

## Indigenous knowledge of yak breeding and management by *Brokpa* community in eastern Himalaya, Arunachal Pradesh

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Indigenous ways of conserving the animals through adoption of traditional breeding methods, classifying the breeds, diagnosing the diseases, and preventing the disorders and diseases by using locally available ethnoveterinary practices is still found to be rational and predominant in the remote places in India plays a pivotal role in conserving the animals' diversity. This research address the facets of traditional yak breeding systems and healthcare management using indigenous knowledge systems such as local forest, rangeland resources and ethnoveterinary practices. The research was conducted among *Brokpa* community of *Monpa* tribe in randomly selected villages of West Kameng and Tawang districts of Arunachal Pradesh. Participatory rural appraisal (PRA) and personal interview methods were employed to record the data. Result indicates that *Brokpa* community has developed local ways of conserving the yak breed. They select male and female breed in their traditional breeding programme by following certain definite criteria based on the phenotypic characters and productivity of animals. Informal rural social institutions play decisive role while exchanging the traditional yak breeds to be used in breeding. The healthcare of yak is maintained by selecting and feeding a range of indigenous grasses, trees and shrubs apart from the predominant system of accessing the rangeland ecosystems. Various diseases and disorders are combated by applying the ethnoveterinary practices based on locally available plants and practices. The economy and livelihood of *Brokpa* community are significantly affected by the stocks of indigenous yak breeds and their level of productivity. The role of indigenous knowledge of *Brokpa* in conservation and management of traditional breeds of yak can be used in participatory animals' biodiversity conservation.

**Keywords:** *Brokpa*, *Monpa*, Yak conservation, Ethnoveterinary practices, Indigenous knowledge, Traditional yak breeding

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The indigenous knowledge (IK) tuned to local culture, social system, need based, tested over centuries and dynamic in nature allow the local people to adapt to social and ecological attributes, thus contributing to food security and overall enhancement of the sustainability of natural resources<sup>1-6</sup>. The quantity and quality of IK varies among community members, depending upon gender, age, social status, intellectual capability, profession and degree of connectivity with surrounding natural resources<sup>2,4,5,7</sup>. Conservation of biodiversity and other natural resources in Arunachal Pradesh over a long period of time has been possible because of the cultural, spiritual and other social institutions of diverse tribal people that have guided the relationships between local communities and their resources<sup>8-11</sup>. Indigenous traditional practices relating to healthcare and conservation of yak practiced by the *Brokpa* (a pastoral community of *Monpa* tribe, whose

profession and livelihood is dependent on yak rearing and moving them for grazing) community of *Monpa* tribe of Arunachal Pradesh represent a cost effective, valuable, but as yet untapped resource for extending many aspects of basic animal healthcare, especially to poor and smallholder producers in remote or difficult environments. The importance of *Brokpa's* knowledge for traditional breeding, conservation of local breeds and use of ethnoveterinary practices depends on the self-organizing capacity of pastoral systems based on the institutional adaptability of the pastoralists and the ecological resilience of the vegetation used as fodder for healthcare and increasing productivity of yak<sup>9</sup>. Looking to importance of indigenous knowledge of traditional breeding of yak and using ethnoveterinary practices in maintaining their healthcare, an attempt has been made to conduct the study among *Brokpa* community of *Monpa* tribe of West Kameng and Tawang districts of Arunachal Pradesh.

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## Methodology

Arunachal Pradesh is one of the 7 sister states of Northeast region (NER) of India. The State is largest among Northeastern states and is divided into 16 administrative districts of which West Kameng and Tawang districts find important names for their biocultural heritage. The economy of *Monpa* is basically agrarian and rural based. They practice both permanent and shifting (*jhum*) type of cultivation. Maize, paddy, millets, buckwheat, wheat, barley, soybean, French bean, chilies, potato, cabbage, cauliflower, apple, etc. are some of the major crops grown by the *Monpa* tribe. Animal husbandry in which yak and sheep are major domesticated animals, play pivotal role for food and livelihood security of *Monpa* tribe. This community living in various ecosystems of region are experienced and well known and for their traditional knowledge of bioresources.

