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Transhumance And Environmental Interaction In The Indian Eastern Himalayas:

THE BROKPAS OF WESTERN ARUNACHAL PRADESH

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Abstract: The present study explores the agricultural practices, socioeconomic conditions, and environmental interactions of the highland communities, called the Brokpas, residing in the western districts of Arunachal Pradesh, India. The study is based on field research in Tawang and West Kameng, examining how altitude influences land use and farming systems: the Brokpas practice transhumance, a pastoral system involving seasonal livestock migration between high and low pastures. The environmental impact of their practices, particularly the creation of manmade pastures, is assessed, highlighting concerns over ecological degradation. The paper also addresses the challenges faced by these communities, including limited access to healthcare, education, and modern farming resources. Traditional methods, such as Jhum cultivation and transhumance, are explored alongside new influences from the market economy. The study emphasizes the need for sustainable development initiatives, including permanent infrastructure for the nomadic herders and mobile schools to address educational challenges.

Keywords: Transhumance, Brokpas, Arunachal Pradesh, Eastern Himalayas, Pastoralism, Environmental Impact, Sustainable Practices, Ecological Impact.

I. INTRODUCTION:

Arunachal Pradesh located in the Indian eastern Himalayas is the largest state among the North Eastern states of India, it spans 83,743 square kilometres. According to the 2011 Census of India, it has a population of 1,382,727, with a density of just 17 people per square kilometre. This Himalayan state has vivid range of topography with altitudes ranging from the 150-meter elevation in the southern plains near the Brahmaputra River to peaks exceeding 7,000 meters in the north. The region experiences significant climatic variation due to its unique geographical position within the Indian subcontinent: the southern plains are characterized by a humid subtropical climate, while the northern areas are known for their temperate climate and snow-covered mountains. The physical determinants in the area play a vital role in determining the agriculture and economic setup of the state. Arunachal Pradesh, with its rich array of floral and faunal species, is recognized as a biodiversity hotspot within the Eastern Himalayas. This state has very high ecological significance hence; any developmental planning including agriculture, undertaken in Arunachal Pradesh must prioritize the protection of its unique biodiversity.

Despite the rugged Himalayan terrain and the thin topsoil, mostly covered with cobbles and other rock fragments agriculture in Arunachal Pradesh remains heavily dependent on its physical environment (Riba 2011). Most of the ethnic groups in the state rely on traditional subsistence farming, termed Jhum cultivation or shifting cultivation; this method is often criticized as being technically and economically underdeveloped and inefficient. Environmentalists frequently blame Jhum cultivation for causing environmental degradation. However, this criticism tends to overlook the lack of practical, actionable solutions provided by environmentalists, planners, and the government to assist these farmers. In addition to Jhum cultivation, Arunachal Pradesh features several other agricultural practices, for instance, in the Ziro Valley, the Apatani people practice advanced paddy-cum-fish farming. The state also supports small-scale

sedentary wet rice cultivation in the foothills, valley regions, and terraces cultivation on gentle slopes by marginal farmers. Other agricultural practices in the region include agro-forestry, horticulture, floriculture, pisciculture, sericulture, and animal husbandry. Transhumance mode of

II. STUDY AREA:

In this paper, an attempt is made to study the agricultural practices socioeconomic conditions and environmental interaction, of tribes living in the two western Districts of Arunachal Pradesh. The picturesque Tawang and West Kameng (Fig.1) apart from its scenic beauties attract a lot of tourists and researchers due to its unique cultural and agricultural practise. Tawang and West Kameng situated in the Indian Eastern Himalayas are in the extreme western part of Arunachal Pradesh. They share borders with Bhutan to the west, Tibet and China to the north, East Kameng District to the east, and Assam to the south. This region is home to several highlander tribes, including the Monpa, Sherdukpen, Lishpa, Chugppa, Aka, and Miji. Among these, the Monpa tribe holds the highest population.

