ANIMAL GENETIC RESOURCES OF BHUTAN

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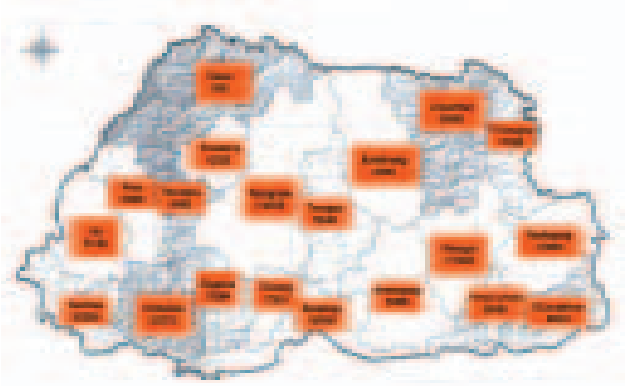
CHAPTER 1: NUBLANG

Dr. Lham Tshering, Dr. D. B. Rai

Introduction	*Nublang* is the traditional cattle breed of Bhutan since its presence dates back to time immemorial. It is a *Bos indicus* breed of cattle which is believed to have originated from the Sangbay geog of Haa. The *Nublang* is a priority breed for conservation since it is facing numerous threats to its existence such as the introduction of high yielding exotic breeds in the country and restricted forest grazing.
Species	Bovine
Breed name	*Nublang* (Male), *Thrabum* (Female) , Siri
Scientific name	*Bos indicus*
Local names	*Chulang, Thralang*
Photographs	 *Thrabum* *Photo Courtesy: NBC*  *Nublang* *Photo Courtesy: NBC*  Heifer *Photo Courtesy: NBC*  Bull *Photo Courtesy: NBC*

Origin and Population size	The origin of *Nublang* is linked to the legendary lake-*Nub Tshonapata*, located on the western mountain ranges of Haa and above Nakha village in Sangbay geog. The legend resonates over many generations that the first breeding bull was gifted by the **Tshomoen* of *Nub Tshonapata* to a cow herder who generously provided food and shelter to the *Tshomoen*. According to the elders of Sangbeykha, the gifted bull actually appeared, heading towards the herd of the herder, after a few days of the departure of the *Tshomoen.* The herder took good care of the bull and crossbred it with his herd. Soon the *Nublang* breed became popular and spread widely in the region. Thus Sangbey geog came to be known for the best *Nublang* breed in the kingdom. The local cattle population was estimated at 250,*000* (RNRCensus, 2000). However, this census does not reflect the true *Nublang* population because Mithun hybrids and back crosses are also included in the figure. Livestock experts are of the view that true *Nublang* resources may be less than 20% of the total figure reported in RNR census, 2000.
Geographic spread / map.	Dzongkhag Wise *Nublang* Population.  Source: Livestock Statistical Bulletin(2007)
Utility	*Nublang* plays an important role in Bhutanese farming systems as a source of : · Draught power · Manure · Dairy products · Social security.

* Lady of the lake

Its multifaceted role has made the breed the most suitable breed in the extensive to semi-intensive cattle production system in Bhutan.

Distinguishing Features

Table 1: Breed standards of Nublang.

Body part	Desirable	Not desirable
Head	Long face, long hair on poll, base of horn and ear, horn directed outward, upward and forward *(Rob cha aey go go)*	Short face, sparse hair, Horn directed sideward, backward *(Rob cha tok kay)*
Neck	Short neck, well developed and pendulous dewlap *(oeay cheay tsa lay ptsha)*	Long neck, short dewlap
Hump	Well developed with growth of thick long hair from its top *(Bjala tseau pup pup zum)*	Small hump, less hair
General body conformation	Proportionate *(Gu-ju-demdem)*	Big head, thinner posterior part
Limbs	Strong, tall *(Kang lub tum rim rim)*; rounded hooves *(Meak chu tey re re)*	Weak, short, pointed hooves
Tail	Long,Hairy,Thick switch *(jum tsalay ptshak)*	Short, thin with sparse hair on switch
Sheath	Tight and big with abundant prepucial hair *(Pho cho boam , jaou ray chu ngey ngey)*	Small sheath, sparse hair

Physical (body) parameters

Colour: Multi coloured usually black, black and white, red, red and white.

Average wither height : 111 cm
Average Body length: 127 cm
Average heart Girth: 149 cm
Average Body weight: 249 kgs.

Genetic variation /Diversity	· *Nublang* is genetically unique and distinct from any other cattle in the neighboring countries. · *Nublang* in the eastern part of the country is genetically different from the *Nublangs* in the west and central region.
Management system	· Requires minimal or no management. · Grazes freely in the forest during the day and is tethered at night. · The animal is highly adapted to a wide range of agro-climatic conditions. · Relatively more resistant to diseases than exotic breeds. · Good foraging abilities · High adaptability - can endure adverse nutritional and climatic conditions.
Production performance	Average age at first mating: 43 months Average age at first calving: 55 months Average calving interval: 646 days Average gestation period: 279 days Average lactation length: 264 days Average lactation yield (305 days): 465.6 litres Average fat %: 4.35%
Socio-culture/ religious and economic importance	· Age-old tradition · Time-tested draught power · Affordable · Easily manageable; zero management required · Robust and very adaptive · Contribution to the genepool
Selection environment	· Natural selection based on Phenotypic characteristics in the natural habitats · Challenging due to; * change in natural habitat * increasing predators presence
Breeding structure	· *Nublang* is used as a base population for cross breeding programmes · Lack of a systematic *Nublang* breeding plan *in-situ* which is leading to Inbreeding
Population trend and threats	The *Nublang* breed has survived because of its utility in the traditional extensive cattle production system. However, the production system is changing driven by economic needs

	which could pose a serious threat to sustainability of the breed.Some of the perceived threats are: · The transition from an extensive or semi-intensive system to which this breed is suited to an intensive market oriented dairy farming which entails high yielding cattle breeds contributing to the genetic erosion of the breed. · Crossbreeding *Nublang* with Jersey, Brown Swiss and Mithun to take advantage of the heterosis is increasingly advocated and aggressively pursued to increase productivity, income and better livelihood of the rural farmers thereby diluting the *Nublang* breed . · A sizeable number of *Nublang* cattle in peri-urban areas with easy access and markets are being substituted by improved breeds. · The castration of quality young bulls for draught and meat purposes leads to negative selection and hampers the conservation of *Nublang*. · The population of *Nublang* is declining at an increasing rate. If this trend continues, it would not be long before the breed is endangered. In view of this, sustainable conservation efforts must be explored and pursued to secure the breed for its use now and in the future.
Conservation initiatives	Present initiatives; · Cryo preservation in gene bank - ongoing · Rearing of Nucleus stock at National Nublang Breeding Farm, Tashiyangphu- ongoing · *In-situ* conservation in the field- initiated
Conclusion	*Nublang* is a unique breed of cattle native to Bhutan. As per census RNR 2000, 77% of the cattle population is the local breed, of which true *Nublang* poplation is probably less than 20%. The population is declining due to cross breeding programmes practiced in the country. Strong emphasis is required to ensure conservation of a sizable *Nublang* population, through the following initiatives: · Building a separate project proposal for long term funding to secure *Nublang* conservation plan. · Strengthening *in-situ* conservation and breed development along its breeding tract.

	· Introducing Open Nucleus Breeding Scheme, *Nublang* Herd Book in the village level and strengthening of the existing *Nublang* Breeding Farm. · Use of Embryo Transfer technology in the nucleus farm to complement faster breed development initiatives through selective breeding. · Provision of incentives to *Nublang* breeders.The principle behind this incentive is to compensate *Nublang* owners for depriving them from rearing exotic cattle breeds. · Creation of Association e.g. **Rare Breed Bhutan,** which may be formed/ founded by interested group of individuals/ agencies for conservation of rare breeds of Bhutan. The association can lobby for policy support towards conservation of rare indigenous animal genetic resources of the country as well as generate fund for its conservation.

CHAPTER II: YAK

Dr.Tashi Dorji, Gyem Tshering, Dr. NB Tamang and Dawa L Sherpa

Introduction	Yak farming is an integral part of pastoral systems in Bhutan. About 9,000 farming families (MoA, 1992) in 9 out of 20 Dzongkhags (districts) in Bhutan are involved in this profession. It is the major source of livelihood for these highland people. Yak herding in Bhutan dominates high altitude areas (alpine rangelands) above 3000 *masl.* These areas are characterized by marginal environment, limited opportunities for productive farming, remoteness and poor access to social and physical infrastructures. This otherwise inhospitable area is gainfully utilized by alpine dairy farmers.
Species	• Bovine
Breed name	• Yak Western and Eastern Bhutan types
Scientific name	• *Poephagus grunniens or Bos grunniens*
Local names	• *Yak* (male), *Bji* (female)
Photographs	 Large body size yak from Western Bhutan *Photo Courtesy: NBC*  Medium sized yak from Central Bhutan  Smaller body size yak from Eastern Bhutan  Polled yak from Eastern Bhutan

Origin and population size	Present yak population is believed to have originated from wild yaks (*Poephagus mutus*) which are still found in remote mountains of Tibet. Present population size is about 51,500 heads (Livestock Statistical Bulletin(2007)
Geographic spread	 Yaks are reared in alpine areas of Thimphu, Trashigang, Trashiyangtse, Lhuentse, Haa, Paro, Bumthang, Gasa, and Wangdue Phodrang Dzongkhags.
Utility	· Wool-hair based small scale industries such as garments, ropes, tents · Milk, butter and cheese for home consumption and sale · Meat-limited scale in selected pockets. · Security- during financial stress. · Skin-leather to protect them from cold, rain coat, bags · Mode of transportation
Distinguishing features	· Distinguishing features are body dimensions of both the sexes are larger for western region yak, compared to those from the central and eastern regions.The central region yak shows physical parameters that are intermediate between the values of the other two populations. Pronounced sexual dimorphism is noticeable, with males being larger than females.