Six villages, 3 from Dirang (West Kameng district) and 3 from Tawang circles (Tawang district) of Arunachal Pradesh were selected randomly based on the ethnicity, types of agriculture, remoteness, forest cover and dependency of *Monpa* tribe on the use of natural resources. From each village, 30 *Brokpa* (thus total 180) having the age of more than 50 yrs and diverse knowledge of yak rearing and management were selected randomly from a list provided by the Village Extension Workers. Focus group discussions (FGD) were organized to record the IK on traditional yak breeding programme. A survey questionnaire containing open ended questions was applied to a conventional mixed sample to ensure the comprehensiveness of facts on traditional yak management. To have a comprehensive knowledge of local feed resources and indigenous plants resources used in curing yak diseases, the resource flow maps were developed in each village with the old age and knowledgeable *Brokpa* to know the resource use pattern at village level. The explanatory research design with complementation of descriptive statistics was adapted to explain the recorded data and draw inference from the study. Informed consent has been obtained from the *Gaon Burha* (traditional village chief) for sharing and publishing their knowledge system to acknowledge them formally. While seeking informed consent, the researchers have explained the purpose of the research, its sponsors, potential benefits and possible problems associated for people and the environment, research methodology and participation of residents of the community. They

were given an opportunity to read the summarized facts of research through their *Gaon Burha* (village chief).

## Results and discussion

### Traditional breeding system management

The yak (*Poephagus grunniens* or *Bos grunniens*) is regarded as one of the remarkable domestic animals of *Monpa* tribe as its products are important components of their daily diet and livelihood. Domestication of yak in particular has led to progress, prosperity and economic advancement for *Monpa* people because of the value of the yak as a packing animal and its products from milk, hair, hides and meat - and the availability of its dung as a fuel in the areas above the tree line. A herbivore, in Arunachal Pradesh, the yak lives predominantly on the hills of West Kameng and Tawang (1,828.8 to 3,352.8 m amsl) districts (Figs. 1 & 2). These areas are, to a large extent, predominantly occupied by *Brokpa* and virtually no cropping is done in these rangeland ecosystems. There is no frost-free period in year (near the hills at 2,743.2-3048.0 m amsl). At high elevation, the overall ecosystem is characterized by a harsh climate with cool moist summers, severely cold winters, where grazing resources are restricted by very short growing seasons. In these places, the traditional breeds of yak is conserved and reared for livelihood by the *Brokpa* (Fig. 3). Some of the breeds for example *Zo* can easily be reared at 1,828.8 m amsl also under uneven to flat ecosystems where mixed vegetations of shrubs and grasses are predominantly found. *Brokpa* have the sound traditional breeding knowledge of yak, thus they maintain a wide range of diversities of yak breeds (Table 1). The observations revealed that the breed *Sing Galang* has high number of sperm count if it crosses with female, it results in swelling of stomach of female (physiological indicator), hence *Brokpa* do not prefer to use this breed as bull in their traditional breeding programme. It is preferred and used only for meat purpose. *Zo* is used mainly for carrying load, but not as a bull in breeding programme. *Dzomo* is prized for its quality milk, ghee and *churpi* (wet cheese made of fermented yak milk). *Bham Dzomo* is the highly preferred female breed for milk, ghee, *churpi*, etc. while, *Brim Dzomo* has white milk with high fat content and used for making of quality ghee and *churpi*. No less than 124 different combinations of yak with different local types of cattle, both *zebu* and *Bos taurus* in Nepal conserved by the traditional community through their own breeding programme have been reported<sup>12</sup>.

Table 1— Indigenous breeds of yak conserved by *Brokpa* for traditional breeding

Parents used in crossing		Produced offspring	
Female	Male	Female	Male
Kot	Yak	Dzomo	Zo
Dzomo	Galang	Kot	Sang
Kot	Galang	Sing Kot	Sing Galang
Sing Kot	Galang	Ta Kot	Ta Galang
Ta Kot	Galang	Bha Kot	Bha Galang
Bha Kot	Galang	Galangmu	Galang (pure male)
Galangmu	Yak	Dzomo	Zo
Sing Kot	Yak	Sing Dzomo	Sing Zo
Dzomo	Yak	Tui Dama	Tui Shang
Bha Kot	Yak	Bha Dzomo	Bha Zo
Ta Kot	Yak	Ta Dzomo	Ta Zo
Galangmu	Yak	Bham Dzomo	Bham Zo
Tui Dama	Galang	Tui Dzomo	Tui Zo
Tui Dama	Yak	Garmu	Garyak
Garmu	Yak	Kyukmu	Kyukyak
Kyukmu	Yak	Zyang or Bree	Yak
Bree	Yak	Bree	Yak
Bree	Galang	Brim Dzomo	Brim Zo
Garmu	Galang	Gar Dzomo	Gar Zo
Kyukmu	Galang	Kyuk Dzomo	Kyuk Zo