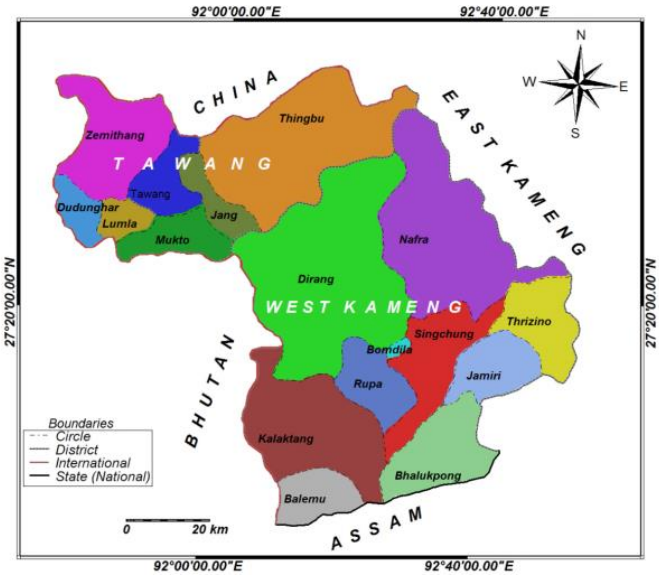

Fig. 1. Location Map

According to the 2011 Census, the combined population of these districts is 136,963, with a population density of 15 people per square kilometre. The region experiences an average annual rainfall of 1,516.65 mm. It has a climate characterized by a brief, wet summer and a cold, dry winter. Summer temperatures can reach up to 25°C, while winter temperatures often drop below freezing up to -5°C. Snowfall can be experienced from November to the first week of March. Some of the Significant Rivers in the region include the Tawang River, Tawangchu, and Nyamyanjchu, Tenga, Bichom, Gacham, Norgum, Dirangchu, and Jamiri rivers.

III. MATERIALS AND METHODS:

This study is based on field research and a review of primary and secondary materials related to the highland dwellers of western Arunachal Pradesh. The research involves data collection through participant observation and semi-structured interviews with key informants, including Brokpas, Ungpas, other knowledgeable members of village communities and the government authorities. To determine the physical aspect of the study areas, data from GPS tracking was utilized. Detailed ground verification was conducted in the grazing grounds (Broks) of West Kameng, extending up to the borders of India and Bhutan.

The data collected from the field and other sources have been utilized to understand the livelihoods, grazing patterns, effect of altitudinal variations on land use, transhumance, environmental interactions, and agricultural methods of highland communities in western Arunachal Pradesh.

IV. ECONOMIC DIVISION:

Based on their economic activities, the Monpas of this region are categorized into four distinct groups: Ungpa; the farmers engaged in the cultivation of cereals and other crops, focusing primarily on agricultural production. Tsongpa; this group consists of individuals involved in commercial activities and trade. They are key players in the local economy through their trading endeavours. Dzopa; the members in this group specialize in labour-intensive jobs, particularly as masons and construction workers. They play a crucial role in providing essential services and contributing to the infrastructure development of the community. Brokpa; Brokpa's, are the herdsmen, they practise transhumance, moving between highland pastures in West Kameng and Tawang, extending to the borders of Bhutan. They engage in livestock rearing and seasonal migration to find grazing grounds for their herds.

V. IMPACT OF ALTITUDE ON AGRICULTURAL SYSTEMS:

Topographical features significantly influences local practices and lifestyles, including mobile animal husbandry. (Manderscheid 2001). Elevation is an important physical aspect in mountainous regions, which governs land use, agricultural systems and other economic activities therefore, an altitudinal model determining agricultural practices, land use and land cover is attempted and developed by the investigator based on field observation and interaction with Brokpas & Ungpas. Based on the model an appraisal on the

altitude-wise distribution of the farmers and their landuse/ landcover and agricultural practices has been put forward (Fig. 2).

The Ungpas, residing at altitudes between 1500m and 2700m above sea level are primarily engaged in subsistence agriculture that remains both technically and economically underdeveloped. Despite the challenges posed by rugged Himalayan terrain, thin topsoil, and limited access to modern farming resources; they sustain their livelihoods through traditional farming methods. Their agricultural practices, missing mechanization with no access to fertilizers, focus on mixed cropping and crop rotation. Their subsistence agriculture is supplemented by horticulture, with fruits like apples, kiwis, and walnuts adding diversity to their economic activities.