Physical (body) parameters

Table 1: Average body measurements of adult yak in three regions of Bhutan

	Western Region		Central Region		Eastern Region	
Traits	M (n=31)	F (n=32)	M (n=9)	F (n=19)	M (n=6)	F (n=12)
Height at withers (cm)	136 1.2**	117 0.8	129 1.9	110 5.8	128 2	113 1.6
Body length (cm)	159 1.7	137 1.2	152 4	133 1.2	148 1.7	133 2.3
Chest girth (cm)	194 1.7	165 0.9	185 3.5	165 1.3	177 2.8	160 1.6
Body weight (kg)*	419 11	264 4	369 22	252 4.5	323 12	239 8
Height at hips (cm)	107 0.9	97 2.2	101 1.8	91 0.9	101 1.2	93 1.7
Cannon circumference (cm)	21 0.2	17 0.2	20 0.3	16 0.2	19 0.2	16 0.2

Genetic variation/ diversity

- Based on genetic distance estimates and phylogenetic analysis through use of micro-satellite markers, Bhutan's yak population can be categorised into two groups. Western and Central region yak could be considered as a single population, distinct from the Eastern Bhutan yak. Eastern region yak thus represents a unique gene pool and therefore a separate conservation strategy would be warranted.

Management system

- Seasonal migration
- The herd size of yaks in Soy Yaksa (Western region) is 85 animals, twice that of upper Choekor, Bumthang (Central region)
- Average herd size is 16 animals in Merak Sakten (Eastern region) (Win, 1993)·

Reason for these bigger herds are:

- Higher number of absentee ownership
- High dependency on yak resource due to limitations of cropping options
- Availability of more pasture (private pasture and absentee owners).
- Less preference for sheep or cattle.

	o Making best use of absentee owner's rangeland to maximise profit. · Housing- free range system in alpine areas with simple enclosure for calves, penned in simple shed during night. · Supplements are provided during the time of milking.In addition, milking cows occasionally receive gruel, made of minced and boiled yak head and pig fat apart from concentrate fed during milking. Herders in Soey Yaksa (Western region) also make hay out of wheat, oats and native grass grown in their limited area for feeding during winter. Turnips and radish are also stored as winter feed. This practice however is uncommon in other places. Dry cows, castrated males and other non-producing animals do not receive any feed supplementation.
Production performance	**Milk production** · Average milk yield is 0.906 l/day/cow or about 0.82 kg/day/cow **Wool and hair production** · Hair and wool from Yak is a valuable item and essential for daily life of the herder. The yak hair is used for weaving tents, bags, rugs, garment, blankets, raincoat and ropes. Wool is water proof and durable and is used for making scarves and garments. · Hair and wool is harvested in May and June. Castrated males and females are sheared while yak calves below one year are not sheared. To retain its majestic look in front of other bulls, breeding bulls are also not sheared. The inner soft wool is plucked by hand. If soft wool is not harvested it is reported to naturally shed by summer. · On average, 0.8-1.0 kg of hair and 0.4 kg of wool is obtained from the castrates per year. Hair and wool yield from adult female is similarly about 0.6 kg and 0.2 kg respectively.
Socio-cultural /religious and economic importance	· The size of the yak herd indicates the wealth of the owner. Access and control of this important resource gives social and financial security to herders. A wealthy yak herder owns over 100 yaks in addition to horses and sheep. A poor herder may own either few or no yaks. · In Soey Yaksa, *Yak lha* (religious ritual to please god/goddess of yak) is performed on the 17th day of the 6th Bhutanese month every year. It is presided over by local monks from their own village or from lower valleys. It is considered to

	be a very special occasion and, if not celebrated at the right time, it is feared that bad omens will afflict the herd. In this ceremony, some yaks are designated to respective local deities. For instance, the breeding sire is meant to belong to *Lingshi gieu gonpa (gieu kencho);* a black castrated yak for *Goem* and black female yak for *Lham*, while certain groups of yak are designated to the *Jhomo*, goddess of the Jhumolhari mountain. Special religious threads are tied on the ear or the forelock of breeding bulls, while holy water is poured onto other animals. · In Choekor,(Central Bhutan)a village astrologer or elderly herdsmen performs a simple ritual. Sacrifice of a yak calf in Lunana (Gyamtsho, 1996) and adult animal for the *Chundu* in Haa have been reported. · An elaborate celebration of yak dances is common in Shingkhar in central Bhutan and other parts of the country
Selection environment	· Natural selection through weather, climate, roughness of terrain. · Presence of increasing predators · Grazing competition · Degrading fodder resources /deterioration of rangelands
Breeding structure	· Good yak breeding bulls (big body size and height) are kept for breeding and other bulls are castrated though mating is at random. · The ratio of male to breedable female is very low. Some communities maintain two breeding bulls for a herd size of 250 heads. The holding period of these breeding bulls within that herd is not less than eight years. Moreover, breeding bulls are selected by the farmers from their own herd which has caused greater probability of inbreeding. · Most herders follow pure line breeding though in some areas crossbreeding is also practised · Considering western and central region yak as a single genetic unit different from that of eastern Bhutan, crossing these two population groups may result in greater heterosis as opposed to current practice of crossing between central and western region yaks.
Population trend and threats	· National figures indicate that there has been an increase in population from 34,711 (MoA, 2000) to 45, 538 (MoA, 2005)

	Threats: · Predation of yaks by wild animals. Almost five or more yaks per herd annually fall victim to predation. · Gid disease is still rampant in those herding areas. · Quality and quantity of pastures is declining drastically due to invasion of grazing resource by base scrubs and unwanted weeds over the years. Herding areas is dominated with scrubs dominating the palatable plant species that include Juniper and *Balu, Sulu (*Rhododendron species). · Modern education and growing urban - rural migration are the other threats.
Conservation initiatives	· Cryo-preservation in gene bank- Planned · Rearing of nucleus herd - Not done · *In situ* conservation in field- Planned * Selection of pocket areas * Group breeding schemes
Conclusion	· In the high altitude areas of Bhutan, yak herding has continued for generations. Though there is no decease in yak population, several threats such as decline in quality and area could discourage yak herders to continue with the rich and unique yak herding tradition. Therefore measures must be put in place to ensure that this animal genetic resource is conserved and sustainably utilised for the benefit of present and future generations.

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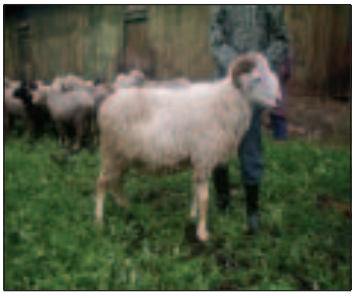
CHAPTER III : SHEEP

Dr. Tashi Dorji, Gyem Tshering, Dawa L Sherpa, Dr. NB Tamang

Introduction	Domestic sheep are kept mainly for wool and manure. Wool is very important for home-based small-scale industries in Bhutan. The role of sheep for table consumption or as a source of meat is limited to a few districts in southern Bhutan. Sheep are reared across a wide range of environment from sub-tropical areas in the south to temperate-alpine areas in the north benefiting a large section of the people.
Species	· Ovine
Breed type	Jakar, Sakten, Sipsoo and Sarpang types
Scientific name	· *Ovis aries*
Local names	· *"Lu"* is the general terminology used for sheep in local language.
Photographs	 Jakar Ewe  Jakar Ram *Photo Courtesy: NBC*  Sibsoo Ram *Photo Courtesy: NBC*  Sibsoo Ewe *Photo Courtesy: NBC*

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Jakar Sheep free range grazing
Photo Courtesy: NBC

Sakten Ram: *Photo Courtesy: NBC*

Sarpang type

Sibsoo type: *Photo Courtesy: NBC*
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<tr>
<td>Origin and population</td>
<td>
· In Merak-Sakten (Eastern Bhutan), the oral history seems to trace their origin to *Tsona* in south-east Tibet. It was stated that the present day residents of Merak-Sakten migrated with their yaks and sheep to avoid the wrath of their local ruler. The time of their migration could be dated to 7th century during the era of the famous Tibetan king Srongtsen Gampo (Wangmo, undated).
· In the Black mountain ranges of central Bhutan, local people refer to Tibet as the source of their sheep. In Tsirang shepherds describe their indigenous sheep as Bonpala and Garpala, which is the same nomenclature used for indigenous sheep in Sikkim (Vij *et al*. 1997). These sheep are considered to share a close relationship with the Tibetan breeds. The sheep in southern Bhutan (in the districts of Samtse, lower Chukha, Sarpang) could have similarities with the north-east Indian breeds.
· Total population: 12,202 heads (Livestock Statistical Bulletin,2007)
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<table>
<tr><td>Geographic spread</td><td colspan="4"> 
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<tr><td>Utility</td><td colspan="4">· Home based small scale industries.
· Very good manure compared to other livestock.
· Consumption and sale of mutton which is limited to selected pockets.
· As a source of security during financial problems.
· Sheep skin can be used to make leather garments to protect from cold and the rain in eastern Bhutan, back cushions for carriage and sitting mats.</td></tr>
<tr><td rowspan="2">Distinguishing features</td><td>Sheep Types</td><td>Identifying features</td><td>Distribution</td><td>Estimated population (2001)</td></tr>
<tr><td>Jakar type</td><td>Small body size, predominantly black coat, brown head and limbs, medium fine hair Most females are polled, males have horns.</td><td>Temperate areas of central Bhutan (Sephu, Phobjikha, Gogona in Wangdue; Tangsibi,Bemji, Jongthang,Semji in Trongsa; Ura, Chumey, Chokortoe, Tang valley of Bumthang).</td><td>11,000</td></tr>
</table>

Sakten type	Medium body size,white and mixture of black or brown colour. Black or brown head, relatively finer coat. Both sexes have horns, Roman nose	Merak, Sakten valley,Khaling, Kangpara, Thrimshing in Eastern Bhutan.	7,000
Sipsoo type	Tall, white and patchy colours, black head, a few are polled, longer coarse fibre,Roman nose, short and tubular ears, known for prolificacy, twins is common	Sub-tropical areas in south Bhutan (Darla Dungna, Phuntsholing in Chukha; Sipsu, Dorokha in Samtse; Beteni, Tsirang and Dagana Dzongkhag).	6,000
Sarpang type	Small body size, males have horns, a few females are polled, predominantly white coat colour.	Sub tropical belt in south Bhutan (Bhur, Dekiling and Choekorling in Sarpang Dzongkhag)	1,000

