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Importance of yak in the high-altitude agriculture

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Livestock is an essential component of the Indian agricultural sector. The distinct physical, economic, and sociocultural features of the eight states that make up the north eastern region of India-the seven sisters namely, Arunachal Pradesh, Assam, Meghalaya, Manipur, Mizoram, Nagaland, and Tripura, as well as their single brother state, Sikkim-give it a distinct identity. Numerous animal genetic resources, such as cattle, buffalo, sheep, goats, pigs, horses, and many more are found in north eastern India. In addition to these conventional livestock species, NEH region has an accountable population of the yaks. Thus, this manuscript's primary focus will be on the importance of yaks in the high-altitude agriculture and ultimately to the sustainable development of the northeastern Indian region.

Keywords: High-altitude agriculture, Livestock, Sustainable development

THE northeast region of India occupies 7% of total land area and is also one of the world's most bio-diverse regions, reflecting ecological and cultural contrasts between the hills and the plains. Arunachal Pradesh, Meghalaya, Mizoram, Sikkim, and Nagaland are almost entirely covered by hilly areas, 40–50% of Assam by plains, whereas Manipur and Tripura have both plains and hilly regions. Agriculture is the prime source of livelihood for the majority of the rural population in this region, followed by animal husbandry. Livestock production in the northeast is predominantly the endeavour of small holders. Almost 90% of the rural households keep livestock of one species or the other. The importance of the livestock of NE India is more pronounced owing to limited arable land, a high proportion of the meat-eating population, and rapid urbanization. Animal production plays a significant role in the sustainable development of northeast India by economic contribution, employment generation, and nutritional security.

Contribution of livestock to agricultural economy of NER

Livestock plays a significant role in the economy of the northeast region of India by providing a vital source of income for many rural households. It contributes to livelihoods through dairy, meat and egg production. Livestock also contributes to food security and nutrition and thereby supplying essential proteins through dairy products, meat and eggs crucial for the local population. Also, the contribution of livestock in the agricultural GDP for the country increased from 24% in TE 1992–93 to 28% in TE 2002–03, whereas, the share of livestock in agriculture of NER had declined from 20% to 18% during the period.

Yak- The unique bovid of NER

Even though yaks make up a very small portion of the NER livestock, they are very important to the socio-economy of the NER ethnic communities. Yak is a very important animal in northeast India, both traditionally and commercially. The herding communities view yaks (*Peophagus grunniens*) as the "almighty livestock" because of their profound cultural, socio-economic and customary links. Yaks are well suited to the severe weather and hypoxia that come with grazing at elevations greater than 3,000 m above mean sea level in the Himalayan mountains. Yaks are the largest creatures found in frigid climates and they can withstand temperatures as low as -40 °C.

The native high-altitude yak has evolved multiple unique adaptations, including morphological, physiological, biochemical, and genetic changes due to long-term selection. Yaks require only 33% of the feed as consumed by the cattle and does not compete with any livestock. Yak is regarded as the multi-purpose bovid as they provide livelihood and nutritional security to the communities rearing them. Yak is a multi-purpose animal as it is primarily raised for milk, meat, fibre, and

Yak *(Poephagus grunniens)*

Farm of ICAR-NRC on Yak

draft purpose. Yaks are also used as pack animals for transportation. Yak wool is also used to make traditional clothing and handicrafts.