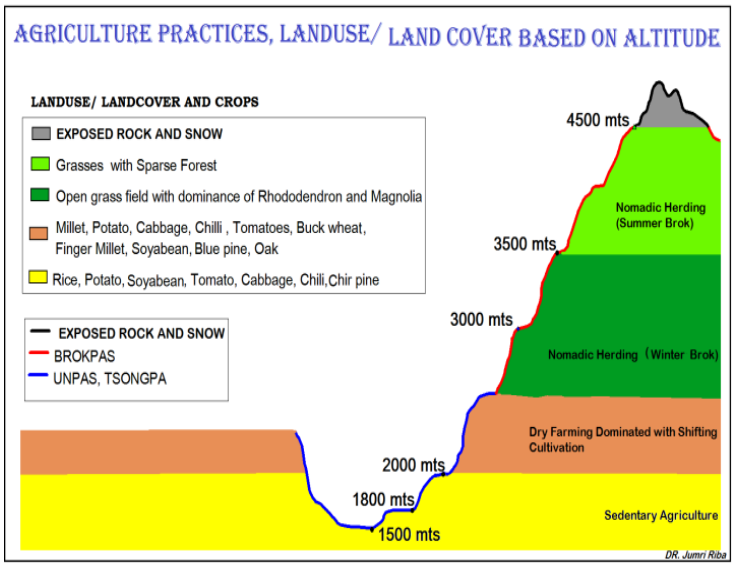

Fig. 2. Agricultural model based on altitude GPS-based

Small pockets of flatlands, found at altitudes ranging from 1500 to 2000 meters above sea level, are used for sedentary agriculture. These areas are often characterized by very small farm sizes, making them uneconomic to operate. Wet rice cultivation is practised in fields situated near perennial rivers where irrigation is available. Farmers plough the fields using oxen and basic, rudimentary tools. Field verification revealed that synthetic and chemical fertilizers are not used by the farmers, particularly in rural areas. The high cost and limited accessibility of fertilizers leads to lower crop productivity. In the same altitudinal zone, the steeper slopes with scanty water are used for growing crops like soybeans, tomatoes, cabbage, and chillies. These crops are cultivated on a much larger scale compared to wet rice. The surplus vegetables produced in the areas with good road connectivity are sold in local markets and some part of the produce is supplied to markets in the state capital and other parts of Arunachal Pradesh, providing a vital source of income for the farmers.

Fig. 3. Mulched oak leaves in the field

The altitudinal zone in the area ranging from 2000m to 2700m above mean sea level (AMSL) is predominantly used for dry farming, and shifting cultivation (Fig.2). The farming methods and equipment used are quite basic and primitive. To enhance soil fertility, farmers mulch their fields with the shaded leaves of Brant's Oak, (Fig.3) which increases the humus content in the soil, improving the yield of crops (Riba, J. 2011). Major crops grown in this zone include maize, potatoes, buckwheat, finger millet, cabbage, and soybeans. Maize is the dominant crop, covering approximately 80% of the cultivated fields. These crops are typically sown during the cool season; they grow throughout the rainy season and are harvested during the dry period.

Most of the shifting cultivators in this zone are the farmers who lack land in gentler topography or whose land holdings are too small for extensive dry farming. Despite the limitations, crop diversification and crop rotation are practised in this zone. Farmers grow coarse grains crops with vegetables such as pumpkins, cucumbers, yams, and ginger, aiming to produce everything needed for family consumption. The practice of crop rotation in this zone is done by growing maize and soybeans together for one season, and then rotating crops in the same field, by cultivating chillies, tomatoes, and cabbages in the next season. Besides wet rice cultivation, dry farming, and shifting cultivation people are also engaged in horticulture they grow fruits like apples, kiwis, and walnuts, which further contributes to their agricultural output and sustenance.