Physical (body) parameters

Table 1: Body parameters (cm) of local sheep population of Bhutan

Sheep Type	Sex	Height at withers	Body length	Chest girth	Paunch girth	Ear length	Horn length	Tail Length
Jakar type	M(n=89)	63.4	69.8	77.0	77.7	10.8	28.6	15.2
	F(n=63)	58.9	65.2	72.1	73.3	10.5	*	14.4
Sakten type	M(n=44)	64.4	66.3	77.3	75.9	10.9	41.2	15.0
	F(n=28)	65.4	68.0	80.2	78.9	11.7	16.0	15.2
Sipsu type	M(n=20)	70.6	72.9	79.4	78.9	7.9	41.5	17.2
	F(n=93)	67.3	71.0	78.6	75.9	8.6	13.8	17.4
Sarpang type	M(n=5)	59.8	63.4	69.0	75.6	8.4	14.5	12.2
	F(n=67)	57.6	59.5	71.0	74.0	7.2	7.8	11.1

n: Number of observations M:Male F:Female

Body weight: For all category of sheep average body weight up to six months is 15kg, 6 months to 1 year is 25 kg and average weight for adults above one year is 34kg

Genetic variation /diversity	Cluster and principal component analysis from blood samples revealed that Jakar and Sakten types were extremely close, but different from Sibsoo type phylogentically. Jakar and Sakten are close to Mongolian- Chinese sheep group, the Bhyanglung group and also the Baruwal group while Sibsoo types belonged to same group as Baruwal (Tsunoda *et al.* 2007).
Management system	· Seasonal migration · Flock size - 14 to 24 nos. · Housing - free range system in alpine areas with simple enclosure, penned in simple shed in villages at night. · Actual sheep owners in villages hand over the sheep to yak herders to tend the sheep under certain arrangements. · Rearing pattern - combined rearing of sheep and yak, sheep with cattle or sheep alone. · Except for salt, sheep do not receive any supplementary feed. · In high altitudes, sheep compete for fodder with yak, wild sheep and other herbivorous animals and cattle at lower altitude.
Production performance	**Wool production –** · Average from 300- 800gms per sheep per annual shearing. **Reproduction** · Average age at 1st service 18 months. · Average age at 1st lambing 23 months. · Average lambing interval 12 months. · Reproduction Low. **Body weight-** · Birth weight. 2.3 kgs. · Weight at 6 months 15.1 kgs.
Socio-cultural /religious and economic importance	· Sacrifice of sheep to appease local deities is commonly practiced in eastern and central Bhutan. · Wool, manure, financial security (could be sold in times of immediate financial need) are the most important uses of sheep as stated by farmers in central Bhutan while in the southern districts, uses are for mutton and manure. · Sheep wool is considered an important raw material for making unique traditional garments in the east. In some villages of Trongsa and Wangdue, flock owners also sell raw wool at the rate of Nu. 20 to Nu. 30 per kg. · In eastern Bhutan, the sale of live sheep to Tawang, Arunachal Pradesh provides additional income, fetching over Nu. 2,000 (1US$=Nu. 45) per sheep.

	· Flock owners reported that in the past their sheep served as an important pack animal, especially to carry salt from Assam, India. This tradition has now stopped with improved road networks and easier access to essential commodities. · Mutton and manure are considered equally important in the southern districts. Mutton is especially important as a source of animal protein because residents here do not consume beef due to religious reasons. It is eaten mostly during festive occasions. In places like Chukha, farmers derive substantial income from mutton. In 2000, a kilogram of mutton cost Nu 50-65, a castrated male Nu. 2,500 to Nu. 3,000 and an adult female sheep around Nu. 1,500 to Nu. 2,000. · Some communities in Samtse use sheep milk to make cheese and butter. Locals consider fermented cheese from sheep milk as a delicacy and as medicine. Sheep butter when applied to injury from burns is reported to heal the wound much better than conventional therapy. · In central and Eastern Bhutan, meat from sheep that have died from natural causes are thinly stripped and air-dried.
Selection environment	· Natural selection through weather, climate, roughness of terrain. · Increased presence of predators. · Grazing competition. · Dependency on yak herders for rearing sheep.
Breeding structure	· Good rams (big body size, tall and good wool) are kept for breeding while other rams are castrated. · Mating is not planned and there is no systematic breeding; rams, if existing in the flock, mate freely with ewes in heat. · Breeding rams are often bred from the same flock, though some farmers also own government supplied improved rams for community use.
Population trend and threats	· The breed is at risk and has undergone natural selection for ability to survive and produce under stationary and migratory system of management. Threats: · Limited population · Predation of sheep by wild animals · Labour shortage for rearing sheep · Change in farming system with other alternatives and income generating opportunities · Readily available garments/ready made yarn with choice of colours and affordable.

	· No systematic marketing and no mechanised wool processing equipment. · Grazing competition thereby loss of habitat
Conservation initiatives	· Cryo preservation in gene bank- Ongoing · Rearing of nucleus flock at National Sheep Breeding centre in Bumthang- Ongoing · *In situ* conservation in field- Planned * Selection of pocket areas * Group breeding schemes
Conclusion	· There is rich diversity in terms of body size, wool colour and quality among the indigenous sheep population of Bhutan. From phenotypic description and geographical locations, four native types can be recognized. However, cluster and principal component analysis from blood revealed that Jakar and Sakten types were extremely close, but different from Sibsoo type phylogentically. · Traditional sheep farming has become less profitable, especially in central Bhutan and the sheep population is showing a declining trend. The future of sheep in Bhutan may lie in the development of dual-purpose local sheep adapted to Bhutanese environment. Existence of diverse local types both in terms of body size and wool quality gives good opportunity to develop the indigenous sheep industry through selective breeding. · Initiate income generating schemes from sheep as immediate measure to prevent fast decline of sheep population · Selective breeding of local sheep may also ensure long-term conservation and sustainable use of native sheep genetic resources in Bhutan.

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CHAPTER IV: GOAT

Dr. N.B.Tamang, Dawa L Sherpa, Gyem Tshering, Gyem Thinley

Introduction	Worldwide, goats are used for producing milk, meat and fine fibres (mohair and cashmere). They are also used for biological control of troublesome weeds in many countries (e.g., in Australia and New Zealand (Pierce, 1990; RIRDC, 1997) Goats are generally reared along with other livestock. These animals have the ability to utilize and survive on otherwise wasted fodder resources such as weeds (*Artemisia, Eupatorium* and other wasted plants) which are not palatable to other livestock. However, because of browsing habits, goats may destroy tender plants/saplings if grazing goes uncontrolled.
Species	· Caprine
Breed name	
Scientific name	· *Capra hircus*
Local names	· *Ra*
Photographs	   *Photo Courtesy: NBC*  *Photo Courtesy: NBC*  *Photo Courtesy:NBC*  *Photo Courtesy: NBC*

<table>
<tr><td>Origin and population size</td><td>Local goats are said to have originated in the village though they are genetically affected by Indian breeds in southern areas and /or Tibetan goats from northern areas (Mannen, et al. 2007). The Bhutanese goat has originated from bezoar type of wild goats. Present population is 28,300 heads. (IMS, DoL, 2007)</td></tr>
<tr><td>Geographic spread</td><td>Goat population is concentrated in Samtse, Chukha, Dagana, Tsirang and Sarpang. A small goat population is also found in Trashiyangtse and Wangdue.
  </td></tr>
<tr><td>Utility</td><td>· Goats in Bhutan are used for meat, manure, religious offerings and commercial purposes</td></tr>
<tr><td>Distinguishing features</td><td>Irrespective of gender, the coat color is mostly black with fewer white and brown with typical black dorsal lines. Horns are mostly twisted and the face bearded. The ears are generally dropping with a few horizontal.

Table 1:Physical observation
<table><tr><td>Coat color</td><td>Mostly black,white,brown with dark dorsal line</td></tr><tr><td>Horn</td><td>Mostly twisted</td></tr><tr><td>Bearded</td><td>Mostly bearded</td></tr><tr><td>Long hair</td><td>Few long haired</td></tr><tr><td>Ear</td><td>Mostly dropping and few horizontal</td></tr></table>Source: Timsina et al.(2005)</td></tr>
</table>

Physical (body) parameters	**Table 2: Physical Measurements** Body Measurements Body length (cm) 54.8 heart girth (cm) 61.72 Wither height (cm) 51.85 Ear length(cm) 12.6 Source : Timsina *et al* (2005)
Genetic variation/ diversity	· Morphological, biochemical and mitochondrial DNA variation analysis revealed that notable frequency differences were not observed among local goat populations. However they are genetically affected by Indian breeds in southern areas and /or Tibetan goats from northern areas (Mannen, *et al*. 2007).
Management system	· In mid-altitude areas significantly higher numbers of farmers tethered their goats on fallow land while in low-altitude areas more farmers stall-fed them. Farmers in both areas however also allowed open grazing.
Production performance	· Local goats are of small size but are known for good quality mutton. The meat is tender and has good taste. Live weight of adult goat is about 15 kg. Bhutanese people are not habituated with goat milk which is rarely consumed. **Table 3: Reproductive parameters of goats**

Parameters	**n**	**Mean**	**SE(mean)**
Age at puberty (months)	15	6.8	±0.12
Age at first kidding (months)	15	12.2	±0.14
Kidding interval (months)	15	6.5	±0.04
Kids per year (nos)	15	2.5	±0.08
Life expectancy of Doe (yrs)	15	12.8	±0.23
Productive life of Doe(years)	15	9.8	±0.13
Total kids during lifetime(no)	15	19.6	±0.51

