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Rantak - the Traditional Watermill of Ladakh, India

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ABSTRACT

The present study was carried out in order to explore the knowledge about the indigenous machine used for the grinding of locally grown cereal crops and legumes of this remote mountainous region of India, i.e., Ladakh. *Rantak*, the traditional watermill of Ladakh driven by fast moving water, is used by the rural folk to grind wheat, barley, pea, etc. It is made from locally available materials by the local experts of village. Most of the mills become non functional during the harsh winter season of the region due to freezing of water as well as the turbine. This eco-friendly and safe structure in use since times immemorial has withstood the test of time.

Keywords: Granite, Grim, Ladakh, *Rantak*, *Skuru*

INTRODUCTION

The Ladakhis have tapped local resources for the purpose of grinding grain. There is no record evidence of using the hand driven mill, *chakki* for grinding of grains in Ladakh as in other parts of India. Water driven mill is however being used since times immemorial in the region which is still in use. Mountain villagers of Ladakh traditionally use fast flowing snow fed mountain streams and rivers to power their flour mill, which is known as *rantak* or *churak* in local language. Most of the mills in Ladakh have been in the family of the mill-owner, *rantak pa*, for generations. This indigenous machine is used to grind wheat, barley, grim (husk less barley), buckwheat, pea, broad bean and many more. The threshed and cleaned grain is dried and then ground with the mill that once started, runs continuously. Barley is the main crop of the Ladakh (Angchuk et al. 2009). It is roasted and grounded into flour called as *tsampa* (Tibetan) or *namphey* (Ladakhi), which is the staple food of the region. Wheat is the second major crop next to barley (Sharma et al. 2008). It is grounded as such and the flour so obtained is locally known as *paqphey*. The mill never stops, except for when it needs maintenance. Because of the obvious need for water, grinding mills are built next to rivers or streams. This sometimes makes them vulnerable to flooding in peak summer season. The traditional mills in some villages of Ladakh are washed off by the flash flood caused by the cloudburst in 2010, which results into heavy casualty and loss of properties.

The water of the streams, rivers and its tributaries is diverted and is made to rotate the mill. In winter, the water remains frozen and the mill do not work, so the villagers grind the grains in summer months and store the flour for winter use. The flour, so stored does not spoil because of cold and dry climate (Mann 2012). However in some villages particularly in Sham area of Leh district, these remain functional even in the harsh winter by making fire around the rotating turbine.

Mill operators and elderly people of Chuchot village of Leh district were communicated in local dialect for the current study. A survey about the number of presently functioning mills had been done either by personal visit or by meeting with the *Sarpanches* and progressive farmers of various villages of Ladakh (Table 1). Two villages from each block of the two districts i.e., Leh and Kargil of Ladakh were randomly selected for the current study.

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Table 1: Current status of functional watermills in Ladakh

District	Block	Village	No. of mills
Leh	Leh	Phyang	5
		Spituk	4
	Chuchot	Chuchot	3
		Matho	12
	Kharu	Kharu	2
		Martselang	5
	Nyoma	Mudth	8
		Nidder	2
	Durbuk	Tangtse	2
		Phobrang	4
	Saspol	Saspol	9
		Hemis-shukpachan	15
	Khaltsi	Fotoksar	5
		Skurbuchan	7
	Diskit	Khardong	12
		Khalsar	4
	Panamik	Pirit	6
		Thati	5
Kargil	Kargil	Minji	5
		Karkitchoo	3
	Shakar-Chiktan	Shakar	6
		Khangral	5
	Shargole	Wakha	7
		Pashkum-A	8
	Taisuru	Panikhar	5
		Akchamal	7
	Drass	Pandras	3
		Bhimbhat	3
	Gund Mangalpur/	Saliskote	5
	Trespone	Tambis	4
	Zanskar	Karsha	7
		Tongri	5
	Lungnak	Raru-Monay	4
		Kargiak	8
	Sankoo	Barsoo	5
		Sankoo	8

Principle

The water driven mill is used to convert the kinetic energy of the moving water into mechanical energy. The fast moving water forces the turbine to rotate which further led to the rotational motion of the grinding stone upon the stationary stone.

