrigation channels in any given village seems to determine which kind of rotational scheme is used. If the village is small enough and the irrigation channels are few enough, rotational system of water distribution are pegged to the household, rather than the channels. For example in Leh and Sakti, water distribution is arranged by channels. In Phey (small village of around thirty-three household), water distribution is arranged by the household. In small villages it is fairly easy to arrange whose field will get water according to the rotational system. In a village where distribution is arranged by channels, the field lying along the given channel is irrigated in order, which may belong to a large variety of households. These predetermined rotational scheme between households, are in accordance to *bandabas*.

In the rotational system, monitoring/surveillance appear to be the most significant element. Because village affiliation is a lifetime sentence, the ignominy of being caught cheating may provide a sufficient deterrent to abuse within the system. However<sup>5</sup>, as the village becomes large, more and more anonymous, and more influenced by a cash economy, anomic situation is increasing, especially in and around Leh.

### **2.1. Chhur-pon (water supervisor)**

The word *chhur-pon* means Lord of the water, derived from *chhu* meaning water and *pon* meaning Lord. Water supply to individual families for irrigation is supervised by a *chhur-pon*. The *chhur-pon* is an official, selected by the villagers, who is in charge of water distribution for irrigation and is perhaps the most important functionary in this regard<sup>6</sup>. He is expected to have the following qualities:

1. *ska-tsir shes-kan*: one who knows the order of the ska, from where the water of *yu-ra* is diverted to the field . He is expected to know the conventional fixed order, and the priority for irrigating the crops of that particular village.
2. *chhu-tsir shes-kan*: one who knows the order in which water to be distributed to a particular crop, in what quantity and when.
3. *yul-dat-chan*: one who considers the fields of the whole village as his own

4. *chhu-a sta-thog gya-la cho-shes-kan*: one who knows how to preserve water in times of scarcity.

Another quality in view of the villagers is that, the *chhur-pon* must be a lucky person. There should be sufficient snowfall during his term. A person of these qualities was selected by consensus in earlier times. Nowadays rotation system is prevalent in most of the villages. The office of the *chhur-pon* has been in existence ever since people can remember, except in villages where water is available in abundance. In some villages the word *chhur-pon* is also assigned as individual house name (in Ladakh every house has a name), this is a clear indication of the importance of *chhur-pon* in these villages. May be, those houses were responsible for water distribution during earlier times.

If water is available in abundance then a *chhur-pon* is not required, as in the case of Hunder village of Nubra block. Even in villages where there is/are *chhur-pons*, his task is reduced to a great extent when water is in abundance. If the scarcity of water in a village is acute, then, more than one *chhur-pon* is required, even if the village is small in size. The tenure of *chhur-pon* differs among villages. For example in some villages of Leh area the tenure is usually three to four years and in some it is annual. In return for their service a *chhur-pon* is given *so-nyom* (one man load of cereal crop; may differ regionally) after the harvest. In Leh, nowadays, where there are seven *chhur-pon*, each is also paid two hundred rupees a month during the cultivation season, in summer. In some villages like Phey even the *so-nyom* is not given.

The *chhur-pon* has thus quite difficult duties to perform. In case the water is being directly diverted into the *yu-ra* from the *ma-yur*, then, the *chhur-pon* has to stay near the *yur-go* (often he has to sleep at night guarding the *yur-go*). In some villages like in Phey, the main *yur-go* is guarded by a group of people on a rotational basis. Very often when the water is scarce they have to sleep near the *yur-go*.

As a customary respect for water, while stopping or releasing water from *ma-yur* to the *yu-ra* the *chhur-pon* has to keep his *gon-cha* (long overcoat) at ankle length and can not tuck it into his belt as is often done while working.

It is expected of the *chhur-pon* to distribute water according to the rota system, and monitor the activities of other farmers. At the operational level he is not much seen in the picture. Members of the village monitor each other's activities, and this system is inbuilt, as all the members are aware of how much and at what time water has to be diverted into their *yu-ra*. The farmer receiving water first monitors that the water is not diverted earlier than the decided time, and the farmer who receives later monitors that his turn for water is not delayed.