Socio-cultural /religious and economic importance	· Sacrifice of goat to appease local deities is commonly practised in Southern Bhutan. · Goat reaches marketable age within one to two years resulting in the start of household cash flow within a short time.They are sold at best prices and farmers get better income to enhance their livelihood. Goats can be sold as and when there is urgent need of cash; it thus provides social security to smallholder resources and poor farmers. · Farmers reportedly use cash earned from goats, for schooling of children, overcoming food shortage, paying taxes, repairing houses, etc. · Bhutanese people believe that goat milk and meat has medicinal property to cure sub-tropical diseases including Malaria. Medicinal value of goat milk to cure sub-tropical disease (*"Ragi om tshepai nye lu phen"*) is documented in Bhutanese literature
Selection environment	· Natural selection through weather, climate, roughness of terrain.
Breeding structure	· Farmers either maintain their own breeding stock or use bucks from neighbouring households or villages. The breeding stock if maintained are selected within the local population and crossbred among the existing breeds. One or two males are kept in the community for breeding and rest of them are castrated at an early age to fatten for sale.
Population trend and threats	· The goat population in Bhutan is about 28300 head with maximum concentration in sub-tropical belt namely Chukha, Samtse,Sarpang, Tsirang and Dagana Dzongkhags (MoA, 2007
Conservation initiatives	· Cryo preservation in gene bank- Not planned · Rearing of nucleus flock - Small trial ongoing · *In situ* conservation in field- Not initiated yet * Selection of pocket areas * Group breeding scheme
Conclusion	· Goats are used mainly for meat purpose in goat rearing areas of Bhutan. There is a favourable consumer demand for goat meat. Thus it fetches premium prices compared to meat from other livestock. Provision of fast growing and prolific meat purpose breed, made available either through selection from

	existing flock or import of goat breeds for crossbreeding could improve the value of animal and bring higher returns. · Goat rearing is much easier than large ruminants as housing is simple, management is easy and it can survive on feed sources that are not usually utilized by other ruminants. · Support for goat farming by way of making technologies available, training on improved management practices and research on sustainable goat farming practices are desirable.

Acknowledgement

Authors thank Dzongkhag Livestock Officers of Sarpang, Tsirang, Chhukha and Dagana for their kind co-operation and assistance to carry out the study. We remain indebted to Extension staff of Jigmechoeling, Gelephu, Rangthangling, Tshendagang, Tashiding Phuntsholing-Pachu and Goshi for time spent with the research team. Logistical support of Officer In-charge(s) RNR RSC, Bhur and Darla is acknowledged. Support of the Director, Council for RNR Research of Bhutan and the Program Director, RNRRC Jakar to carry out the study is appreciated.

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CHATER V: POULTRY

Karma Nidup, Penjor, Phub Dorji

Introduction	Animal genetic resources are necessary for food, environmental and socio-economic stability. It is important to keep the diversity of animal genetic resources for sustainable development of agriculture. The conservation and utilization of animal and poultry resources in developed countries are different from the developing world. In developed countries, only breeds with high economic values and their hybrids are raised in great numbers. On the other hand, the developing countries rich in breed resources have inadequate conservation and indiscriminate importation of foreign breeds which have caused deterioration in quality and reduction in the number of native breeds. In both cases, a worldwide crisis of genetic resources resulting from depletion of animal and poultry gene pools is impending. It was estimated that 40% of all breeds of domestic livestock and fowl have been lost since 1970 (Alderson, 1989; Wu, 2001). The 2006 Report from FAO, "Livestock's Long Shadow", predicted that global meat consumption will more than double by 2050 (from 2001). Where will all this meat come from? The short answer is: from chickens. Already, around 50 billion of that 60 billion figure is poultry (Silva, 2008). But, is the world doing enough in terms of genetic conservation of this invaluable food resource for the future? Entries of national breeds of poultry into the Global Databank for Farm Animal Genetic Resources maintained by FAO started only in 1995, and amounts to about one-third of the number of mammalian breeds (Hoffman, 2008). This low level of breed recording in poultry indicates that national governments have paid less attention to these species. More poultry than mammalian breeds have an unknown risk status (Figure 1), because countries were unable to report population data to FAO, which is required for classification. Moreover, more poultry breeds than mammalian breeds are classified as being at risk. Inclusion of Bhutanese poultry breeds in the global databank is not comprehensive enough and needs to be updated.

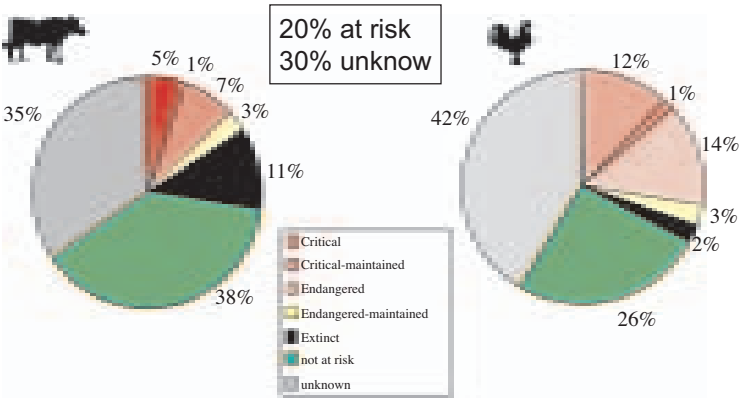


Figure: 1

Bhutanese poultry and other animals, as well as rare varieties of agricultural plants, represent the biodiversity that is close to Bhutan and upon which Bhutanese are most dependant. Bhutanese poultry breeds were important contributors to human welfare in the past, and may possess characteristics that will be needed again to meet new or re-emerging needs.The loss of these invaluable genetic resources through negligence would be a tragedy for humankind.

CHICKEN RESOURCES IN BHUTAN

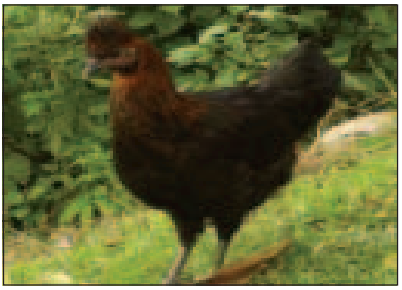
In June 2 1999, a National Vision book, Bhutan 2020, was released to commemorate 25 years of golden enthronement of His Majesty the King Jigme Singye Wangchuk of Bhutan (PCS, 1999). The vision statement 286 states, "While we refer to our rich biodiversity, we are as yet unsure how varied the nation's biodiversity actually is. If we are to turn biodiversity from a constraint into an opportunity, we must, as a first step, accord priority to completing a full inventory of the nation's biodiversity resource base". In line with this, the College of Natural Resources of the Royal University of Bhutan, has unveiled the nation's rich poultry biodiversity resources in the country through a series of small inventory studies. Plumage, feather patterns, and other external phenotypic characteristics were used to identify different breeds, varieties, and strains of chicken resources in the country. The term poultry and chickens are interchangeably used as the only type of poultry reared and recorded in Bhutan are chickens, which have a fabulous

	array of colours and patterns. It is said that over thirty genes influences colour in chickens, which helps to explain the extraordinary array of feather colours and patterns. Single, Rose, and Pea are common types of combs, which is usually controlled by just two genes, the rose and the pea gene. Single comb results when no dominant R or P allele shows up on either gene.Categorically, Bhutanese chickens are divided into three groups: Exotic, Improved and Indigenous chickens. Rather than 'breed', the word 'line' is used hereafter to refer to chickens exhibiting similar plumage and physical characteristics. For the intended purpose of this book, only the indigeneous line of chickens will be addressed.
Species	Avian
Breed name	Indigeneous lines: *Bobthra,* Native White, Frizzle, *Kauray,* Naked Neck, *Belochem*, Native Black, Short legged *(Baylaitey), Shekheni.*
Scientific name	
Local names	*Bobthra: Seim* (Dz), *Paile* (Lh); *Jhapay maap* (Dz), *Rato baley* (Lh). Native White: *Yuebja kaap* (Dz) Frizzle: *Pulom* (Dz), *Dumshay* (Lh) Naked Neck: *Khuilay* (Lh) Barred Yubja: *Poolsuri* (Lh) Native Black :*Yuebja naap* (Dz), *Kaalo kukra* (Lh) *Shekheni* (Lh) *Baylaitey* (Lh)
Photographs	  Seim Jhapay Maap – Rose comb variant

Photographs

Jhapay Maap -Single comb variant

Photo courtesy: NBC



Belochem

Photo courtesy : NBC

Naked neck (male)

Photo courtesy: NBC

Naked neck (female)

Photo courtesy : NBC

Frizzle (Female)

Frizzle (male)

Photo courtesy : NBC

Baylaitey (Female)

Photo courtesy : NBC

Baylaitey (male)

Photo courtesy : NBC

Kauray
Photo:country NBC

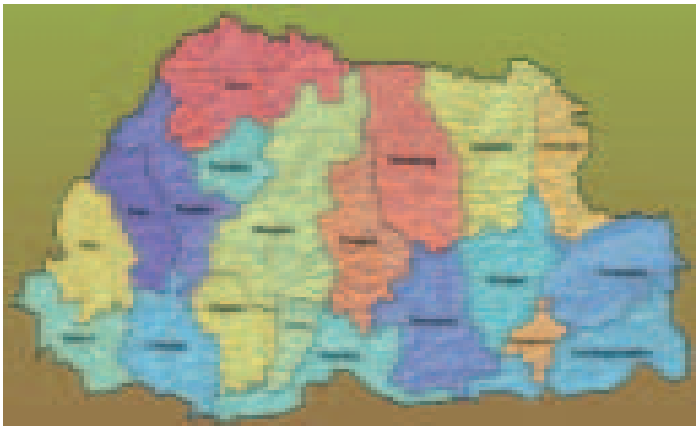
Yuebja Kaap

Yubjha Barred (female)

Yubjha Naap (a)

Yubjha Naap - black variant (b)
Photo:country NBC

Shekheni
Photo:country NBC

Origin and population size	Who introduced chickens in Bhutan? Where were they brought from? There is no record or evidence of these as of now. Chickens have existed in Bhutanese villages from time immemorial withstanding changes and test of time. They are found in almost all agro-ecological zones ranging from wet-subtropical to alpine regions. Frizzle and Naked neck are found mainly in warmer regions of southern foothills. Record suggests over 63% households in Bhutan raise chickens. The total chicken population in Bhutan was estimated to be 152,488 in 1981 and 230,723 in 2000 (Figure 10).
Geographic spread	 Poultry population is scattered all over the country however it is more concentrated in Samtse, Chukha, Dagana, Tsirang, Mongar, Trashigang and Sarpang.
Utility	· Source of animal protein in the form of meat and eggs · Financial security through sale of meat and eggs and live birds · Pest control · Provide manure for farm use

