Chuskor: an indigenous watermill for sustainable resource utilization by the Monpa tribes of Arunachal Pradesh, India

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The Monpas are one of the major tribes of Arunachal Pradesh inhabiting the western-most part of the state. They live in close proximity to the forest and other natural resources with rich indigenous knowledge system (IKS) for sustainable development. Chuskor, an indigenous technique for grinding grains into fine flour operated by water power for sustainable water resource utilization is reported here. We also analyse the role of Chuskor as an IKS which, if preserved and continued, may help in the sustainable utilization of renewable resources by local people in difficult mountainous areas.

The environmental discourse has gained increasing attention in almost all international forums on development, and the environment–development relationship is being seriously taken into account in practical policies and theoretical debates. However, some of the most articulate advocates of this environment–development nexus have been the proponents of a more contemporary model of development known as 'sustainable development'. The concept of sustainability and by implication the more specific concept of sustainable development is notoriously 'slippery' and subject to a range of different interpretations[1]. Sustainable development has been defined as development that 'meets the needs of the present without compromising the ability of future generations to meet their own needs'[2]. It includes two major concepts: (i) concept of needs – the essential needs of the world's poor to whom overriding priority should be given and (ii) idea of limitations imposed by the state of technology and social organization on the environment as the ability to meet present and future needs. The concept of sustainability began from the days of Thomas Robert Malthus in 1798. His work *An Essay on the Principle of Population*[3] predicted that the world's population would starve or live at a minimal level of subsistence because food production will not be able to keep pace with the population growth.

Historically, the Monpas are the aborigines of Tawang area and once ruled a kingdom called Monyul that existed from 500 BC to AD 600. They live in close proximity to the environment and are capable of observing, identifying, monitoring and maintaining the resource availability for sustainable development. They understand the importance of natural resources and use the limited natural resources in a sustainable manner. The Monpas possess diverse indigenous knowledge systems (IKS) like basketry, stone houses, equipment for cultivation, pounding, cleaning and threshing of grains, hand-made paper, compost made out of leaves of oak forests (*Parmong*) used as fertilizer, medicinal herbs, carpets, decoration pieces, thankhas (holy scroll painting), red coat (*Beaichuba*) made out of the best wool, the traditional headgear (a cap made out of the hair of black yak), traditional shoes, and intricately carved and beautifully painted vessels. This rich traditional knowledge among the Monpas is inherited from their forefathers and has been passed from generation to generation through oral tradition, customary laws, traditional craft, rituals, ceremonies, folks, etc. This vast traditional knowledge for sustainable development is still practised and considered to be of immense value.

A unique indigenous technique known as Chuskor (flour mill operated by water power for grinding grains into fine flour) is one of the finest examples of their IKS for sustainable development. This technique is environment-friendly and the energy is derived from renewable water from small streams and rivulets. It is found in almost all the villages, as the Monpas consider it to be a symbol of wealth in the society. The owner of a Chuskor is known as a Chuskor-dekpa. Chuskor is one of the best IKS for sustainable water resource utilization and needs to be conserved. Therefore, in this note we analyse how the Monpas utilize water resources through the traditional water mill and also to suggest suitable measures for conservation and continuity of the Chuskor system.

The study area lies approximately between 91°30′–92°45′E long. and 27°22′–27°50′N lat. (Figure 1). It shares an international border with Tibet and Bhutan. The topography of the district is mostly mountainous and its greater part falls within the higher mountain zone, consisting of tangled snow-clad peaks and valleys. Tawang Chu and Nyamjang Chu are the main rivers. The vegetation is broadly classified into temperate, subalpine and alpine forests. On an average the study area receives 1653 mm of annual rainfall and monthly mean maximum and minimum temperatures of 20.88°C and –0.07°C. The Monpa society is basically agrarian and rural-based. They practice both permanent and shifting (Jhum) type of cultivation. Besides, yak raising (Brokpas) and sheep herding (Yengtpas) form other important components of their economy. The entire district is divided into 180 villages and 10 administrative circles with a total population of 49,950 (2011 census). The administrative circles of the district include Bongkhar, Dudungkhar, Jang, Kitpi, Lhou, Lumla, Mukto, Tawang, Thingbu and Zemithang.