The normal breeding season of yak is from June to September. Most yaks have their first calf when they are around 4-5 yrs of age. Generally, there are two calves in every 3 yrs. Bulls are first put into service when they are 3-4 yrs old. It is believed that if the male used for crossing has thick and short horn, there will be more chance of production of male in the offspring. Alternately, if it has long and thin horn, there will be female in their offspring. Handsome male is selected with intent to obtain the female yak. The age of the male and female are decided by the size of their horns and counting the rings in it. Ring formation is visible after 5 yrs age. This knowledge is more predominant among the elder *Brokpa*. For breeding programme, *galang* and yak are used as male. *Zo* is most preferred as pack animal, followed by yak. Similarly, a number of indigenous yak breeds are maintained and used in breeding programme to inherit the desired attributes in a particular breed. The criterions and attributes selected in a particular breed are preferred to out the local needs of *Brokpa*, who mostly live in fragile ecosystems. Some researchers in their study of traditional yak husbandry found interesting results in the knowledge of traditional community of Eastern Himalaya and described that knowledge used in selecting the parents and producing a particular progeny is quite rational<sup>13,14</sup>. In some cases, traditional community used more comprehensive and complex knowledgebase in their breeding programme. Thus, the use and continuation

of century tested experiential wisdom of *Brokpa* community find the scientific support and validity.

The existence of informal rural social institutions in the *Brokpa* community plays a decisive role in exchanging the male and female yak breed. For example, *phala* is a traditional institution of *Brokpa* in which one *Brokpa* borrow the productive bull yak from other *Brokpa* for crossing the *Zo*. If the offspring is *Dzomo*, 3 kg *ghee* is given to the owner of bull. If it is *Zo*, 3 kg *churpi* is given to the owner of male yak. Some of the customs like *nuser* (*nu* means milk, *ser* means yellow) is performed after yak calving. In this custom, colostrums of calving yak are distributed (*yongpen*) among the relatives and members of *phala*. By this way, yak related traditional knowledge and network is developed and enhanced among the *Brokpa* people which helps in sharing the knowledge and practices of yak healthcare. These institutions collectively care the yak breeds during the stay of herds in grazing land as well as collect the feed materials. A collective decision is taken by this institution to combat any problem or need related to yak management. For example, making the yak shed the members of this institution work together. Sometimes, the resource rich yak owner purchases their male yak breed from neighboring country Bhutan for using them in breeding programme. For this job, elder *Brokpa* is selected, who choose a particular breed based on his years of experiences in rearing the yak. This process of purchasing the yak from Bhutan provide an ample opportunity between the *Brokpa* and traditional community of Bhutan to develop the cross cultural biocultural knowledge related to yak rearing and management under varying socio-ecological systems. The owners of yak heir the *Brokpa* and pay them monthly wages and provide foods made of indigenous crop products. In most cases, care of yak, selection of feeding materials, treatment of diseases using locally available plants and processing of milk and meat based products are performed by *Brokpa*. Thus, the role of *Brokpa* in conserving the improving the yak breed was found to be comparatively more valuable than the owners.

With the passage of time, population of local breed of yak is decreasing as per the perception of yak owners. Previously, one pastoralist has more than 50-100 yaks, even 400-500; 1000 sheep and more than 50 cows. But increasing population and changing social values led to a sharp decline in their

biodiversity. Hybridization on a large scale of yak with local Tibetan cattle led to sharp decline in the pure yak population<sup>13</sup>. The closer of the border with Tibet to the former traffic in yak has affected the availability of new sources of breeding stock<sup>14</sup>.