Distinguishing features	Poultry Types : Bobthra:*Seim* (Dz), *Paile* (Lh); *Jhapay maap* (Dz), *Rato baley*(Lh). *Bobthra* is the most common line of indigenous chicken found in Bhutan. Many farmers believe they are the immediate descendant of the jungle fowl and for this reason, male and female of this line are collectively called *Bobthra* (Dz). They are also called *Bja Katseri* due to its high resemblance to Red jungle fowl. *Plumage:* Male: Rich golden brown to reddish brown head,hackle, back, and saddle; breast and body are wheaten shaded. Tail is greenish black with sickle feathers. Female: Head is orangey red. Hackle is light orange with black-greenish stripe down the middle of each feather. *Comb, wattles & earlobes:* Rose, pea, and single comb varieties. Single comb is common. Wattles are red, large, and moderately long in males. Females have well-rounded and small wattles. Small, oblong earlobes; ear lobes are small and white in females.Males have red oblong earlobes. *Shank:* Shank and toes come in slate, black, yellow and white colours.
	Native White: *Yuebja kaap* (Dz) *Shayto khukra* (Lh) Many believe the Native White or Yubjha kaap is the lineage of conventional commercial White Leghorn (WLH), which was once introduced in Bhutan more than two decades ago. However, farmers in Bhutan have reared pure white indigenous chickens many years even before WLH was first introduced in Bhutan. *Plumage:* Plumage is white throughout entire body, varying from lustrous to dull. *Comb,wattles & earlobes:* Small single comb, wattles, and earlobes. Comb and wattles are red. Earlobes are white. *Shank:* Shank and toes are in white and slate.

	Frizzle *Pulom*(Dz). *Dum-shay* (Lh) Local name *Dum-shay* (Lh) meaning "like Porcupine". *Plumage:* Frizzling is largely a characteristic of this single breed. The mutation manifests as feathers grow outward instead of lying smoothly along the body.The shafts of the contour feathers are curved.This characteristic is controlled by an incompletely dominant autosomal gene (F/f), which has been mapped on chromosome 7 linkage group II. Frizzling can occur in many other lines. For example, seim frizzle conforms to the standards for frizzle as size, shape, and colours but also with uniform curly feathers throughout its plumage. *Comb, wattles & earlobes:* Has three different combs (rose, pea, and single). In some variants, wattle is almost absent while in other, it is very prominent from small to large in size. *Shank:* Shank and toes come in slate, black,yellow and white colours.
	Naked Neck:*Khuilay* (Lh) *Khuilay* - meaning 'bald'. The naked neck is a notable and dominant characteristic characterised by complete lack of follicles in the neck and fewer or no feathers on the head. A featherless neck is an excellent adaptation for a hot environment as it is mostly found in Southern part of Bhutan. Naked neck has been reported in number of breeds including Transylvanian Naked neck, Malay Game, Cou Nu du Forez (France), Shingangadi (Zaire), and also in a number of local chicken populations around the world. This is true with Bhutanese local chicken population as well since this trait has been found to occur in other types of indigenous chicken population. The gene for naked neck (Na) is an autosomal dominant and is mapped on chicken Chromosome 1. Naked neck has a broad and flat back with prominent and square breast. As a broiler, they dress very nicely. Carcass is easily and quickly plucked and bare areas do not have as many feathers under the skin. *Plumage:* The plumage is generally soft-feather red. Feather colouring is very diverse: white, black, brown, partridge, speckled, and wheaten colour. The skin on featherless area is bright red

	and usually with a fairly irregular texture. Comb, wattles & earlobes: Naked neck line is seen with rose, single, and pea type combs. *Shank:* Most are found in slate shank while some are found in yellow shank. Presence of white shank is also reported.
	Barred Yubjha,*Poolsuri* (Lh) *Plumage:* Both male and female have feathers crossed with sharply defined bars of black against white. Bars are irregular in size or uniform throughout the feathers. Females' bars are generally narrower and darker than those of a male, which is dominated by underlying white feathers in its wings. *Comb, wattles & earlobes:* Males have medium to moderately large oval wattles and earlobes.Comb and wattles are bright red. *Shank:* Mostly cleaned and yellow legs and toes. Few are slate coloured.
	Belochem Local Name: *Belo* means traditional 'sun-cap'. *Plumage:* Comes in varying colours and feather patterns. This group of birds are characterised by a crest of head feathers. They look very stylish.This line is considered to be critical around the world. It is also true in Bhutan as not many are found across the country. *Comb, wattles & earlobes:* Comb is very small and possibly concealed by crest feathers. *Shank:* found in slate and black colour.
	Native Black *Yubjha naap* (Dz),*Kalo kukhra* (Lh). *Plumage:* Uniformly black, ranging from shiny greenish black to duller black, over entire body in both sexes. It is believed that the meat of *Yubjha naap* black variant has medicinal values.

	Comb, wattles & earlobes: Small well-defined combs in females, and medium size comb in males. Both pullets shown here are from same group but different variants. Unlike variety a, which has slate shank, variety b is completely dark including comb, earlobes, shank, and skin. *Shank:* Slate to entirely black.
	Short legged *Baylaitey* (Lh). This line is medium-built and resembles ancient English Dorking breed typically characterised by short shank. Some have feathers on their shank.The word *Baylaitey* refers to "exotic". This is because of its large and graceful looks, somewhat similar to pure bred exotic chickens. *Plumage:* Colour and pattern varies from *Baylaitey* to *Seim*, *Yubjha naap* and Native white types. *Comb, wattles & earlobes:* Unlike other lines,short legged line has large comb and extremely large and long wattle. Earlobe is also large. *Shank:* Short shank and sometimes feathered
	Shekheni (Lh) *Shekheni*: The word refers to "lean and thin". In this poultry type, both males and females have long, slim shanks and very slim bodies. It has a longer shank compared to other lines. It has large and graceful looks somewhat similar to many pure bred exotic chickens. *Plumage:* Golden penciled hackle and saddle feathers. Male has black and white spotted feathers on the breast with dark greenish sickle and main tail feathers. Females have white feathers with broad muscular breast. *Comb, wattles & earlobes:* Most of the variants in this line found with single combs. Male has large and prominent single comb with medium sized wattle.

	Female has relatively larger comb than most female lines with medium sized wattle. Both have white ear and earlobes. *Shank:* Both males and females have long shank comparatively longer than other lines. Shank and toes are normally yellow but some are white with few slatted.
	Kauray.(Lh) *Plumage:* Colouring is almost Crele, an unusual multicoloured and barred combination. Male : orange-red against pale straw on head, hackle, back, and saddle. The feathers underneath are barred grey and white. Female: head and hackle are pale gold barred with greyish brown. Front of neck and breast have wheaten shades with a mix of greyish white on tail and wing feathers. *Comb, wattles & earlobes:* Mostly are single comb with more than five points that stand upright. Medium, thin, smooth wattles and earlobes. *Shank:* Found in yellow, white, and slate colours.
Physical (body) parameters	
Genetic variation/ diversity	The entire mitochondrial D-loop sequences(1232 bp) from eight lines suggest that Bhutanese chickens are genetically diverse and originated from the Red Jungle Fowl (Nidup *et al.*,2005).However, genetic differentiation among Bhutanese native chicken population was small when estimated from blood groups and morphogenetic characteristics (Yamamoto *et al.,*2007).

Table 1: Genetic distance between Bhutanese indigenous chickens calculated using Kimura distance method. (Source: Nidup et al., 2005)

	Barred Yubjha	Naked Neck	Kauray	Seim	Yubjha Naap	Jhapay Maap	Yu Bayla	Frizzle	
Barred Yubjha	0.0								Barred Yub.
Naked Neck	0.0008	0.0							Naked Neck
Kauray	0.0008	0.0016	0.0						Kauray
Seim	0.0024	0.0033	0.0033	0.0					Seim
Yubjha Naeb	0.0057	0.0065	0.0065	0.0082	0.0				Naeb Yubja
Jhapay Maep	0.0114	0.0123	0.0123	0.0123	0.0073	0.0			Jhapay M.
Yu Bayla	0.0098	0.0106	0.0106	0.0106	0.0057	0.0065	0.0		Yu Bayla
Frizzle	0.0115	0.0123	0.0106	0.0123	0.0073	0.0082	0.0065	0.0	Frizzle
Yubjha	Barred Neck	Naked	Kauray	Seim Naeb	Yubjha Maep	Jhapay Baylae	Yu	Frizzl	

Genetic distance amongst eight lines of Bhutanese chickens estimated from entire mtDNA D-loop sequences was calculated using Kimura genetic distance method as shown in Table 1. This method suggest variation amongst Bhutanese chickens (Nidup *et al*., 2005)

Management system

REARING, HOUSING AND FEEDING SYSTEM

Chickens are raised in four types of rearing systems (Figure 2-5): intensive system, semi-confined backyard system and scavenging system (free range). Most chickens in villages are reared in scavenging system, which is one of the most economical and sustainable feeding systems to utilize feed resources in the villages. Birds search their own food, scratching and picking on the ground in and around the household boundaries.

Figure 2: Confined intensive system

Figure 3: Confined backyard

Figure 4: Semi-confined backyard

Figure 5: Scavenging and free range

Scavenging chickens feed on earthworms, crop residues, or any available feed resources. Some households provide water while in many cases birds have to find it themselves. Concentrates are provided to confined chickens. Chicken sheds are made of locally available materials such as wood, plank and bamboo mats.

HEALTH AND DISEASE CONTROL

Major diseases of chickens in Bhutan have been predominantly Newcastle disease (ND) followed by Infectious Bursal disease or Gumboro, Marek's disease, Corrhyza, Fowl pox, and internal parasitic disease (especially coccidiosis). Like in many developing countries, ND is the most devastating disease of village chickens in Bhutan (Nidup *et al*., 2005; Nidup & Tshering, 2007). Thermostable I-2 vaccine, which was introduced in 2002 to tackle ND amongst village chickens (Alders, 2002) has not made any major impact as of now. A concerted effort for an appropriate and strategic poultry health programme is required.