Distribution of yaks

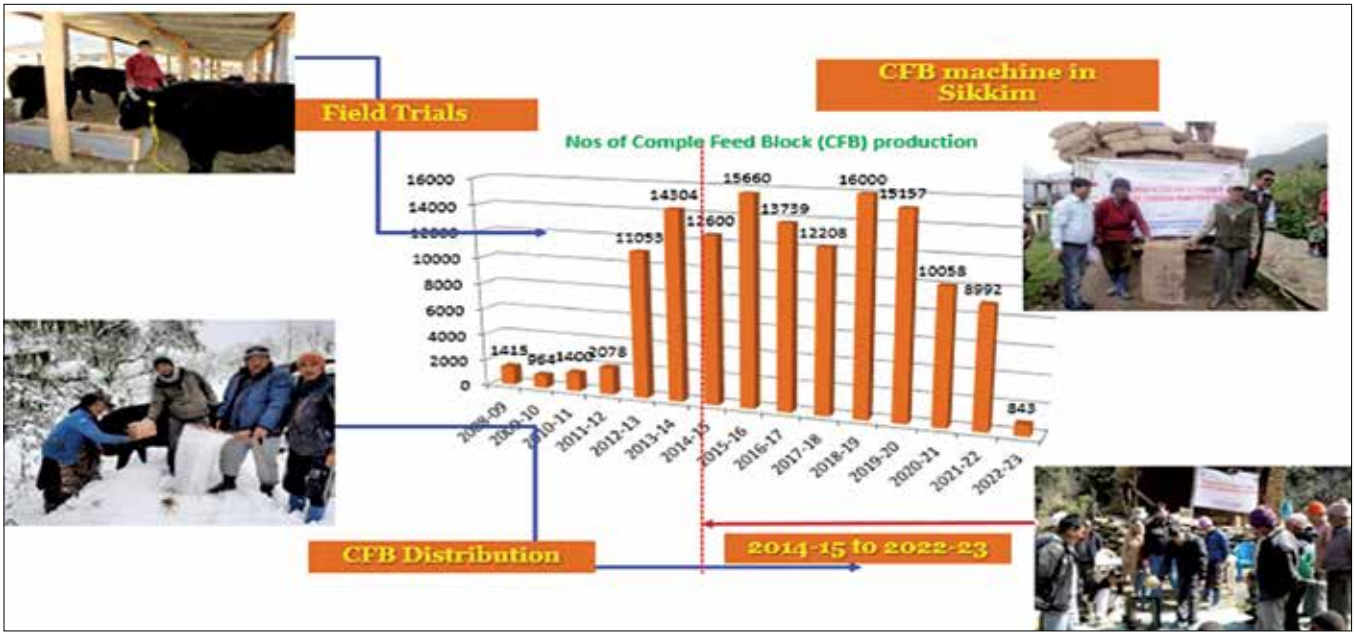
In India, around 58 thousand yaks are reared under transhumance by various pastoral nomads of UT of Ladakh, Jammu and Kashmir, and states like Arunachal Pradesh, Sikkim, Himachal Pradesh and West Bengal for their livelihood and nutritional security. The pastoral nomads are known by different names in the respective regions namely, *Brokpas* in Arunachal Pradesh, *Dokpas* in Sikkim and *Changpas* in Ladakh. Yaks primarily inhabit in higher altitudes of the Himalayas especially states like Arunachal Pradesh and Sikkim. Yak is also somewhat responsible for the national security as it is reared across the high-altitude international borders vis-a-vis Indo-China, Indo-Bhutan, Nepal and Pakistan. Therefore, Yak is also a very strategic animal for keeping vigilance on the borders in the States of Ladakh, Jammu and Kashmir, Arunachal Pradesh, Sikkim and Himachal Pradesh. Yaks are also integral to the livelihood of pastoral communities and feature in local traditions and festivities. Therefore, yaks are inherently associated with the religion, culture, sentiment and social life of the pastoral nomads and ethnic communities. Indian yaks have been phenotypically categorized into five types; White, Bare Back, Bisonian, Hairy Forehead and common type. However, based on genetic characterisation all the types are similar. Yak population of Arunachal Pradesh was characterized for its production and physical traits for breed registration and sub-sequentially based on unique characters the first breed named "Arunachali" was registered in year 2018.

Traditionally, Yaks are raised under transhumance system of rearing on highland pastures and during summers, yaks have the availability of lush green pastures whereas during winters, only dry pastures and tree fodder is feasible. As far as the population of yaks is concerned in the NER, there are around 24,075 yaks in the Tawang and West Kameng districts of Arunachal Pradesh and 5,219 in the North, East and Western districts of Sikkim according to the Livestock Census 2019.