### Indigenous tree and shrub species as fodder

Dynamics of ecosystem and food security forced the *Brokpa* to use local bamboo leaves as fodder for their yak and *Dzomo*. The grass cutting is restricted by the community from yak grazing land. Violation of this rule invites the fine imposition decided by *Chhopa* (a traditional rural social institution, who framed and exercise the rules to govern the behaviour). However, under grasses and fodder scarcity, bamboo leaves are chopped down from the rangelands with prior permission from *Chhopa* chief and fed to the *Dzomo*. It was observed that apart from the grazing, *Brokpa* have the location specific traditional ecological knowledge to select a range of diversified indigenous trees and shrub species as fodder for the yak as the supplementary feed (Table 2). These feed resources are found to be more valuable during the time of grass scarcity. The preference for indigenous trees species are decided based on certain criterions like easy availability, time of collection, distance, place of collection, etc. According to the season, these trees and shrub species found at different altitudes and having different growth speed, are lopped and fed to the yak. They vary in order of their importance and ranking from each other on account of their palatability, liking of yak as well as the nutritional quality.

### Indigenous practices for yak health

Local alcoholic beverage called *rakshi*, made of indigenous barley/maize/finger millet/rice, is not only a part of the traditional and customary foods items, but also used in treating many diseases and disorders in yak. Some yak cures are based on astute observation. For instance, liver and other body parts of fish are given to the yak along with beer made from finger millet and indigenous varieties of maize. This is fed to yaks suffering from weakness, particularly to old yak. For improving the health of pregnant yak, a mixture of corms and stems of *Colocasia* and tender leaves of *shishnu* (*Urtica parviflora*) are boiled till their quantity is reduced by 50%. The mixture is allowed to cool and is then fed to the yak. Generally, yak are kept out-of-doors all year-round. Calves remain with the dams up to weaning, usually till 5-6 months old. The residue after preparation of *ghee*, and *churpi* is given to the yaks because it is nutritious. If the female is not conceiving, her tail is slit and she is starved and more loads is given to make her weak.

The fresh residue remained after preparation of local alcoholic beverage, called *lohpani* (made from maize/rice/barley/finger millets) is mixed with tablets of *pham* (2-3 yeast tablets -made from paste of local rice and green leaves of *Solanum khasianum*), *nying* or *Aconitum ferox* (0.5-1.0 gm), barley flour (250 gm), lice (one) and rat faecal matter and is given to the yak suffering from constipation (Fig. 4&5)<sup>19</sup>. After the age of 4-5 months, the calves of yak are given the boiled leaves of *shishnu* (*Urtica parviflora*). To induce the puberty, about 30-40 gm of rat excreta along with barley flour is given to female yak. For the

Table2— Indigenous tree and shrub species used by *Brokpa* for feeding yak

Local name	Plant name	Growth speed	Main lopping season	Mean score	Preference ranking
<i>Blemkar</i>	<i>Buddleja asiatica</i> Lour	Medium	Year round	9.10	I
<i>Salyx</i>	<i>Salix humboldtiana</i> Willd	Fast		9.10	I
<i>Syluli</i>	<i>Acer campbellii</i> Hook f. and Thoms	Slow	June-August	9.00	II
<i>Domkar</i>	<i>Symplocus racemosa</i> Roxb.	Fast	June-July	9.00	II
<i>Zimbu</i>	<i>Ligustrum myrsinites</i>	Medium	June-July	8.70	III
<i>Maar</i>	<i>Castanopsis</i> sp.	Medium	July-August	8.70	III
<i>Bamlakpa</i>	<i>Embelica</i> sp.	Medium	June-July	8.00	IV
<i>Maarma</i>	<i>Spirarea</i> sp.	Slow	April-July	7.69	V
<i>Khaksuma</i>	Not available	Very slow	June-July	7.00	VI
<i>Ngek Sing</i>	<i>Symplocus paniculata</i> Mig.	Medium	June-July	7.00	VI
<i>Phrengpa</i>	<i>Quercus wallichiana</i>	Slow	June-July	6.58	VII
<i>Kar Sing</i>	<i>Acer hookeri</i> Lindl	Medium	June-July	6.10	VIII
<i>Matekpa</i>	<i>Lithocarpus fenestratus</i> (Roxb.) Rehd.	Medium	April-July	6.00	IX