Construction

The circular grinding stones are made up of granite. The stones are mounded into circular shape by using tools such as iron hammer and rod. Weight of each stone is reduced up to 100 kg. It takes about 2-3 days for two men to make each of the stone. Its transportation to far away areas is a hectic one. It is driven by a pair of *dzos* (cross between yak and local cow). A wooden block is fixed into the hole at the centre of the stone which makes it to roll like a tyre. Two men are required, one for making the *dzos* to move and another for holding the stone. Furthermore three to four men are required for assistance to move the stone through the fields, canals and river. On installation, it is tested for the smoothness, by using sand and then charcoal. Adjustments are made by using some metallic tools. Repairing of the grinding stones is also done at an interval of 20-25 days. The hopper is made by an expert who used to make local baskets *chepo* in the village. It is made up of a hard indigenous grass which is known as *chipkyang* and sticks of willow tree. The other wooden parts are also made by local carpenters of either willow or juniper (*shukpa*) while the iron parts are made by the blacksmiths. The wall of the underground tunnel is made up of stones and is covered with flat rocks, locally called as *yamangs*. Dried wood of juniper is also used for this purpose because it can withstand the huge weight of the grinding stones and it has also a long life as compared to the common willow wood. A house encloses the mills and each mill has a separate room. The house is made up of local bricks and wooden blocks, sticks, grasses and mud are used as roofing materials.

Operation

Water from a stream or river is diverted and collected in a small reservoir which is known as *tiyur*. Excess of water is drained off from this reservoir through an exhaust, *chuphosa*. Water is also removed through this when the mill is idle. The villagers have made wooden channels placed at steep gradient through which the water is made to pass forcefully. Just under this fall is fixed a turbine which makes the runner stone to rotate connected through a shaft. The turning force produced by the water on the paddles is transferred directly to the runner stone, causing it to grind against a stationary bed stone. 2-3 grains at a time are fed into the central hole of the rapidly rotating top stone and ground between the two stones. *Thaktharak,* when touched with the upper rotating stone shakes the hopper thus grain is discharged from it. The flow is maintained more for barley as compared to wheat because it is brittle and grind easily. The flour makes its way to the edge and falls into a trough encircling the stone. About 250-300 kg of flour is made from the mill in a single day.

The operator of the mill has to stay at the *rantak* for the whole period for refilling of grains and making adjustments. The refilling is done into the hopper every four hours, even at night. A wooden *pankha* is used for the collection of the flour. *Phebyaq* made up of a piece of sheep skin with wool on it, is used for cleaning of this basal trough. A traditional sieve *phechaqs* made by cutting strips of animal skin with wooden frame is used for sieving of the flour. The flour is filled in bags made up of yak wool having capacity of about 80-100 kg. It is believed that sometimes, the mill makes noise due to the abuses made by people. It is called as *rantak rdoney* in local language. A cup of tea is dropped into the hole of the upper stone in order to correct it. Spitting is another solution for this. Although most of the mills become non functional during winter due to freezing of the turbine, however in some villages of Leh and Kargil districts of Ladakh, these are made functional by making fire near the turbine. Fire is made by dung, charcoal, dried leaves of trees and dried grasses.

Parts

The various parts of the traditional watermills (Fig. 1a-h) are made by local carpenters, blacksmiths and other experts of the village. These are made by local available materials such as willow, rocks, wild grasses, etc. Juniper wood replaces the willow in areas where this kind of tree is available because it is more durable than the willow wood.

I. Above ground parts

a) *Wa or wato:* It is the channel made up of wood placed at a gradient slope which supplies water to the mill. Water is controlled at its mouth, *wago,* with the help of an iron or wooden plank. *Wa or wato* is about 8-10 feet long which is made by removing the corky portion of a straight willow trunk.

b) *Chepo:* It is the hopper, a conical basket for holding grain made up of *chipkyang*, a long and hard indigenous grass and willow sticks and covered with animal skin. It is tied with the ceiling of the room with the help of ropes. It can hold 150-200 kg depending upon its size. It is narrower at the base which is known as *tutu*. A wooden perforated square piece known as *melong* for controlling the flow of the grains (*khot*) is attached to the *tutu*. A grooved opening at the bottom which discharges the grains is known as *shingskyan*. *Thaktharak* is generally made up of horn of male sheep or goat.

c) *Doa:* Two circular heavy stones made up of granite make the grinding process. The upper stone, the runner, rotates fast upon the lower stationary stone, bed. The former stone is locally known as *gong-do* and the latter one is known as *yoq-do*. The grains from the hopper are dropped into a hole, *mik*, at the centre of the upper stone.