Constraints and challenges of yak production

Yak production faces several constraints and issues as a lot of hard-work is required in hostile geo-climatic conditions.

- There is inadequate nutrition during lean period due to the reduction in grazing areas and reduced forest covers.
- Limited genetic variation leads to inbreeding and reduced resilience to diseases.
- Changing weather patterns affects grazing lands and water availability and thereby impacting livestock health and productivity.
- Seasonal availability of quality forage limits livestock nutrition and overall health.
- Diseases like brucellosis and infestation by parasites significantly affect yak and population leading to reduced productivity and increased mortality.
- Traditional grazing and husbandry practices may also hinder modern and improved production techniques.
- Lack of infrastructure such as veterinary services and transportation can impede growth and productivity.
- Predators attack is also another major concern for the livestock herders along with inadequate government policies and support systems hindering the development of sustainable yak farming.
- Remote areas often have limited access to markets making it difficult for producers to sell their animal products and hence get refrained from the well-deserved economic returns.



"Complete Feed Block technology" has been extensively popularized among the yak rearers. For the maintaining the continuous supply of feed, 6 manual CFB making machines and around 35000 CFBs were distributed among the tribal farmers of Arunachal Pradesh and Sikkim

Technological support for yak farmers by ICAR-NRC on Yak in collaboration with other government organizations

Technological support for yak farmers can significantly enhance productivity and sustainability by utilizing artificial insemination and genetic selection to improve herd quality and disease resistance, by implementing digital health tracking systems for early disease detection and management. There are other key areas where improvements can lead to further enhancement in the productivity of the yak farming and these include:

- Sustainability and improvement of yak farming
- Genetic improvement of yak
- Conservation and multiplication of yak germplasm
- Value addition of yak products and developing market linkages
- Livelihood security improvement of yak farmers

Sustainability and improvement of livestock farming

- ***Cultivation and propagation of the fodder:*** In order to ameliorate the degraded high altitude pasture, suitable grasses and legumes have been propagated. Further to mitigate the winter fodder scarcity, complete feed block technology has been implemented in parts of Arunachal Pradesh and Sikkim complemented with conservation of the green foliage through ensiling in poly-bags especially maize and salix.
- ***Animal health care:*** Effective healthcare for Yak is essential for their productivity and well-being which has been achieved up to some extent by the timely vaccinations against common diseases like brucellosis, FMD, Lumpy skin disease, Haemorrhagic septicaemia (HS) and Black quarter to reduce the disease incidences. Besides this, deworming programmes have also been implemented along with regular health check-ups for signs of illness enabling early detection and treatment of the various health issues.
- ***Preparedness for winter:*** Preparing feed for yak is extremely crucial for their health and survival in the harsh cold conditions for the peak winters.
- ***Genetic improvement, conservation and multiplication of germplasm:*** Yak germplasm exchange with Sikkim is being done. Yak semen straws conservation and distribution to AHD of different yak tracts is also a regular practice.
- ***Breed characterization of yak population of NER:*** Yak population faces challenges due to climate change, habitat loss and changing agricultural practices. Therefore, conservation efforts are crucial to ensure sustainability of this species. Hence, supply or exchange of superior yak bulls to farmer of NER for breeding purpose is being done, breeding programmes are implemented and awareness about these species is inculcated among the herders from time to time in the rearing regions.