## **2.2. Watering the field**

The amount of winter snow determines the anticipated supply of water during summer, which further determines whether marginal fields should be sown or not in spring. The weather in spring determines whether the irrigation water supply will start early or late, since cool cloudy weather delays the snowmelt. This affects the ploughing and sowing time and the sequence in which the crops are sown.

Water from the stream is diverted into the pond (if there is pond in the village), through the *ma-yur*, and eventually into the family *yu-ra*, or water from the *ma-yur* is directly brought into the *yu-ra*. If the pond is fed by spring water, then the opening of the pond is done as decided.

Fields are irrigated for the last time in autumn after the soil is ploughed when harvesting of crop has been done. This practice causes the water to freeze in the soil, and prevents it being flown away and is available when the spring thaw occurs, so the soil is moist for ploughing.

The web of irrigation system binds the Ladakhi villagers to each other and these webs reflect a shared source of life. The easy intimacy and consensus-based decisions flowing from the web of village solidarity might suggest an ideal form of Greek democracy. However the same web creates claustrophobic technique of surveillance by which villagers keep each other in check<sup>5</sup>.

### **3. Case study of Phey Village**

Phey is a small village of 33 households with a total population of 176. It is located 15 kms. to the west of Leh, at 34°10' latitude and 77° 28' longitude. The total area of the village is 113.72 hectares, out of which 50.88 ha are irrigated and 0.81 ha is un-irrigated, culturable waste including gauchers and grooves consist of 30.35 ha. The rest 41.68 ha area is not available for cultivation (Census village Directory, 1981; Evaluation and Statistics Office, Leh).

The village is arbitrarily divided into two parts viz. *stag-lung* and *yog-lung* (upper and lower fields; *stag* means upper, *yog* means lower and *lung* means fields). In *yog-lung*, wheat is grown as a single crop or mixed with *rHan-ma* (pulse crop).

The major source of irrigation is the stream and spring water. The village is well endowed with water springs. The water from these springs are collected in the ponds and then used for irrigation. To a great extent the majority of fields lying in the lower part of village (*yoglung*) is irrigated by these spring water. The upper part i.e. *staglung* and some parts of *yoglung* are totally dependent on the *tok-chhu* (streams water) coming from Phyang village. In other words, the stream water is shared between Phyang and Phey villages (Phyang situated upstream and Phey at lower stream). The amount of snowfall in the preceding winter season and the prevalent weather condition determines the amount and time of arrival of melted snow water.

Spring water is the sole source of water in Phey village for drinking purpose of man and animals. Though animals are sometimes taken to the river but humans don't consume it<sup>e</sup>, the river water is used only for bathing and washing clothes. Bathing or washing clothes in or near the premises of spring water pollutes the spring water and the residing *lhu* (female deity associated with the water and earth) is offended. To appease the *lhu* and placate them, timely spiritual cleaning ritual like, *lhu-stor* and *sa-dak don-dol* is performed by each household, and *bhum-skor* festival at the village level is performed once a year.

#### **3.1. Stag-lung (upper part)**

Whole of *stag-lung* for irrigation is dependent on *phu-chhu* (stream water arising from *phu*<sup>f</sup> of Phyang village. According to the *bandabas*, people of Phey have right over the *phu-chhu* from late evening to early dawn after 21<sup>st</sup> June (summer solstice) only. After harvesting of crop (in around first week of September) and before winter arrives, the fields in the *stag-lung* area is ploughed and heavily irrigated. The water gets frozen in the soil and remains there till the spring thaw, when it is time to do sowing (around 1<sup>st</sup> week of May). Irrigation just before sowing is not required because there is already enough moisture in the soil. Before that (21<sup>st</sup> June) *phu-chhu* is available to Phey only in cases when water in the stream is in excess, and such situation are not too often. Generally the retained soil moisture is enough till water comes down from Phyang, though at times there is scarcity of water in Phey depending on the prevailing weather condition.