VI. BROKPA THE TRANSHUMANT PASTORALISTS

Transhumance is a form of pastoralism in high-altitude regions that involves the seasonal movement of people and their livestock between fixed grazing areas. Typically, in this practice the herders move their animals to higher altitude pastures during the summer and descend to lower valleys in the winter. Traditional transhumance has been practised across the different parts of the world and it holds a significant importance for pastoralist societies (Ladio et al., 2004). The practice of transhumance has several important impacts on the local economy, particularly in regions where pastoralism plays a significant role (Mace, R. 1993). The movement of transhumant pastoralists often creates small economic hubs where local markets develops and these markets benefit from the trade of dairy, wool, leather, and livestock products, boosting local commerce (Negi, C.S. 2007). In some areas, transhumance has become a cultural attraction, drawing tourists interested in traditional ways of life. This creates opportunities for eco-tourism, which adds value to the local economy. Furthermore, by moving livestock seasonally, transhumance helps manage grazing pressures on pastures, preventing overgrazing and promoting sustainable land use (Borgerhoff et al., 1994).

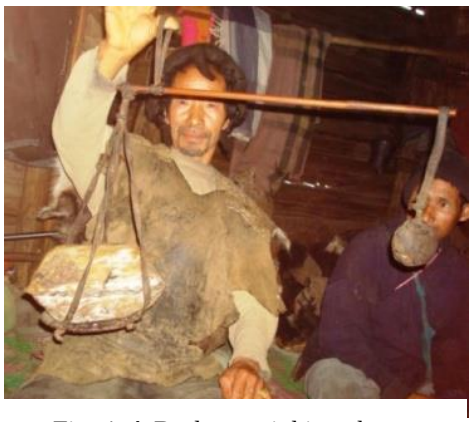

Fig. 4. A Brokpa weighing cheese

Fig. 5. Nor Brokpa Milking a Yak Breed

In the western portion of Eastern Himalaya, Arunachal Pradesh, pastoralism has been practised since time immemorial (field source 2022) mainly to produce food for families and to fulfil the needs of clothing shelter and recreation. The term Brokpa is a combination of two Monpa words Brok and Pa. Brok means grazing land (pastures) Pa stands for the man who grazes the herd, so the complete meaning of Brokpa is 'The Herders' (Fig.4). The Brokpas are subdivided into three different groups depending on the cattle they rare. They are, Nor Brokpa; (Fig. 5) whose herd consists mainly of yak and yak breeds hence, they are better known as yak herders. Wa Brokpa; rare cows as the main cattle of their herd. Shesha Brokpa; is the Shepherd. The traditional economies of the Brokpas are characterized by cattle transhumance and the use of forest resources in different altitudinal belts. In the study area the Brokpas travel seasonally in a cyclical process with their cattle from the lower reaches to the higher reaches. Transhumance in this challenging mountain environment of western Arunachal is a near ecological system of agriculture when compared to the massive Jhum practice in Arunachal Pradesh.

VII. DEVELOPMENT OF BROKS (PASTURE) AND ECOLOGICAL IMPLICATIONS

The pastoralist economy is in serious decline herders are unable to sustain them through pastoralism and their traditional way of life due to economic and environmental challenges (McCabe et al., 1992). Impacts of pastoral grazing practices affect ecosystems, vegetation, resource availability, besides it helps in understandings the sustainability of grazing systems (Coppolillo 2000). The repetitive cutting of trees by transhumant near the makeshift camp of the grazing areas has led to very serious anthropogenic repercussion, the continuous expansion of grazing areas, are contributing to environmental degradation. (Thakur et al., 2011).Community based approaches like System regulation, education, and adaptive management are some of the effective tools in sustaining grassland ecosystems. (Wilkes et al., 2010).

Fig. 6. Manmade Grazing Land at an altitude above 3800 m AMSL

Fig. 7. Depletion of trees for pasture

Based on observations and interactions with the Brokpas, it has become clear that there are two distinct types of pastures, or "Brok," utilized by the community: natural pastures and manmade pastures. Natural pastures (Fig.6) are characterized by peaty, mountainous soil that retains a substantial amount of water, which supports the natural growth of grasses. Manmade Pastures, on the other hand, are predominantly reclaimed from subdued areas that once had dense