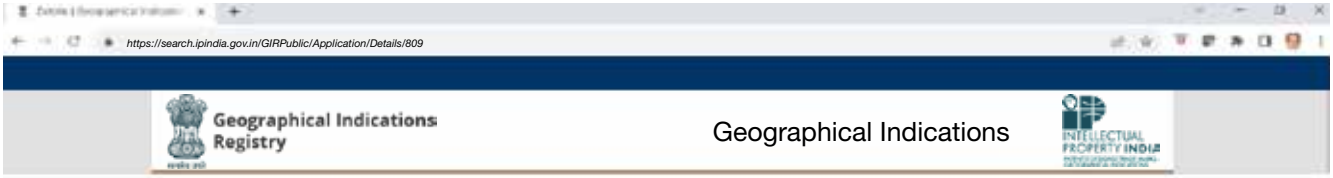
Germplasm conservation and upgradation through biotechnological tools

Biotechnological tools play a significant role in these efforts, providing advanced methods for genetic conservation, breeding and enhancement. Therefore, various biotechnological interventions have been done for germplasm conservation and upgradation including:

- Frozen semen technology and artificial insemination
- Estrus synchronization and timed artificial insemination (TAI)
- Multiple ovulation and embryo transfer (MOET) and *in vitro* embryo production (OPU-IVF).
- First IVF yak calf "NORGYAL" was born on 15th July, 2013 using OPU, IVF and Embryo transfer technology.

Curd/yoghurt | Ghee | Ripened Yak Cheddar cheese | Mozzarella cheese

Diary products from yak



Application Details

Application Number	809
Geographical Indcations	Arunachal Pradesh Yak Churpi
Status	Registered
Applicant Name	ICAR-National Research Centre on Yak (ICAR-NRC)
Applicant Address	Dirang-, District: West Kameng - 790101, Arunachal Pradesh, India.
Date of Filing	28/12/2021
Class	29
Goods	Food Stuffs
Geographical Area	Arunachal Pradesh
Priority Country	India
Journal Number	175
Availability Date	31/05/2023
Certificate Number	511
Certificate Date	03/10/2023
Registration Valid Upto	27/12/2031

https://search.ipindia.gov.in/GIRPublic/Application/Details/809

Value addition of yak products

Yak-milk and its products: Yak milk and dairy products such butter *(Mar)*, ghee, curd, wet cheese *(chhurpi)* and hard cheese *(Churkam)* gives the pastoral nomads an essential source of vitamins and nutrients Therefore, various value-addition strategies have been incorporated to the Yak milk and its products for enhancing its market-value such as:

- Yak milk whey beverages incorporated with Kiwi fruit pulp
- Flavoured Churkam

Technology has been developed for health-conscious consumers to develop low fat dietary fibre enriched paneer from yak milk. The technology has additional benefit of utilizing the separated milk cream for Ghee making. ICAR-NRC on Yak is further developing processed cheese from yak milk.

For their constant efforts for working on the yak and to enhance the yak milk production along with its value-addition, ICAR-National Research Centre on Yak, Dirang could secure the first ever yak milk product "Arunachal Pradesh Yak Churpi" with the Geographical indicator tag with the collaboration of the yak herders.

Yak fibre (A boon to the brokpas): Yak fibre also known as yak wool is a natural textile derived from the coat of the yak. This unique fibre is highly valued for its warmth, softness and durability making it an important resource for local communities and the textile industry. Yak produces three types of fibre: coarse outer hair, a mid-type and a fine down fibre, which grows prior to the onset of winter as additional protection for the yak against cold. The amount of fibre produced by individuals and the proportions of coarse hair and down varies with the region where the yaks are kept and the associated climate, and with breed, sex, age and the season and method of harvesting the fibre. The average age of clipping is 12–18 months. A mature yak can produce 250–750g fine/down fibre and 1.5–5.0 kg coarse fibre.

Value addition of yak fibre: Yak fibres open up new possibilities to help and improve the economic conditions of herdsmen through value addition. Value addition of yak fibre is very crucial to achieve 3–4 times better economic returns and for this yak fibres can be blended with other natural fibres like wool (sheep and angora wool) and jute to form yarn and fabric with different designs.

Keeping all these aspects in mind, ICAR-National Research Centre on Yak has come up with various yak fibre value-added products like yak fine fibre-sheep wool blended products and yak-jute blended garments and products such as Chitpa Jaamu, Phachung (bags), knitted caps, mats, charmar, coats, etc.