##### **3.1.1. Watering of stag-lung**

The stream water (passing through Phyang village) is the sole source of irrigation in *stag-lung* (upper part). This water arrives in *stag-lung* area of Phey village after passing through the neighbouring Phyang village situated up-stream.

When water doesn't arrive during early spring when sowing has been done, one person from Phey village is selected on rotation basis to approach the monks in Phyang monastery. One monk then accompanies him to the upper valley near the *phu*, the monk then performs some rituals for timely arrival of water into the stream. People believe that such rituals do have effects; they help to bring in enough water in the stream.

The sharing of this stream water between Phyang village (lying upstream) and Phey village (lying low stream) is governed by the *bandabas*. According to it, Phey will get water from late evening to early dawn. For local people the time starts when sunrays passes through *pholong chenmo* (a large stone) lying somewhere in lower parts of Phyang village. It is the case only when water in the stream is scarce, on the other hand, when water in the stream is abundant then Phey gets water at daytime also. But during the early spring when first and second irrigation is given, at this time the water in the stream is not abundant, so farmers in Phey have to irrigate their fields at night time. During early spring when water has just arrived in the stream for the first time, it is a common occasion to see farmers with lamps, spread across the *staglung* irrigating their field at night time.

All these activities take place when water is not enough, especially during the early spring time around the first and second irrigation of fields. Later, when the temperature rises and there is enough water in the stream then night guarding of *ma-yur* (main channel) is not required and the fields are irrigated during day time.

Even if water in the *togpo* (stream) is enough, guarding of the *yur-go* (control sluice by main channel) is necessary, to check any overflow, blockage, and damage. For this purpose two individuals from each household is selected rotationally and they are expected to monitor the situation upto the main *yur-go* (control sluice by main channel). But there have been some cases of cheating when the individuals came back midway, without reaching the water point of main *yur-go*. To check this problem of cheating the villagers devised a simple but effective method. After guarding the *yur-go* the individual has to take a small flat stone and breaks it into two pieces. One piece is kept on the side of the *yur-go* at an identifiable place, the other piece he keeps with himself and hands it over to the next person on the rotation to guard, who then after reaching at the *yur-go* matches the two pieces. The perfect alignment of the two stones then confirms that the individual was really guarding the *yur-go*, and this cycle goes on.

In *yog-lung* (lower part) the water distribution of pond water is based on *tong-tsir* (household order), but in *stag-lung* (upper part) it is based on *ska-tsir*, i.e., according to the order of *ska* (control sluice by field). Watering begins from the most eastern side or western side field of the *stag-lung*, and this order of beginning are rotated annually e.g. if this year watering started from the eastern fields, then next year it will start from the western most field, i.e., order of irrigation is from west to east or vice-versa along the gradient of the *yu-ra*. The amount of water in the *yu-ra* determines how much fields can be irrigated at one time, and accordingly the *chhur-pon* (water supervisor) informs the people to come and open their *ska* and irrigate the field. Before a field is completely irrigated he has to inform the next household (in order) to open their *ska*.

Farmers are aware of when they would get water for irrigation, so most of the time they are found standing besides their *ska*, and the *chhur-pon* (water supervisor) need not go to the individual house to inform them about their turn. But sometimes when the *chhur-pon* finds no-one near the next *ska* (control sluice by field) which has to be irrigated, then he has to personally inform that household to come and open

their *ska* and irrigate their fields. Even then if no one turns up, watering is allotted to the next *ska* in the line. The household who misses their turn to irrigate their field will now get water only in the next cycle. No trade is allowed between household regarding watering i.e. if someone does not want to irrigate his field, s/he can't sell his right to another farmer.