The present study is based on primary data. Information was collected through personal interviews, field observations and a structured schedule. A sample of 10 villages each from Dudungkhar, Jang, Kitpi, Lhou, Mukto and Thingbu circles was randomly selected for the present study. The village elders, artisans, owners of Chuskor, both men and women were interviewed to obtain data related to the indigenous technique. The Focus Group Discussion (FGD) was adopted to discuss and understand the processes and functions of the various parts of Chuskor. Information on sources of indigenous materials used in the various parts of this technique was derived from personal interviews with the owners and artisans. Participant observation was another tool to understand the age-old traditional Chuskor system.

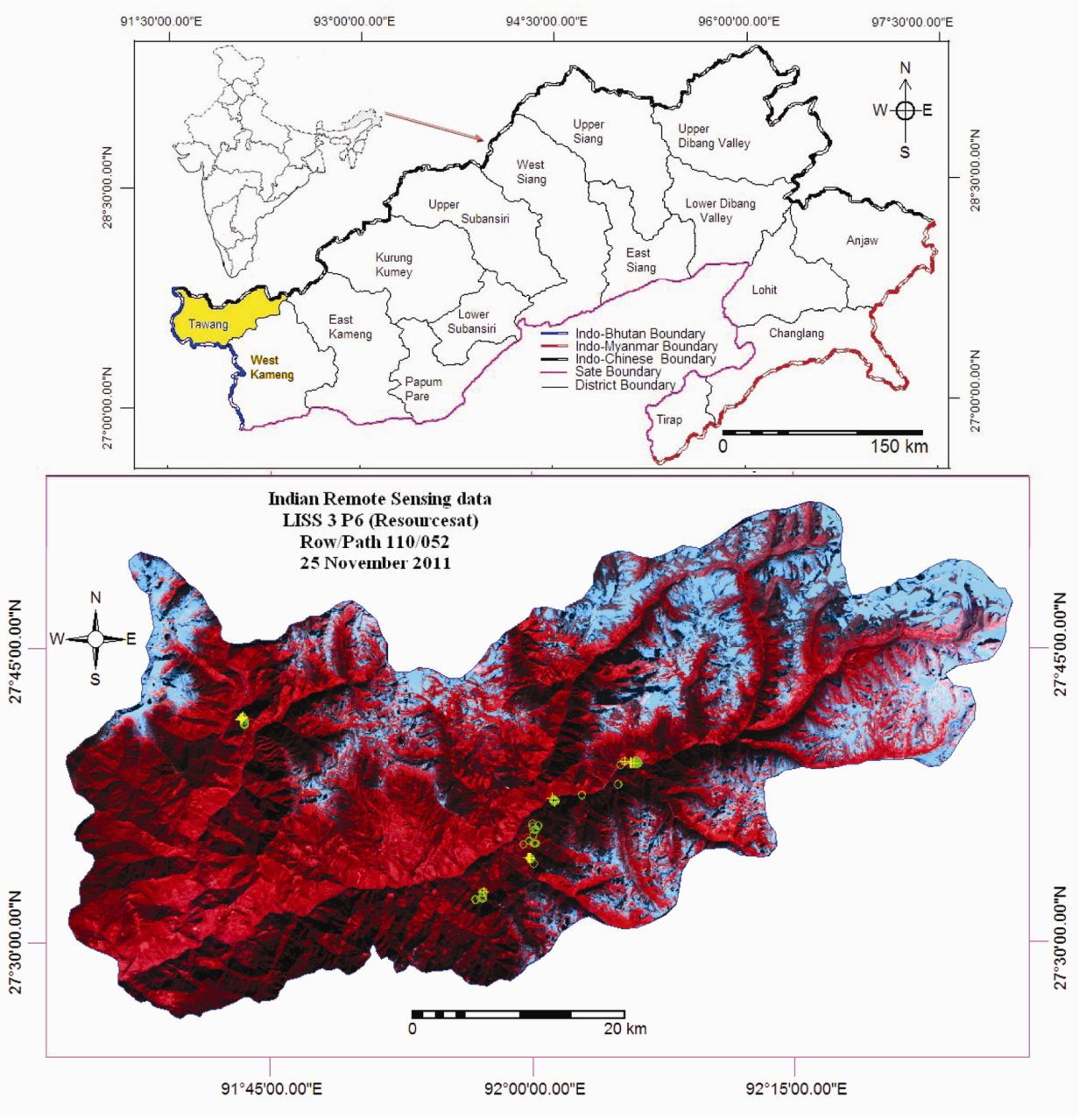

Figure 1. Location map of the study area in Arunachal Pradesh, India.