Note: The ranking of indigenous trees species used for fodder as done in the focus group discussions (FGD) with 10 *Brokpa*. Measurement for ranking was done using four point continuum scale i.e. very good with score 3 good with score 2, moderately good with score 1 and poor with score 0

same disorder, the mixture of flour of local varieties of maize and salt is regularly given and gradually the quantity is increased. Juice of *bimomba* leaves are used for curing the wound inflicted on the cut over placenta (*nadi*) after calving of yak. The dung of yak collected during grazing is used for generating smoke to control the population of mosquitoes and flies. *Satparni* (*Alstonia neriifolia*) latex is used for successfully curing the wounds in yak. Worm infection in wound is controlled by applying the decoction made of green leaves of local tobacco. To cure diarrhoea, influenza and dysentery in yak, the tuber of a local plant, *Tshando* (a shrub found in between the cracking rocks, producing blue colour flower and found in temperate ecosystem) is utilized as ethnoveterinary medicine. It must be used in mild moist form and is given in very less quantity (sometimes in mg) with *rakshi*. Yak owner gives a mixture of green bamboo leaves and jaggery for quick dropping of retained placenta. About 0.2-0.5 gm *nying* (*Aconite ferox*) mixed with 250 ml of inferior grade *rakshi* is given for deworming in yak calf. For increasing the milk yield in sick yak, 4 eggs mixed with flour of local maize, salt and bamboo leaves are given to the animal. Some local grasses like *jhansing* is preferred more for rapid increase in milk yield.

The yak is reared even during the calving period under grazing and forest condition. Just after calving, *Brokpa* feed mixture of common salt and flour of finger millet, barley and maize is given to the mother for recovery from pain and increasing the milk efficiency. During 1950s, feeding common salt exported from Tibet was a custom and popular to rear the yak and *Dzomo* and this was obtained through the barter system between the *Monpa* tribes of Tawang and Tibet. Through a barter system on specified ecological edges, *Brokpa* exchanges the yak milk products with local grains (maize, barley and wheat) from villagers. They exchange not only salt, but also other yak products like *churpi*, *ghee*, wool, etc.

### **Socio-economic dynamics of yak conservation**

In recent times, the access and services to previously remote pastoral areas has improved and there is an increased demand for yak products. Trade of yak products is also an important way of capital accumulation for *Brokpa* community. Income is derived from most of the products, from the sale of yak products like *churpi*, meat, toffee, skin and hairs and from providing bulls for breeding. *Brokpa* also

tries to exploit year-to-year fluctuations in resources in order to optimize herd productivity. The wool harvested from the local yak is used for making various types of cloth and other items. Bags are made from wool and used for carrying food materials to agricultural fields. Yak has made life possible for *Monpa* in harshest environments and they can be reared up to 4,267.2 msl. In purely pastoral areas (*Chander*, *Somteng*, *NagaGG* and *Sela* top), where merely dependency on cultivated agriculture is not sufficient, yak allows people to subsist and, in many areas, to live quite well. In the mixed pastoral areas where both animal husbandry and cropping is found, yak is an important component of agricultural production systems. Apart from the home consumption of yak products, yak husbandry is also the mainstay of the *Brokpa* economy and contributes 32.0% in livelihood system (Fig. 6). In grazing areas, where pastoralists rely for their subsistence mainly upon the yak, the social status and wealth of the nomads is judged, as in other traditional pastoral societies, by the number of animals owned. The products obtained from local yak are used in many cultural and ritual occasions (31.0 % contribution). The milk products and meat are used in various modes and combination with local crop produce and hidden harvest from the wild areas (37.0%).

In the past two decades, alternative sources of feed and improved veterinary facilities have been reducing the losses of animals during hard winters in some approachable villages of Dirang and Thembang circles of West Kameng district. However, maximizing yak numbers by herders has been widely perceived as having caused rangeland degradation in pastoral areas through overgrazing. If reproductive rate is higher than normal in 'good' years, or if supplementary feed has been available during winter, herd size increases and greater opportunities are created for marketing. The market-pricing process has made pastoralists more aware of the possibilities inherent in slaughtering livestock earlier in the season. This system is more predominant near Tawang town, where slaughtering of yak is increased for last two one decade. In the more remote yak-raising areas, the marketing of yak products is still limited due to cultural ethics, social norms, a few market outlets, poor communication and high transport costs. In particular, yak herders have not yet been able to tap specialty markets for yak products that could bring higher prices.