II. Under-ground parts

There is a tunnel under the ground for the passage of water. It contains *skuru*, *maqdan*, *wamjuk* and *phapstaq*. Its wall is made up of stones and height is normally of back-height.

a) *Skuru:* It is the wooden turbine which is a cylindrical structure remains in vertical position. On its top, a 'T' shaped iron shaft is fixed which is known as *sroq*. A mixture of saw and oil is used to tightly fix the base of the shaft into the turbine. The upper horizontal part of the 'T' is called as *latache* or *tia* remains fixed into the runner stone at its centre. The lower portion of the turbine is fitted with wooden blades/wings (*shoqpa*). These are 8-10 in number. The base of the turbine rests upon the spindle, *phang* with rounded base that rotates upon a shallow bowl shaped *pagor*. Both of these are made up of white marble, *chagar*. For easy slippery action of the *phang* above the *pagor*, oil is sometimes used.

b) *Maqdan:* It is a wooden plank which acts as a link between the *skuru* and the *phapstaq*.

c) *Phapstaq:* It is either made up of wood or iron. It is also a 'T' shaped structure. Its upper horizontal portion remains above the ground and the lower vertical portion is attached with *maqdan* through an attachment *khoqzer*. It controls the degree of grind.

d) *Wamjuk:* It is the outlet for the water. A wooden frame *shoqkhat* made up of willow sticks is used at this part in order to capture the blades which are sometimes got off from the turbine.

House: A watermill house consists of few rooms. Each mill is normally enclosed by a room. Every mill has a room for the operator (*rantakpa*) to live in. He uses this as living, dining, kitchen as well as bedroom.

Fig. 1 a-h: Various parts of the traditional water mill. **a.** Mill house, **b.** Tiyur, **c.** Wato **d.** Chepo and doa **e.** Skuru **f.** Phapstaq **g.** Phechaqs **h.** Phebyaq

Advantages

- It is a vital, centuries old technology, which has zero operating cost as it does not require fuel or electricity.
- Traditional watermill does not pollute the environment.
- The maintenance is done by the owner himself and the materials required are available in the village.
- The endosperm, bran and germ remain in their natural proportions (Campbell et al. 1999).
- Because the stones grind slowly, the wheat germ is not exposed to excessive temperatures. Heat causes the fat from the germ portion to oxidize and become rancid (Aubert 1989). The flour hence does not get spoiled for years on storage.
- Since only a small amount of grain is ground at once, the fat of the germ is well distributed which also minimize spoilage (Mount 1975).
- Exposure to less temperature also minimizes the loss of vitamins.

- Nutritive losses due to oxygen exposure are also limited by the fact the stone-ground flour is usually coarser (Thomas 1976).
- The taste, texture, flavors and standard of the flour of the watermill is far superior to flour of modern mills (Leonard 1990).
- Baking quality is better as compared to the flour of modern mill.
- Yield is also more (Tundup 2012).

While there is a long list of benefits attached to the watermill, the one disadvantage is that it is time consuming. The speed of the rotation of the stone is dependent on the volume and flow of water available (Denny 2007). This dependence also meant that the speed of rotation of the stone was highly variable and the optimum grinding speed could not always be maintained.

Improvement

Faced with an onslaught of modernity, centuries old traditional watermills are now disappearing fast. It is also true with this far flung region of India and with this an ancient symbol of culture is also disappearing. These are now replaced by mechanized mills operated with the help of fossil fuels and electricity.

The improvement of traditional watermill has been done by improving various components of the traditional mill but the most significant is the replacement of wooden runner with hydraulically better-shaped metallic runner having cup shaped blades (LEDeG 2008). The blades have holes at the periphery to ensure an even flow of water and smooth movement of the turbine. The stone bearings have been replaced by cast iron and mild stone bearings, thereby increasing the number of revolutions per minute.

Since Ladakh has acute shortage of oxygen level in the atmosphere due to less vegetation, it is thus important to use such technologies which are eco-friendly. The traditional mill, *rantak*, is one of these technologies which are highly suitable for this cold arid region of India. The government in partnership with the local non-government organizations should improve the design and technology of watermills to preserve them and encourage their use. After this it should be popularize among the local populace. The *rantak* principle should be used for other operations also such as oil expelling, wool and pashmina weaving, wood cutting, etc. as in other Himalayan states of India like Himachal Pradesh, Arunachal Pradesh and Sikkim.

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