	Another emerging problem is the threat posed by bird flu (Avian Influenza), which could be detrimental to the population and genetic resources of chickens in the country. So far, regular surveillance program did not indicate evidence of any incursion of bird flu virus in the country (Nidup & Tshering, 2007). However, Bhutan cannot remain complacent due to its porous border and livestock trade with India, location in an important flyway (central Asia flyway) for migratory birds, and the nature of integrated livestock faming system. The National Contingency Plan or National Influenza Pandemic Preparedness Plan is in place to prevent and control bird flu in Bhutan (Tshering, 2007; Nidup & Tshering, 2007).
Production performance	PRODUCTIVITY Attempts to collect concrete information on production and reproductive performance of various lines of indigenous chicken are being made by CNR, Royal University of Bhutan. Information collected so far (unpublished) and observation made in the farm suggests that egg production is clearly very low in indigenous lines when compared to imported exotic chickens. The observational production data from farmers for Naked neck and *Yubjha naap* are given in Table 2.

Table 2: Production observations of Naked neck and Yubjha naap by the farmers. (Source: Nidup *et al*., unpublished)

Production Parameters	Nakedneck (N = 20)			Yubjha naap (N = 35)		
	Mean	St Dev	SE Mean	Mean	StDev	SE Mean
Clutch size	19.25	1.71	0.38	23.57	4.06	0.69
Clutch/yr	2.78	0.34	0.08	2.90	0.34	0.06
Hatching - Weaning (days)	89.00	13.82	3.09	82.00	14.10	2.38
Fertility %	91.68	7.10	1.599	3.95	5.29	0.90
Embryonic Mortality %	12.45	8.49	1.90	7.08	5.45	0.92
Hatchability %	87.22	8.38	1.879	3.20	5.13	0.87
Chicks Mortality %	16.781	1.90	2.661	1.27	8.84	1.49
Grower Mortality %	12.25	17.99	4.02	9.03	7.73	1.31
Layer Mortality %	2.75	5.04	1.13	9.09	8.56	1.45
Wt. at 1st Lay (kg)	1.58	0.44	0.10	1.83	2.30	0.39
Wt. at Peak Lay (kg)	2.16	0.43	0.10	2.20	0.28	0.05
Wt. at end of Production (kg)	2.42	0.34	0.08	2.51	3.41	0.58
Wt. of adult male (kg)	3.11	0.57	0.13	3.36	0.34	0.06
Wt. of adult female (kg)	2.38	0.42	0.09	2.26	0.28	0.05
Age at 1st lay (month)	6.40	0.67	0.15	6.53	0.43	0.07
Age at peak lay (month)	7.22	0.68	0.15	7.54	0.46	0.08
Broodiness/year	3.08	1.09	0.24	2.96	0.37	0.06
No of eggs/ month	19.35	1.81	0.412	5.14	1.85	0.31
No of eggs/ year	53.93	8.21	1.847	1.23	9.00	1.52
Egg Weight (gm)	58.72	0.69	0.155	7.10	3.62	0.61

The performance of *Yubjha naap* is better than Naked neck in terms of clutch size, clutch per year, fertility, hatchability, mortality rate (embryo, chick, and grower), and egg production. On the other hand, layers mortality was lower in naked neck. There are virtually no differences in adult weight. In an experiment conducted on *Seim* (Dema, 2005), the fertility, embryonic mortality, and hatchability was better for scavenging *Seim* than those reared in CNR poultry farm (Table 3). Production data from other lines are yet to be recorded.

Table 3: Reproductive performance and natural hatching by *Seim hen.* (Source: Nidup *et al*., unpublished)

Reproductive performance	**CNR Farm**	**Farmers**
Fertility (%)	84.72	85.53
Embryonic Mortality (%)	16.23	14.87
Hatchability (%)	79.6	84.55

One of the most prominent characteristics of indigenous chickens is broodiness, a maternal instinct in birds, often misinterpreted as an unwanted characteristic. Hen sits on eggs for 21 days (natural incubation) in each brooding. Because of this intensive broodiness, the clutch size is small and the number of eggs laid per year is less. However, number of chicks hatched and brooded per hen every year is an excellent indicator of high productivity. This could be one of the reasons why exotic breeds or strains introduced did not thrive well in Bhutanese villages because of low incidence of broodiness and poor mothering abilities.

The shapes of the eggs are oval. Shell colour varies amongst indigenous lines from white to light brown. Similarly, the shell colour of exotic stains BV 380 is dark brown. The Figures (6-9) show eggs from four lines of chickens.

Figure 6: Barred yubjha eggs

Figure 7: Eggs from Yubjha naap

Figure 8: Eggs of Naked neck

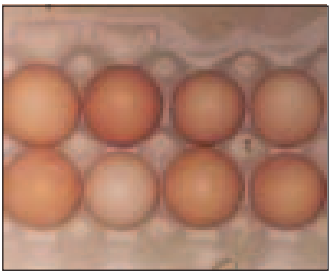


Figure 9: Eggs from 380 BV exotic strain

Socio-cultural /religious and economic

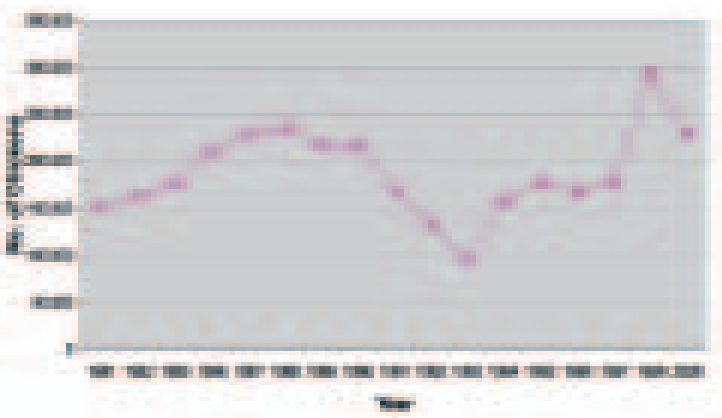
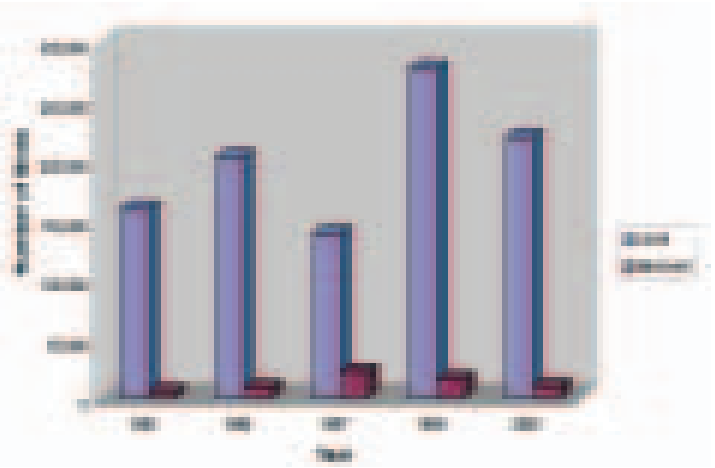
Chickens play very important roles in the livelihood of many Bhutanese people. They are kept for dual purposes providing scarce animal protein in the form of meat and eggs. They are also sold or bartered to meet family needs such as clothes, school fees, and essential household commodities. They also fulfil a wide range of other functions (pest control, provide manure) for which it is difficult to assign monetary value. They have both economic and socio-cultural importance to the people of Bhutan.

Economic Importance: A simple cost benefit analysis study on village chicken farming conducted by College of Natural Resources in Dop Shari geog, Paro Dzongkhag, is shown in Table 4.

Table 4: Cost benefit analysis of village chicken farming. (Source: Wangmo *et al*., 2005)

Items	**Quantity (No.)**	**Rate (Nu.)**	**Amount (Nu.)**	**Total Amount (Nu.)**
Average Total Income from eggs	2546.82	5.00	12734.10	12734.10
(a) Average Gross Income or Average Total Revenue				
(b) Average Total Variable Cost (ATVC)			3105.41	
(c) Average Total Fixed Cost (ATFC)			890.35	
(d) Average Total Cost –ATC (b + c)			3995.76	
(e) Average Net Surplus (Benefit) (a - d)				8738.37

	Each farmer has earned an average total net benefit of Nu.8738.37 per year with an average of nine laying birds. This is much higher than national average annual income of Bhutanese farmers (HRD, 2003). The price tag for each egg was then Nu. 5.00. Now, the chicken-egg situation has changed. The cost of locally produced eggs has increased to Nu. 300.00 per tray (thirty eggs). Given this situation, farmers would earn Nu. 17476.76 per year. This suggests that chickens are potential tools for alleviating rural poverty. *Socio-cultural Importance:* Chickens feature regularly on menus to entertain guests and to revitalise the health of a woman during pregnancy and after delivery. Eggs and meat are part and parcel of social, family, and special festival celebrations. Many *Lhotshampas* in the southern part of Bhutan are Hindus and believe in the caste system. Some of them believe that *bhoot* (ghost), *pret* (evil spirit), *bokshi* (witches), and *graha dasha* (a bad position of the planets) can cause disease in people and livestock, crop failures, or accidents. Chickens are sacrificed to make offerings along with incense, flowers, and food to pacify spirits and planets. Depending on their social hierarchal status, they also have preferences for certain lines of chickens. For instance, Subbha group of *Lhotshampa* caste need *Dhum-shay* (Frizzle) line for *Bhim Singh pooja* while the Adhibasy group prefers the white indigenous chickens for *Chot pooja*. Therefore chickens contribute in keeping social, cultural, and traditional beliefs alive.
Selection environment	· Natural selection through weather, climate, disease and predators
Breeding structure	· Random mating amongst native lines takes place. · High incidence of inbreeding is expected due to small population size. However, loss of genetic variation resulting from inbreeding is not yet studied. No adequate investigative studies have been conducted nor measures introduced to prevent inbreeding. · The extent of cross breeding between native cockerels and exotic female strains is very negligible. This is indicated by a dominant population size of pure line indigenous chickens despite continuous distribution of exotic pullets to the farmers for over four decades.