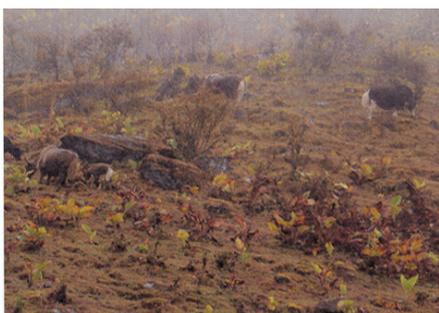
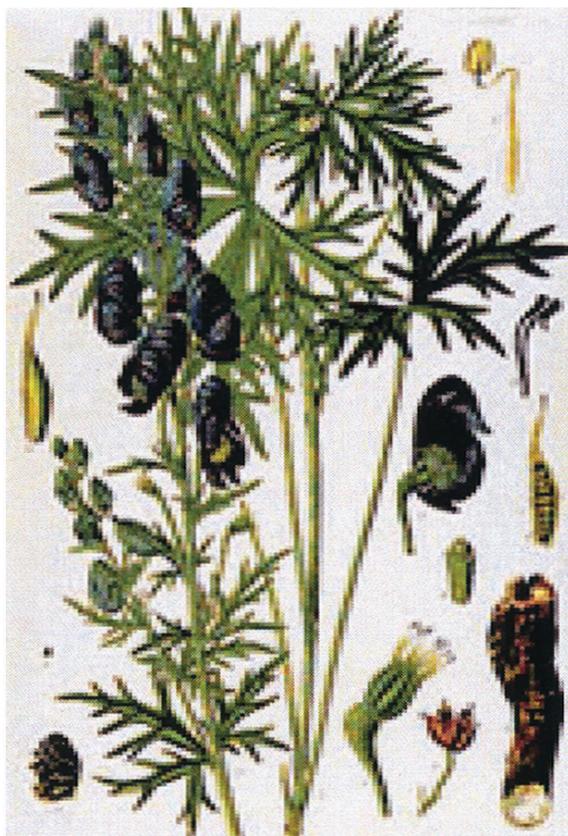
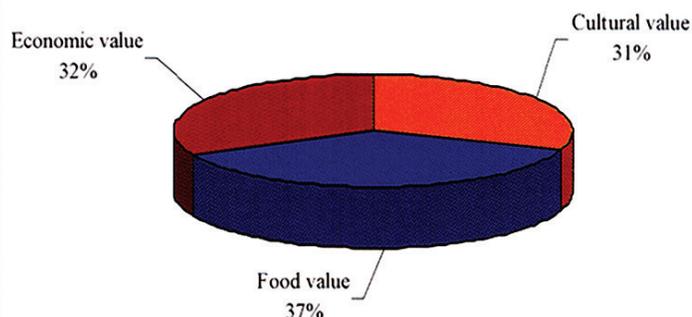
Fig.1 Rearing of yak by *Brokpa*

Fig.2 Yak grazing before Sela-top



Fig.3 Yak habitat in temperate ecosystem

Fig. 4 *Aconitum ferox*Fig. 5 *Nying (Aconium ferox)*Fig. 6 Role of yak breeds in the life of *Brokpa*

## Conclusion

*Brokpa* people are competent in maintaining the traditional breeds of yak. They consider several important characters like productivity and health while selecting the yak breed for breeding, thus they have maintained about 20 indigenous yak breeds. The *Brokpa* community prefer local breed of yak for the meat and milk products due to the compatibility of food habits and socio-environmental factors. Existence of informal rural social institutions plays a pivotal role during the breeding and conservation of yak breeds as well as related biological resources. For the sound healthcare management of yak, the

community considers some of the local attributes in grazing land and moving the yak to keep them healthy. Selection of indigenous grasses, shrubs and trees as supplementary feed during the lean season is found to be quite rational. Curing different diseases and disorders by using ethnoveterinary medicines are based on years of informal experimentation, location specific observations and locally available plants and practices. Local breeds have developed special traits to cope with the high fluctuations in climatic factors (temperature regime) and forage supply. *Brokpa's* indigenous knowledge based strategies in components of livestock husbandry and nutrition, production and

reproduction, breeding, veterinary medicine and social capital are intermingled with each other and play a significant role in conservation of local yak breeds and improve their health and productivity. Such rich knowledge systems of local pastoralists and traditional community are rich heritage and stuff for the formal science to have source of hypothesis and maintain the sustainability. This is not the example of a particular region or country, instead such heritage and wisdom of culture and biological diversity of animal breeds and their healthcare management are discussed by various scholars<sup>15-18</sup>. The development of pastoral economies is the key to poverty alleviation and improving food security, as well as to the wider goal of creating sustainable livelihoods. These can be well facilitated through utilization of local knowledge systems of breed management and healthcare practices for yak adopted by *Brokpa* people.