mixed vegetation but lacked grasses as undergrowth. To convert areas into usable pastures, the Brokpas set fires in subdued regions to manage shrub growth and prevent the regeneration of young vegetation. They target large, mature trees by stripping their bark from the base up to a height of 1.5 meters, causing the trees to die (Fig.7) and dry out and making them easier to burn. After the trees have fully dried, the Brokpas burn the cleared area again and wait for the grass to grow. In case of insufficient growth of natural grass they transplant grass turfs from existing grazing lands, by the third or fourth year, the newly cleared area becomes suitable for grazing with lush green grasses. The manmade pastures provide strong benefits to the Brokpas, in increasing the grazing land, but there are significant ecological concerns associated with these practices. The most pressing issue is the rapid depletion of shrubs and trees, which poses a serious threat to the local ecology and environment. The methods they use disrupt ecosystems, reduce biodiversity, and lead to soil degradation. Furthermore, the losses of trees are affecting wildlife habitats and worsening environmental degradation. Therefore, the ecological impacts of manmade Brok and grazing practices must be addressed to ensure the long-term health and sustainability of the environment.

VIII. GRAZING PATTERN:

The environmental changes are disrupting the traditional migratory patterns, threatening the sustainability of their herding practices, reducing the quality and availability of pasture (Sharma et al., 2022). Without proper management and rotational grazing practices, the cumulative effects of heavy grazing pressure during the colder months can further accelerate land degradation (Wilkes et al., 2010). Seasonal variations in diet can lead to differences in the nutritional content of animal products, such as meat, milk, and wool, depending on the specific forage consumed by the animals. (Coppock et al., 1986)

The nomadic herders of the Brokpa community practice a two-pasture utilization strategy, Winter Pastures with a Grazing period of about 150 days from November to April and Summer Pastures with a grazing period of about 190 days from May to October. During the summer, from the 1st week of May, they migrate with their cattle from the lower reaches towards the higher peak grassy mountain having colder weather. The migration to the higher altitude area is done in search of grasses as fodder and to maintain the health of the yaks & yak breed that are vulnerable to foot and mouth disease, and other bacterial infections due to rising summer temperature. However, cows and mountain sheep are more adapted to the rising temperature than the yaks.

The Brokpas plan their moves with an approach that they reach their last grazing area near the international borderline of India at Arunachal Pradesh by the end of July and by the first week of August, they start to retreat with their cattle for the lower reaches. By the end of the first week of October, they arrive at places with less snowfall, which is safer for the herders and their herds. During summer pasture, the milk yield by yak and its breed is higher due to the abundance of fodder like Kyllinga monocephala, Poa annua, Fimbristylis squarrosa, and Eragrostis spices. Alopecurus spices. Pogonatherum crinitium, Eriochloa spices. As winter approaches, it becomes miserable for both the Brokpa and their herders and the herd yields minimum milk during this period due to inadequate grass. During the Winter the grasses die out and the Brokpas collect fodders for the herd which primarily are the leaves of the trees, that are locally available, some trees used as fodder are Blemkar (Buddleja asiatica) Domkar (Symplocos racemosa), Salix (Salix humboldtiana), Syluli (Acer campbellii), Maar (Castanopsis spp.), Zimbu (Ligustrum myrsinitis), Phrengpa (Quercus wallichiana), Dudhilo (Ficus nemorlis) and Chiple (Reevesia pubescens). Brokpas face these hardships until the summer approaches with flashy green grasses in the pastureland.

The Brokpas also follow a distinct grazing pattern where mountain sheep and yaks are not grazed together. According to the Brokpas, yaks tend to avoid areas previously grazed by mountain sheep. As a result, mountain sheep and cow breeds are grazed in areas abandoned by the yaks. To maintain this grazing pattern, yak herders move ahead of the other nomadic herders. The nomadic herders, who manage mountain sheep and cows, only graze their animals up to half the distance covered by the yak herders, and then retreat to lower areas. This staggered grazing period, combined with the natural fertilization from the herds' dung, plays a vital role in replenishing and regenerating the grasses and eventually, the yaks return to graze these areas during their retreating descent to lower altitudes.

IX. CHALLENGES

The traditional practices, coupled with a lack of awareness, have often been identified as contributing factors to the poor health conditions among pastoralist communities (Saverio, K. 2001). The Brokpas' living conditions present an unhygienic picture (Fig. 8) they may go an entire season or more without bathing, eat with unwashed hands; they rub their greasy hands to their bodies and clothes and clean their utensils with tree leaves and lichens. During field visits, it was also observed that their cooking utensils had not been cleaned for months, accumulating layers of fat and grease.