### 3.2. *Chuu-tsir* (order of irrigation)

First, irrigation is given to cereal crops called *zing-ska*, next to *ol-ska* (alfalfa/lucerne), and then to *tsas* (trees). E.g. this year *zing-ska* started from *thur* (western side), and *ol-ska* started from *gyen* (eastern side); next year *zing-ska* will start from *gyen* and *ol-ska* from *thur* direction. This cycle is rotated every year.

### 3.3. Guarding the *ska*

To ensure that there is enough amount of water in the *togpo* (stream), without water being diverted to channels in Phyang village all along the *togpo*, and to check damage to the *yur-go* (main/mother channel), a simple but effective guarding mechanism is present.

Phyang village is situated along both side of the *togpo*, and along the stream are many *ska* (control sluice) from where water is let flow into *yu-ra* (intermediate channel) extending upto various fields. To ensure that there is no diversion of water into these *yu-ra* at night time (when the Phey village has right over the stream water), the farmers of Phey guard these *ska* (Figure 3) during night time.

The various rivulets of melted glacier water from the *phu* forms the *togpo* (streams). The stream water after passing through the valley of murubog and Phyang village reaches Phey village. There are seven major *ska* (control sluice) along the *togpo* from where water is drawn in the *yu-ra* (intermediate channel) by the villagers of Phyang. The names of those *ska* are given below in descending order in the direction towards Phey (Figure 3): (i) *Olsar ska* (ii) *Barzi ska* (iii) *Thang-nak ska* (iv) *Gompa-ai-yog ska* (v) *zamzor ska* (vi) *Mankang Kongma ska* (vii) *Mankang yogma ska*.

The name of these *ska* (control sluice) has been allotted according to their physical proximity to some household or the surrounding area e.g. *Barzi ska* is near to the *Barzi* household. Below the last *ska* i.e. *mankang yogma ska*, lies the main *yur-go* (control sluice by main channel) of Phey. *Yur-go* is the water point from where the stream water is diverted in the *ma-yur* (main/mother channel). It is a kind of dyke made of stone, clay, abandoned clothes, wild grasses, etc. Below the *yur-go* is the *trupunchok ska* from where the *togpo-pa* household (a single household which comes under the jurisdiction of Phey village) diverts the water from *may-ur* into their *yu-ra*.

During cultivation season when water is scarce these seven *ska* along the stream in Phyang is guarded at night time by the farmers of Phey. A group of three or four people (one from each household) does the guarding of these *ska*. These seven groups are rotated to different *ska* e.g. a group guarding the first *ska*, i.e., *olsar ska*, next night comes down to the second *ska*, i.e., *Barzi ska*. The group guarding the lowest *ska* (*mankang yogma*) likewise, guards the first *ska* (*olsar*) the next night, and this cycle goes on.

There is no rotation among the members of a group once they are made into the group, i.e., the composition of the group doesn't change. If a member in a group comes across some urgent work, then he has to inform other members of his group about his unavailability, and his request is generally obliged by the other members.

People guarding these *ska* take their sleeping bags along with their dinner. Occasionally relatives and friends in Phyang or the households situated nearer to the

*ska*, bring tea, local bread and *chhang* (barley beer) for the fellow farmers from Phey who are guarding the *ska*.

As already stated, that guarding of the *ska* is required only when water is scarce. However, the main *yur-go* (control sluice by main channel) needs constant watching, to allow the right amount of water in the *ma-yur*. Apart from being diverted by other people there is danger of too much water in the *togpo* (stream), which may damage the *yur-go*. To prevent it, two people (one from each household) are assigned on a rotation basis to guard the main *yur-go*. The *goba* (village head) doesn't need to go for guarding either the *ska* or the *yur-go*, and the *chhur-pon* (water supervisor) also need not go for guarding, because they are busy supervising the distribution of irrigation water in the village.