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### References

- 1 Posey D A, *Cultural and Spiritual Value of Biodiversity*, UNEP (Intermediate Technology Publications, London, UK), 1999, 25-60.
- 2 Berkes F, Colding J & Folke C, Rediscovery of traditional ecological knowledge as adaptive management, *Ecol Appl*, 10 (2000) 1251-1262.
- 3 Long CL & Zhou Y, Indigenous community forest management of *Jinuo* people's swidden agroecosystems in southwest China, *Biodi Cons*, 10 (2001) 753-767.
- 4 Sarah L, *Biodiversity and Traditional Knowledge: Equitable Partnership in Practice*, (Earthscan Publication, London, UK), 2002.
- 5 Turner NJ, *Earth's Blanket: Traditional Teaching for Sustainable Living*, (Douglas & McIntyre Ltd Quebec Street Suite, Vancouver, British Columbia, Canada), 2005, 10-239.
- 6 Singh A, Singh RK & Sureja AK, Cultural significance and diversities of ethnic foods of Northeast India, *Indian J Traditional Knowledge*, 6 (1) (2007a) 79-94.
- 7 Singh RK, Singh A & Sureja AK, Traditional Foods of *Monpa* tribe of West Kameng, Arunachal Pradesh, *Indian J Traditional Knowledge*, 6 (1) (2007b) 25-36.
- 8 Singh RK, Conserving diversity and culture: *Pem Dolma, Honey Bee*, 15 (3) (2004) 12-13.
- 9 Singh RK & Sureja AK, Community knowledge and sustainable natural resources management: Learning from *Monpa* tribe of Arunachal Pradesh, *TD: J Transdisciplinary Res Southern Africa*, 2 (1) (2006a) 73-102.
- 10 Singh RK & Sureja AK, Dynamics of traditional knowledge and prior informed consent of conservators of indigenous biological diversity of Northeast India, *Proc Nat Seminar Nat Res & Tribal Comm Northeastern India*, 7-8<sup>th</sup> February, 2006, Jawaharlal Nehru College, Rajiv Gandhi University, Pasighat, Arunachal Pradesh, India, 2006 b.
- 11 Singh RK & Sureja AK, *Conservation of *Gymnocladus assamicus* Kanj, A Critically Endangered Tree Species of Northeast India*, Extension Bulletin No 1, College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh India, 2006 c.
- 12 Joshi DD, *Yak and Chauri Husbandry in Nepal* (HM Government Press, Singha Durbar, Kathmandu, Nepal), 17 (1982) 145.
- 13 Nivsarkar AN, Gupta SC & Gupta N, *Yak Production* (Indian Council of Agricultural Research, New Delhi), 1997, 394.
- 14 Pal RN, Yak husbandry in India, In: *The Yak*, by Wiener G, Jianlin H & Ruijun L (eds), (Second edition FAO, Rome), 2003, 293-298.
- 15 Homann S, *Indigenous Knowledge of Borana Pastoralists in Natural Resource Management: A Case Study from Southern Ethiopia*, Ph D Thesis (Department of Livestock Ecology, Institute Animal Breeding and Genetics, Justus Liebig University, Giessen), 2005.
- 16 Mathias-Mundy E & McCorkle C, *Ethnoveterinary Medicine: An Annotated Bibliography*, (Iowa State University Research Foundation, Ames, USA), 1989, 25-40.
- 17 Mathias-Mundy E, How can ethnoveterinary medicine be used in field projects? *Indigenous Knowledge Dev Monitor*, 4 (2) (1996) 6-7.
- 18 Singh RK, The use of *Bhelwa* (*Semicarpus anacardium*) seed for the control of foot and mouth disease, *IKWW*, 2002, 3-4.
- 19 Stuart Rev GA, Chinese Materia Medica, Southern Centre: A translation of an ancient Chinese herbal fascinating, ([www.pfaf.org/database/plants.php?Aconitum\\_ferox](http://www.pfaf.org/database/plants.php?Aconitum_ferox), 20-11-07).