Pastoralism, often viewed as an irrational and underdeveloped system of production, leaves pastoralists in a perpetual state of poverty (Saverio, K. 2001). The livelihoods of the pastoralist are deeply connected to the number and health of their livestock that provides food, clothes and transportation and the well-being of their herds directly affects pastoralist ability to sustain their traditional way of life. (Negi 2007). In the study area, the Brokpas rely heavily on their herds for food, including milk products, meat, and fur. The market economy is a new concept for the Borkpas and this new influence is slowly replacing the practice of barter system between the Brokpas and the villagers. Cheese, known locally as Chura and butter are the most valuable products in their trading system.

Fig. 8.A woman preparing Butter

Access to healthcare is another major concern for the Brokpas, both for themselves and their herds. With no health facilities nearby, they must walk miles through the rugged Himalayan terrain to reach the nearest health centre, making it difficult to seek help for minor ailments. Consequently, they are often excluded themselves from health awareness programs. Veterinary care is limited, to a few areas only, most of the time the Brokpas primarily rely on local herbs to treat their animals when their cattle are sick.

Low school enrollment among nomads is likely driven by belief that formal schooling undermines their traditional livelihood. Pastoralist's had a logical concern that education may push children away from pastoralism rather than support it (Saverio, K. 2001). Due to smaller population size the pastoral communities are marginalized and their demographic weakness makes it difficult for them to be included in development programs and decision-making processes. (Miller 1999).

In the study area Education poses a significant challenge for the Brokpa community, as most children accompany their parents during seasonal migrations between pastures, living in unhygienic and dilapidated temporary shelters. To address this issue, the Government of Arunachal Pradesh initiated efforts to build houses and schools for the Brokpas. In 2011, a primary school was established in New Merakmu Village to educate Brokpa children, but attendance remains very low to non-existent. To overcome this challenge, permanent structures in various Brok locations are needed to serve as camps for both herders and their animals. Additionally, introducing mobile schools could help resolve the low attendance issue by providing education while accommodating the community's nomadic lifestyle.

X. SUGGESTIONS

Without effective management, poor grazing practices can lead to land degradation, threatening both the ecological balance and the economic stability of pastoral communities. (Turner et al., 2005) To mitigate the ecological damage caused by manmade pastures, there should be a focus on sustainable grazing practices. Programs encouraging rotational grazing, reforestation, and controlled grazing pressure should be introduced to maintain the health of natural ecosystems. Mobile health clinics and veterinary services should be established to provide the Brokpas with regular and convenient access to medical care, both for their families and livestock. Additionally, integrating health awareness campaigns into these services could improve hygiene and reduce disease prevalence. Establishing mobile schools near permanent pastures can address the low attendance rates of Brokpa children with an education programs oriented to the pastoralist lifestyle, including agricultural and livestock management training, could better equip the younger generation for future challenges. Efforts should be made to help the Brokpas engage more effectively with the market economy. This could include the development of cooperatives, improved transportation networks, and value-added processing for their products like cheese and butter. The government should prioritize constructing permanent shelters and establishing sustainable infrastructure for herders, particularly in winter pastures. This would improve living conditions and make it easier to provide services like healthcare, education, and market access. Collaborations with environmental organizations could help the Brokpas adopt eco-friendly pasture management techniques while promoting conservation efforts. Reforestation, soil management, and biodiversity protection initiatives should be integrated into any development planning in the region.

XI. CONCLUSION

The Brokpas of Arunachal Pradesh, a transhumant pastoralist community, have sustained their livelihoods through traditional practices of livestock rearing and seasonal migration for generations. Their close relationship with the environment and reliance on natural pastures has shaped their unique cultural and economic identities. However, their pastoral lifestyle is confronted with challenges, including poor health

conditions, lack of access to modern healthcare and education, environmental degradation, and limited engagement with market economies. Though ecologically sensitive the traditional systems of Brokpas offer resilience in a rugged landscape, which also contributes to ecological concerns.

The study highlights the importance of balancing traditional pastoral practices with sustainable development initiatives to ensure the well-being of the Brokpa community while preserving the fragile Himalayan ecosystem. This balance will require concerted efforts in infrastructure development, healthcare access, education, and environmental conservation.

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