### **3.4. Flexibility**

People of Phey divert the stream water into their *ma-yur* (main channel) by blocking the *ska* in Phyang, but they are not allowed to block *ska* beyond certain point (recorded in the *bandabas*) in the upstream area of Phyang. But, in case of severe drought in Phey, the *goba* or the *chhur-pon* of Phyang visit Phey and assess the condition. If they feel it necessary, then people of Phey are allowed to block *ska* beyond the restricted area also, and divert the stream water towards Phey. In case someone needs water for irrigating his vegetable kitchen garden, then he can take water from the *yu-ra* (intermediate channel) after formal consent of the *chhur-pon*, even when it is not his turn to irrigate.

### **4. Conclusion**

Irrigation water is one of the most important resources to a farmer in Ladakh (trans-himalayan cold-arid high altitude region of India). The availability of this resource at the required time and in adequate amount is not always easily predictable.

In such an environment one might expect to find a complex politics of distribution and exploitations. Distribution is certainly complicated, but exploitation is rare. For distribution of irrigation water there exist proper institutional arrangements that ensure that the scarce resource is available equitably and timely. In this connection there is the provision of *chhur-pon* (water supervisor), who is selected on a rotational basis, taking individual household as a unit. He is responsible to arrange water availability according to the pre-decided order. It was found that the order of irrigation is pegged to the household if the village is small and water for irrigation is abundant; in case the resource is scarce then the order of irrigation is pegged to the channel, as there is less loss of water due to seepage compared to when it is pegged to the household.

Whatever may be the system of water distribution, the rules of rotation system bring together those who would be tempted to cheat and those who would be particularly harmed by such cheating thereby it is easy to monitor, than rules that depends on accidental discovery of a rule breaker by someone who may be only indirectly harmed by the infraction.

In many areas the stream water is passed through different villages, e.g., Phyang (upstream) and Phey village share the same stream water. It is expected that the village situated lowstream will not get a fair amount of this water, but it is not like that in this case. There exist institutional arrangements between Phey and Phyang regarding the distribution of stream water. A sort of written agreement also exist (locally called as *bandabas*), which indicates that matter of conflict can be taken to formal courts. Phey has sole rights on this water from late evening till early dawn. During this period farmers in Phyang can not divert the stream water into their



channels, and to check violation of rules, farmers in Phey on a rotation basis guards the water points from where water is diverted towards fields in Phyang.

### Endnotes

- a. It has been reported that farmers in Zangskar produce yield of staple crops equal to those of many developed countries<sup>2</sup>.
- b. *zying* is a general term for fields where cereal crop is grown. *ma-zying* is the mother field or the original field sown by the farmer's ancestors.
- c. Bandabas: The traditional rights between household or villages pertaining to resource sharing is formally recorded in the land records and stored at the patwari's office in Leh, whose duty also includes maintenance of an official register of these rights on a silk document in the village itself, generally referred to as *bandabas* by local people. In case of irrigation, the groups and the distribution pattern of water is in accordance to the *bandabas*. These documents were supposed to be updated every twenty years, though this never happened. One may argue after a study of the application of these irrigation norms and practices in the present scenario that the updation never took place, because they did not lose their relevance.
- d. *Goba* is the head of the village, *goba* as a village head started in Ladakh only during Dogra raj, when Dogra Maharaja Gulab Singh's well known general Zorawar Singh conquered Ladakh in 1834. (for detail see Koshal, 2001)
- e. Local people perceive that river water is light and spring water is heavy. Therefore a sick person, especially stomach sick; is advised to consume water from the river, for it is easily digestible. On other occasions like preparation of *chhang* (locally made barley beer), stream water is preferred.
- f. *Phu* means the upper part of sloping valley. *Phu*, the vast stretches of grazing land lie in the vicinity of the glaciers at elevations of 15,000 to 18,000 feet and serve as pasture (Helena Norberg, 1992). From July to September some of the families spend time here, caring for their animals, gathering dung, and making butter and cheese for the winter.