Table 1. Fibre types: Down, mid-type and coarse fibre

Characteristics	Fibre types		
	Down fine fibre	Mid-type fibre	Coarse fibre
Fibre diameter (μ)	< 25	25–52.5	25–52.5
Length (cm)	3.7–4.1	5.3–13.0	5.3–13.0
Medulla	Unmedullated	Latticed	Latticed
Lustre	Soft	Good	Good
Crimp	Irregular	A few large	A few large

Yak as a pack animal

Yak is the exclusive beast of burden in the high Himalaya due to their high-altitude adaptations, legendary strength and endurance, and sure footedness. Male yaks can carry a load up to 35% of its live body weight and walk 14 km, with a speed of 4–6 km/h.

Recent initiatives taken for promotion of yak farming

In recent years, various initiatives have been undertaken in India to promote yak focusing on their conservation, breeding and utilization such as:

Government Schemes and programmes: National Livestock Mission (NLM) launched by the Indian government aims to promote sustainable development of the livestock sector by focusing on the conservation and development of indigenous species like yak. States like Arunachal Pradesh and Sikkim have implemented integrated livestock development schemes that include provisions for the promotion of yak through financial assistance, veterinary care and access to improved breeding policies.

Research and development: The Indian Council of Agricultural Research has undertaken various research programs focused on yak. Further, ICAR-National Research Centre on yak, Dirang focusses on yak breeding, conservation and research and conducts various awareness and training programmes for farmers.

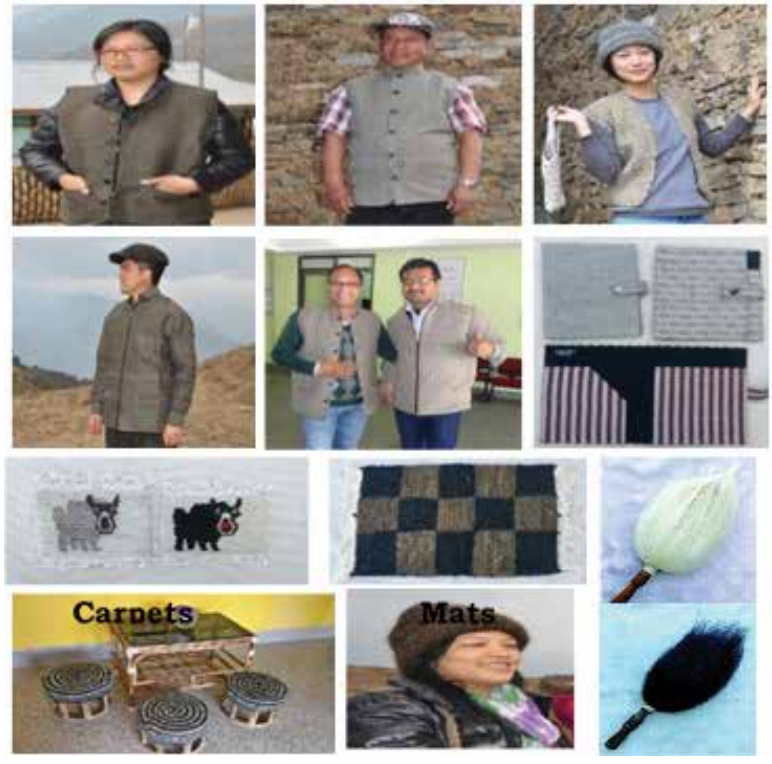
Training and capacity building: Various organizations conduct training programmes for farmers and herders and covers practices in yak management, veterinary care, feed management and marketing of product.

Promotion of yak products: Initiatives have been introduced to promote the processing of yak products including meat, milk and fibre.