The technology employed in the operation of Chuskor is simple. Though at the time of its installation some expenditure and manual labour is required, once installed it does not require much expenditure, except maintenance cost, which makes it a cost-efficient and labour-efficient technique. As it is operated by water power without using any kind of fuel, it is an eco-friendly and sustainable technique for grinding grains. The tools and materials used for its operation are made by Chuskor owners and collected from the available natural resources. The various parts and functions of the Chuskor are presented below.

Water reservoir (Tsechanngp): Water from the small streams or rivulets is stored by digging and clearing the debris (Figure 2 *a*). According to the villagers, the maximum depth of the reservoir varies from 0.5 to 1 m and breadth from 3 to 4 m. The length usually varies from 7 to 9 m to avoid siltation by large boulders in the reservoir. The reservoir is built at 4–5 m above the water mill so that it can produce force or current to rotate the wooden turbines of the Chuskor.

Water regulator plank (Chung-go): This is a piece of wooden plank measuring around 10 × 12 inch fitted at the mouth of the water reservoir (Figure 2 *b*). In other words, it is the key which controls the functioning of water mill through opening and closing the movement of water towards the wooden turbines for starting and stopping the water mill.

Wooden channels (Tse Zarr): A 7–8 m long wooden channel is attached to the water regulator (Figure 2 *d*). The wooden channels are 10–12 inch in diameter and

Figure 2 *a–i*. Various parts of the Chuskor.

are made of pine wood for longer durability in water. The gradient of the channel is maintained to get enough slope and velocity of the water to rotate the wooden turbines.

Stone platform (Kartey): This is the base of the water mill which is made of a piece of flat rock with a hole in the centre over which the turbine is fixed so that it is not washed away when water hits the turbine (Figure 2 *e*). Sometimes a wooden log is also used in place of a flat stone, stone is preferred over wooden log for durability.

Wooden turbine (Grow): The wooden turbine is placed over the stone platform (Figure 2 *e*). Water from the wooden channel hits it and rotates the propeller. The turbine is made of pine wood for its oil content and durability.

Wooden propeller (Olla): It is a wooden log fitted with the turbine at the bottom (Figure 2 *e*). It is 7–8 feet high and is installed vertically above the turbine with the upper end attached to the grinding stone plates. It is also made of pine or any other wood trees having maximum oil content.

Pair of grinding stone plates (Chuskor Khachut-Machut): A pair of two heavy stone plates is used for grinding grains into fine flour (Figure 2 *g*). The upper plate is known as *Khachut* and the lower plate is known as *Machut*. The lower plate has a hole at the centre in which the propeller is fixed with the upper plate. The lower plate is much heavier than the upper plate as it has to hold the turbine and make the whole parts stable. The upper plate has a hole in the corner through which the grains are inserted so that it goes down between the two plates to be grind away.

Conical wooden container (Grom): The conical wooden container has openings at both the ends (Figure 2 *h*). The container hangs over the upper stone plate in such a way that when the grains are stored, it allows them to slowly fall into the hole of the upper stone plate.

Big wooden container (Zongpu): A big wooden container is placed below the grinding stone plates to collect the ground flour that comes out from the stone plates (Figure 2 *c*).

Wooden spoon (Sheng khelim): A small wooden spoon is used to take out the flour from the container and also to put the half-grind grains again into the container (Figure 2 *f*).

Building (Chuskor Brang): This is a two-storied building made from mud and stone (Figure 2 *i*). The lower compartment contains the turbine, propeller and stone platform, while the upper floor has the big wooden container with stone plates and cone-shaped wooden container.