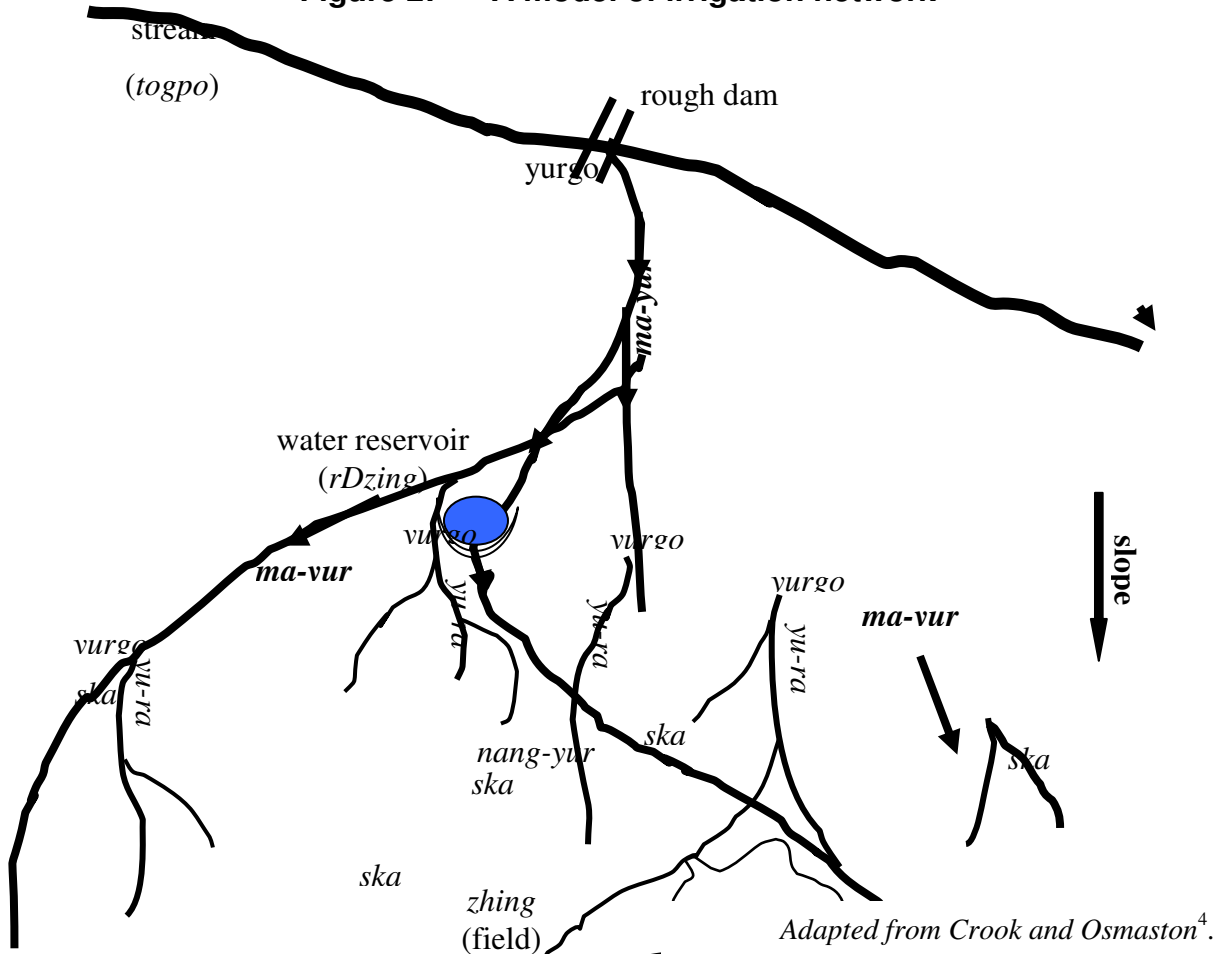
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Figure 1: Ladakh on map



**Figure 2: A model of irrigation network**



**Figure 3: Schematic diagram showing the position of yur-go and various elements of the irrigation network in Phyang and Phey village.**