Promotion of semi-intensive farming: Sedentarization of yak to bypass trans-humance migration grazing patterns keeping in m the climate change and lesser availability of the grazing grounds. Following the semi-intensive system, the daily body weight gain in yaks has increased from 95–120g/day to 400-550 g/day. Similarly, age of attaining puberty has decreased from 3.5–4.5 years to 2.0–2.5 years, calf production by a yak has increased from 1 calf per 3 years to 1 calf per year, yaks have started to come into estrus regularly throughout the year and milk yield has increased from 400–500 g/day to 1.5–2.5 kg/day. Additionally, after nutritional interventions the adult body weight has drastically increased from 200-300 kg to 450–550 kg for male and from 150–200 kg to 250–350 kg for female.

Developing bankable scheme for yak farming

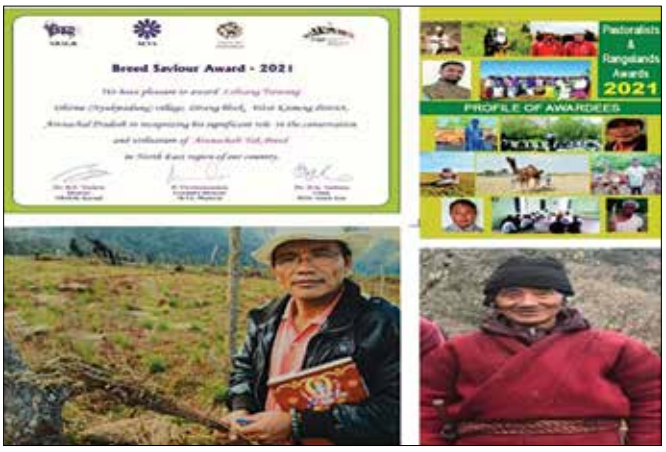
Yak insurance policy: The National Insurance Company Ltd. has approved an insurance policy for yaks, following relentless efforts by the National Research Centre on Yak (NRCY) here in West Kameng district. The insurance policy will shield yak owners against the risks posed by weather calamities, diseases, in-transit mishaps, surgical operations and strike or riots.



- ***Creating awareness about the diversified use of these unique bovines:*** Formation of herder's cooperative society and self-help groups.
- ***Extension and Other STC activities:*** ICAR-NRC on Yak, Dirang in collaboration with Department of Animal Husbandry, Livestock, Fisheries and Veterinary Services conducts various awareness and training programmes under the Scheduled Tribe Component (STC) as well as the NEH schemes of ICAR.

  In collaboration, Govt. of Sikkim also supported yak farmers by providing immediate remedial support to recover the health of surviving starved yaks due to unprecedented continuous and heavy snow during Dec 2018 to March 2019.
- ***Recognition to yak pastoralists:*** Yak pastoralists have rich cultural traditions tied to their livestock. Their practices include unique herding techniques, seasonal migrations, and rituals that honour their animals.

Some of the awards to honour the hardships and challenges faced by the pastoralists to sustain yak rearing:



- Breed Saviour Award 2021-Mr. Lobsang Tsewang
- Pastoralists and Rangeland Award
- 2021 Dungkharpa Welfare Society

SUMMARY

Yak is a livestock species that is specially raised by many ethnic people in NER for their livelihood and nutritional security. Although, livestock sector has slower growth in NER than at national level, but a significant proportion of landless, small and marginal farmers has access to livestock, which offer opportunities for household income augmentation and employment generation. In a nutshell, the scientific raising of yak will enable their impoverished rearers to make ends meet by providing additional money to meet their basic amenities. Thus, it is essential to encourage scientific farming in states where yak raising has a long history by offering institutional, technical, and legislative measures that enhance breeds, feed availability, disease management, food safety, and private investments in NER. The latest advancements in artificial insemination, oestrus synchronisation, timed AI and embryo transfer technologies along with other extension activities will undoubtedly contribute significantly to the goal of generating high-quality germplasm in farmers' fields. Overall, recognizing yak pastoralists is also imperative for safeguarding their way of life, supporting biodiversity and fostering sustainable development.

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