Apart from this, a piece of cloth known as *Febsha* is used for collecting and cleaning the grinding plates after the grinding is over. Earlier, instead of cloth people used the skin of lamb for this purpose. A wooden bowl (*Bre*) is also used for measurement of the flour and

grains and a plate made of bamboo (*Shanggor*) is used for separating husk from the grains.

The study of IKS for sustainable development is of immense importance to understand the hidden practices of the different tribal communities that are not much exposed to the rest of the world. The traditional faith and belief systems of the tribal communities indirectly help in the conservation and sustainable use of the natural resources. For instance, the IKS of Aka tribes of Aruachal Pradesh has been reported to indirectly help in the conservation of many plants and animal resources through their concepts of sacred groves and other belief systems[4]. The knowledge-holding community needs to ensure that its knowledge systems and practices are supported and recorded and that they are not locked out of the research agenda of the major institutions[5]. The present study throws light on the indigenous technique of grinding flour operated by water power among the Monpa tribes of Tawang district for sustainable mountain development. The indigenous technique appears to be simple, efficient and sustainable in the fast changing world where the concern about sustainable use of energy resources is at its peak. Hence, an age-old technique blended with utilization of minimum resources and renewable energy like water can prove cost-efficient, labour-efficient and overall sustainable means of energy utilization. It has zero operating cost, does not pollute the environment and maintenance is done by the owner with the available materials in the village[6]. The taste, texture, flavour and standard of the flour of the watermill are far superior to the flour of modern mills[7]. Building ecological knowledge to understand qualitative changes in complex systems has been a means for improving a group's chances of survival[8]. However, till date the government has not shown any interest in this unique technique. Modern tools like electronic mills run by diesel, petrol, kerosene and other power resources have now become popular among people. People are switching to these technologies that are unsustainable as the resources used in such mills are mostly exhaustible resources. Further, the easy availability of food grains from shops and cooperative societies is also contributing to the shutting down of the Chuskor in the villages.

Therefore, a concerted effort by taking into confidence the village communities to preserve the old traditional knowledge system of sustainable development is need of the hour. There is a growing realization worldwide that people's participation is a crucial factor in sustainable development[9]. The villagers may be encouraged to continue the practice of Chuskor with some incentives and modification over the traditional system. The only disadvantage of watermill is that it is time-consuming, because the speed of rotation of the stone is dependent on the volume and flow of the water available[10]. Simple efforts by increasing the channel gradient, modification of turbine and grinding stone plates can improve the speed and efficiency of the Chuskor system to a large extent. Examples of successful modernization and modification of traditional grinding mills in different parts of the country like Himachal Pradesh, Jammu and Kashmir, Sikkim and the neighbouring countries like Bhutan and Nepal could be disseminated to the Monpas for preservation and continuation of this traditional knowledge system.

Current Science welcomes submission of papers along these lines. – Editors

1. Eden, S., *Prog. Hum. Geogr.*, 2000, **24**, 111–118.
2. Brundtland Commission, *Our Common Future*, Oxford University Press, Oxford, 1987.
3. Malthus, T. R., *An Essay on Principle of Population*, St. Paul's Church Yard, J. Johnson, London, 1798.
4. Nimachow, G., Joshi, R. C. and Dai, O., *Indian J. Tradit. Knowl.*, 2011, **10**(2), 276–280.
5. Singh, R. K. and Sureja, A. K., *J. Transdiscipl. Res. S. Afr.*, 2006, **2**(1), 73–102.
6. Denny, M., *Ingenium: Five Machines that Changed the World*, The Johns Hopkins University Press, Baltimore, Maryland, 2007, pp. 36–38.
7. Leonard, T., *The Bread Book*, East-West Health Books, Brookline, Massachusetts, 1990.
8. Berkes, F., Colding, J. and Folke, C., *Ecol. Appl.*, 2000, **10**, 1251–1262.
9. Roy, S. B., Mukherjee, R. S. and Chatterjee, M., *J. Indian Anthropol. Soc.*, 1992, **27**, 48–55.
10. Hussain, A. and Hussain, N., *Indian J. Hill Farm.*, 2014, **27**(1), 201–209.

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