Population trend and threats	**Trend of Chicken Population in Bhutan**  **Figure 10: Change in chicken population trend.** (Source: Nidup, 2003) The total chicken population in Bhutan was estimated to be 152,488 in 1981 and 230,723 in 2000. Of this, the number of indigenous (local) chickens was found to be 220, 197 birds constituting approximately 95% of the total rural flocks. The remaining population are improved or exotic strains. **Comparative number of Local and Improved Chicken**  **Figure 11: The trends in the number of local and improved chickens in Bhutan.** (Source: Nidup, 2003) Despite specious cross breeding programmes, indigenous chickens have always thrived and outnumbered introduced strains as shown in Figure 11. The population size of each line

	of indigenous chickens is not recorded so far. The common threats that the poultry population faces are: · Disease such as Newcastle disease (ND), Infectious Bursal disease or Gumboro, Marek's disease, Corrhyza, Fowl pox and internal parasitic disease (especially coccidiosis) which affect the poultry population in the country· · Introduction of disease such as the bird flu are imminent threats which have been prevented so far by placing an indefinite ban on the import of live birds as well as poultry products into the country due to the outbreak of Avian Influenza in neighbouring countries. The outbreak of bird flu in Bhutan would mean a disaster and could wipe the whole chicken population in the country. · Predation by dogs and other animals due to the free-ranging and scavenging management system. · Other threats are climate stress and introduction of cross breeding programs with exotic birds.
Conservation initiatives	· Various studies to document genetic and phenotypic characteristics of indigeneous poultry have been carried out by the College of Natural Resources and Renewable Natural Resources -Research Centre, Jakar. This is in view of the significance of maintaining a large genepool of indigenous chickens for the present as well as the future. (Ongoing) · Cryopreservation of germplasm at the Animal Gene Bank in National Biodiversity Center (NBC), Serbithang. This involves collection, processing, and cryopreservation of semen of various lines of chickens.(Ongoing) · Support from the UNDP-GEF funded Integrated Livestock and Crop Conservation Project to explore measures for increasing the production and on farm conservation of native poultry as well as the exploration of niche markets and support in marketing of chicken products (Ongoing)
Conclusion	The Food and Agriculture Organization of the United Nations places high importance on chickens as a source of global food, economy, and the potential tool to alleviate rural poverty in many developing countries. Chickens will continue to play important economic and socio-cultural roles in the livelihood of Bhutanese people, particularly the poor, rural communities. It is of crucial importance that an excellent poultry breeding

	programme is in place to conserve and sustainably utilise the diversity of indigeneous flock and to put in place a strategic poultry health programme that will strengthen the survivability and the continued existence of chickens in Bhutan. Therefore, it is imperative that adequate support is provided to agencies to initiate relevant activities related to poultry breeding, conservation, promotion, and sustainable utilization of poultry genetic resources in the country.

ACKNOWLEDGEMENT

This chapter contains various published and unpublished information from several small research studies conducted by CNR since November 2001. All these studies would not have been possible without encouragement and unfailing visionary support of Dorji Wangchuk, Director, College of Natural Resources, Royal University of Bhutan. The authors wish to thank him whole-heartedly.

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CHAPTER VI: PIG

Dr. M.P.Timsina

Introduction	There are 2 types of local pigs in Bhutan though genetic studies have confirmed that there is a three way origin. Locals also believe that local pigs are descendants of the wild boar and people have been raising them for generations. It has a significant role to play in the Bhutanese way of life and its meat is widely consumed.
Species	Swine
Breed name	*Doemphab and Jituphab*
Scientific name	*Sus scrofa*
Local names	*Yuphab*
Photographs	 Doemphab  Jituphab  Male Doemphab *Photo courtesy*:NBC  Uzurung Jituphab male & female *Photo courtesy*:NBC
Origin and population size	The existence of the local pig breeds is also quite interesting. Nationwide survey findings indicate that local pig breeds existed since generations and their ancestors could be the wild boar. This is because some of the physical characteristics are very closely related to the wild boar. Farmers have been rearing

	this breed since the time of their great grand-parents. There is a spatial distribution of native pigs across Bhutan. Looking at the potential pockets areas across the regions, it indicates that a larger concentration of native pigs is located in Western and West- Central Bhutan compared to Eastern and East Central Bhutan. The population size is 25,556 out of which only 17,742 comprise of local pigs. (Livestock Statistical Bulletin, 2007)
Geographic spread	 Eastern Bhutan: Pemagatsel Dzongkhag under Bangyl and Mikuri villages, of Dungmin geog East Central Bhutan: Zhemgang Dzongkhag under Digala and Langdurbi villages of Bardho geog West Central Bhutan: Dagana Dzongkhag under Pangna, Thangna and Pangsabe villages of Drugaygang geog and Punakha Dzongkhag under Tempekha, Jangkholo and Bintskha villages of Chubu geog and Bjipjokha village of Zomi geog Western Bhutan: Haa Dzongkhag under Moochu, Nakkha and Sombe Ama, Rebji, Kokha, and Dorethasa villages of Sangbe and Sombey geogs.
Utility	· Local meat highly preferred by the Bhutanese community · Sacrifice during annual religious ceremonies · Fattening for sale to meet urgent monetary needs · Source of financial security · Role in religious rites
Distinguishing features	*Doemphab* is considered to be the descendant of the wild boar. It is a pig with a large body size and small, flat erect ears.

<table>
<tr><td></td><td>Jituphab (also termed as Saphab) is small in size with a bulging belly and small, flat erect ears. Generally both of these kinds are called as Yuphab in the Bhutanese context. They most often have 5 pairs of teats.</td></tr>
<tr><td>Physical (body) parameters</td><td>Table 1: Parameters (Adult pigs irrespective of sexes)
<table>
<tr><td>Hair color</td><td>Black</td></tr>
<tr><td>Skin color</td><td>Black to white and few are grey</td></tr>
<tr><td>Hoof color</td><td>Black and white</td></tr>
<tr><td>Tail color</td><td>Black to white and some are even grey</td></tr>
<tr><td>Ear orientation</td><td>Erect</td></tr>
<tr><td>Shape of forehead</td><td>Straight/convex/disc</td></tr>
<tr><td>Number of teats</td><td>Mostly five pairs. Few have six and even more</td></tr>
<tr><td>Average ear length</td><td>7.3 cm</td></tr>
<tr><td>Average tail length</td><td>15.42 cm</td></tr>
<tr><td>Average body height</td><td>60.42 cm</td></tr>
<tr><td>Average heart girth</td><td>52.46 cm</td></tr>
<tr><td>Behaviour</td><td>Docile to hostile</td></tr>
</table></td></tr>
<tr><td>Genetic variation/ diversity</td><td>The analysis of mitochondrial DNA sequence confirmed that native pigs in Bhutan have a three way origin (Tanaka et al, 2007). The East Asian type (Tibet or China) is distributed widely in Bhutan. The South Asian type is found in some pockets under Mongar Dzongkhag. The East Indian types are concentrated in the Southern districts of Bhutan. The native pigs in the South-West of Bhutan have greater gene flow from East Indian wild boars. Moreover, the native pig population of West-Central Bhutan, particularly from Tsirang and Punakha formed the same cluster and did not have genetic differentiation with Bangladeshi pigs. The native pig population from Eastern Bhutan formed the same cluster with pigs from Nepal. This means that pigs from West-Central and Eastern Bhutan are located differently in a dendrogram with marked genetic differentiation. Due to their unique origins, the pigs in Bhutan can be valuable genetic resources.</td></tr>
<tr><td>Management system</td><td>In general, 58% of Bhutanese farmers rear pigs by the confined method with a simple house made from locally available materials. Some farmers rear pigs by tethering and some participate in migration along with cattle in the lower foothills</td></tr>
</table>

during winter and confinement in summer while some practise scavenging system without any housing. Few farmers tend to follow both tethering and confinement systems of management with simple housing. Some follow tethering in their homesteads without any shed.

Majority of the farmers feed pigs with local feed resources that are commonly available in their locality. The most commonly fed local feed ingredients in the degree of availability and importance are alcoholic residue, kitchen waste, maize/ rice bran/hulls, green/seasonal weeds, nettle leaves, pumpkins, yams and taro. Local feed ingredients are fed 2-3 times a day depending upon the quantity available and the age group and body size of pigs.

Production performance

Table2: Reproduction and Production Parameters of the female pig

Age at first service	5-12 months
Live weight at first service (Gilt)	15-22 kg
Litter size at birth	3-9 numbers
Litter size at weaning	2-8 numbers
Piglet weight at birth	0.2-0.5 kg
Piglet weaning weight	3-6 kg
Weaning age	90- 150 days
Adult live weight	60-80 kg
Farrowing index or No. of farrowing/sow/year	1.8
Mothering ability	Good
Adaptability	Very good

Table3: Performance of stud boar

Age at first service (young Boar)	5-9 months
Live weight at first service (young boar)	15-30 kg
Frequency of mating (Boar/week)	1-3 times
Productivity as stud boar	4-7 years
Adaptability	Very good

Socio-cultural/ religious and economic important	· High preference for Local meat in comparison to imported pork · Raised for the specific purpose of meat during annual religious ceremonies · Fattening for sale to meet urgent monetary needs and to supplement household income
Selection environment	· Natural selection through harsh weather and climatic conditions · Thrive even with increasing attack by predators during migratory system of management with cattle · Limited local feed resources · Gene deterioration and threat of extinction due to non-systematic breeding program
Breeding structure	· Random breeding is commonly practised. Some levels of crossing occur with wild boar while scavenging in nearby forest areas. · Very little cross breeding is practiced in the villages with improved pigs supplied from Government Central Farms. · Local pigs are commonly castrated and fattened for immediate monetary needs · There is an absence of systematic and planned cross breeding program using native and improved breeds of pigs in Government Central Farms
Population trend and threats	Population of local pig breed has definitely decreased compared to the past. RNR statistics of Bhutan (1997) indicated that there were 50,355 heads of local pigs compared to 17,742 in 2007. (Livestock Statistical Bulletin, 2007) This clearly indicates that the local pig population has decreased nearly 35% over the last 10 years in our country. Threats: · The breed is at risk and has undergone a natural selection process for their ability to thrive and produce under stationary and migratory system of management. · Limited population and fast genetic erosion · Predation of pigs by wild animals · Feed and labour shortage to intensify Pig production · Farmers have access to better breed choice (improved pigs) that provide higher income generating opportunities · No strong policy and breeding strategy in place for conservation and sustainable utilization of breed

	· Some level of food competition exist with humans
Conservation initiatives	· *Ex-situ* conservation (Cryo preservation of semen) in gene bank has been initiated· *In situ* conservation in the field through selection of potential local pig pocket areas and initiation of community conservation and sustainable breeding schemes - Planned. · Sustainable utilisation of local pigs through the development of niche products and markets - Planned. · Awareness campaigns on the need to conserve pigs among farmers, extension agents, technical staff and policy makers - Initiated.
Conclusion	The decreasing population trend of the native pig breeds is of great concern. Since the local pigs in Bhutan have a three way origin, efforts should be made for the efficient utilization of these genetic resources in the breeding program in order to develop suitable breeds of pigs for Bhutanese farmers. Bhutanese farmers still prefer native pigs due to various advantages and these advantages have to be maximised and fully utilised to ensure that the native pigs of Bhutan do not further decline in future through strategic interventions such as proper conservation measures, improved management practices, technical backstopping from government and establishment of strong market outlets for local pig products.

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CHAPTER VII: HORSE

P.B.Gurung

Introduction	The mountainous topography of Bhutan limits accessibility by road to many places. Thus horses play a vital role in the transportation of goods and services in the remote villages. While the expanding road networks are gradually reducing the dependency on horse (*Equs caballus*) in the country, it is still the only mode of transport in those villages which are inaccessible by road due to rugged terrain. Expansion of the tourism sector is likely to increase the utility of horses for pack and riding purposes.
Species	Equine
Breed name	Local Horse
Scientific name	*Equus caballus*
Local names	*"Yuta"* is the general terminology used for a horse in local language. Male un-castrated are called "*Sep*", geldings are called '*Phochen*' and female as "*Gyoem*".
Photographs	 Local Horse, Tandigang, Tang Bumthang  Boeta at Chamkhar  Local Horse, Gasa  Local Horse, Kurjey, Bumthang All picture: courtesy Authors

<table>
<tr><td>Origin and population size</td><td colspan="2">· Farmers believe that at least four types of local horses exist in the country namely: Yuta (pure local horse), Boeta (breed originated from Tibet), Merak Saktenpata (breed originated from Merak and Sakten) and Jata (breed originated from neighbouring states of India).
· Population size is 25,384 including mules and donkeys. (IMS, DoL, 2007)</td></tr>
<tr><td>Geographic spread</td><td colspan="2"> 
</td></tr>
<tr><td>Utility</td><td colspan="2">· Horses in Bhutan are mostly used as pack animals. · Seldom used for riding purpose.</td></tr>
<tr><td rowspan="2">Distinguishing features</td><td>Horse Types</td><td>Distribution features</td></tr>
<tr><td>Yuta type
Breed Characteristics:
Yuta are pony type of horses, preferred next to the mule. They are characterized by strong forelimbs with narrow chests. The hind limbs are mostly close- hocked and their hoofs are hard and solid.They are surefooted, sturdy, skilled, courageous animals highly adaptable to the local environment.Ther is no uniformity in the coat colour.They can vary in colour from black to bay and grey to white. The load carrying capacity is rather high compared to its body capacity varying from 40-80Kgs. They are satisfied by low management with modest feeding.
Physical Characteristics:
· Height 123 cm,
· Chest Girth 139-140 cm,</td><td>Throughout the country</td></tr>
</table>

<table>
<tr><td></td><td>· Cannon Circumference 14.5-17 cm</td><td></td></tr>
<tr><td></td><td>Merak-Saktenpata type
The horses in these areas are also called Yuta by the local people and have similar characteristics of Yuta.This breed has good body conformation with thin shin bone and the hind legs are usually close hocked.
Physical Characteristics:
· Height 129.3 cm,
· Chest Girth 143 cm,
· Cannon Circumference 17.3 cm</td><td>Trashigang</td></tr>
<tr><td></td><td>Boeta type
These are pony type of horses generally characterized by compact body, a well-developed chest, a strong back,round muscular quarters, strong and thin shin bones with hard and solid hoofs.They tend to have a short neck, with low withers, sloping quarters, a straight back, deep chest, straight shoulders, and a well-set tail. Their legs are short but very strong, and they vary in height from between 12 and 13.2 *hh. They are known for carrying loads over long distances and suited for hilly terrain. They are surefooted, skilled, intelligent, and sturdy. No uniformity can be seen in their coat colour.</td><td>Bumthang, Trashi-Yangtse, Gasa, Thimphu</td></tr>
<tr><td>Physical (body) parameters</td><td colspan="2"><table>
<tr><th>Horse type</th><th>Sample size</th><th>Wither height (cm)</th><th>Chest girth (cm)</th><th>Canon bone circumference (cm)</th></tr>
<tr><td>Yuta</td><td>161</td><td>123.4</td><td>140.5</td><td>15.3</td></tr>
<tr><td>Merak Saktenpata</td><td>3</td><td>129.3</td><td>143</td><td>17.3</td></tr>
<tr><td>Boeta</td><td>6</td><td>124.4</td><td>143.6</td><td>16.1</td></tr>
</table></td></tr>
<tr><td>Genetic variation/ diversity</td><td colspan="2">Study of genetic constitution through multi locus electrophoresis of blood protein revealed that both local and Spiti horses were similar to Asian native horses which had a common lineage with Mongolian horses. The polymorphic loci and average heterozygosity value are not significantly different</td></tr>
</table>

* Hands high

	between Bhutanese local horses and Spiti horses (Nozawa *et al.* 2007) *Yuta* are the most dominant breed (67%) in all the *Dzongkhags* followed by Haflinger cross breed and mules. The *Boeta* are rare and only few crosses are available. The general characteristics of this type of horse could not be recorded so far. Though *Jatas* were reported to exist in many areas in the past, only few *Jata* type of horses are found in some horse breeding areas.
Management system	Usually horses are allowed to graze in native pasture and no pasture is produced specifically for horses. Some farmers exposed to improved horse management practices through farmers' field day trainings go for selective breeding but on a limited scale. In some places, horses are also taken to mountain pastures in summer when there is no work and the agriculture lands are filled with agricultural crops. Shelter to the horses is provided especially in winter. Maize, wheat, buckwheat and paddy are the main concentrate fed to the horses. Drenching of mustard oil and egg are also given to the weak horse to boost their stamina and vigour. Deworming is seldom done in horses. Regular health assessments done with the assistance and support from Livestock staff has reduced the incidence of disease in horses. Scrub animals are castrated on time, thereby improving quality of the horses.
Production performance	· Age at puberty: 24 – 36 months · Age at foaling: 4 – 6 Years · Gestation period: 330 – 350 days · Inter-foaling period: 357 – 758 days · Carrying capacity: 30 – 80 Kgs
Socio-cultural/ religious and economic importance	· Generally horses are kept for carrying loads but in remote places they are also the main source of income. Some farmers generate substantial amount of income through hiring of horses to their neighbours, government institutes, tour operators and contractors. Horses are also widely used to transport horticultural products. · 34% of the total household income of lower Kheng and 35% in Sangbay geog, Haa are from the use of horses. Transportation of mandarin, school rations and other essential items are the main utility of the horses. · Horses also help in alleviating human drudgery in the remote areas. · Horses are also important for local religious ceremonies.

	Selected horses are used as *Tsipta* (riding of deities during auspicious day/ceremony) in some monasteries and celebrations.
Selection environment	Natural selection through weather, climate, roughness of terrain. · Presence of increasing predators · Limited grazing areas
Breeding structure	Only a handful of farmers opt for selective breeding since it is difficult to be achieved in the open pasture. Majority of the farmers throughout the country still breed their horses in a casual way without observing any clear selection criteria. The horses are left freely in the open pasture or in the forest basically with no one to control breeding. Thus, in-breeding continues and leads to deterioration of horse quality.
Population trend and threats	· Local horses account for the largest composition among the equine population, accounting for 79%. Only 7% of the 25,384 horse population is improved breeds largely used for transportation. Equine population is on the decline in areas more accessible to motorable roads whereas the horse population in the remote areas are increasing. Threats: · In the *euphatorium* plant species growing areas (800 – 1200 msl), the equine population is affected by plant poisoning. · Labour shortage, loss of farmers' interest and non-availability of desired stallion(s) are some of the hindrances in equine development in the country. · Farmers' preference for mule due to higher carrying capacity, longevity, surefootedness, disease resistance, low management and high market value. · Large mule production may deplete the mares' population in the long run
Conservation initiatives	· Rearing of nucleus herd at Bumthang- Planned · *In situ* conservation in field- Ongoing * Selection of pocket areas Ongoing * Group breeding schemes Ongoing
Conclusion	The prevailing horse types found in Bhutan are *Yuta, Boeta*, *Jata* and *Merak Saktenpata.* Extensive studies on local horse breeds need to be carried out for substantiating the information available. Concrete steps to conserve and utilise the breed of horses through an appropriate breeding program needs to be initiated to ensure that the local population is not threatened.

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Annex I

Information collection, compilation, proof reading, editing.

Dr. Tashi Yangzom Dorji, Program Director, National Biodiversity Centre.

Sonam Tamang, National Biodiversity Centre

Tshewang , National Biodiversity centre

Technical Group

Dr. Tashi Yangzom Dorji, National Biodiversity Centre**.**

Dr. Lham Tshering, National Livestock breeding Program.

Dr. D.B Rai, National Livestock Breeding Program

Dr. N.B Tamang, RNR RC Jakar

Dr. M.P Timsina, RNR RC Wengkher

Padam Bdr. Gurung, BS&HBF Bumthang.

Karma Nidup, CNR Lobesa

Karma Tenzin, NCWFC, Haa

Tshewang, NBC

Sonam Tamang, NBC