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Sustaining Agriculture through Indigenous Knowledge: Experience of the Chakhesang Naga Tribe

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Abstract

Use of indigenous knowledge in agriculture is not uncommon in India, particularly among tribal communities and small-scale farmers who find the knowledge applicable, acceptable, and reliable even in a situation when modern technologies are in use with considerable impact. As agriculture remains the primary occupation of most of the communities in Northeast India, indigenous farming practices continue to find favour in certain areas despite the rapid spread of advanced agricultural technology. This study investigates into the diverse forms of indigenous cultivation practiced by the Chakhesang tribe in the Phek district of Nagaland. Data were gathered through personal interviews, observations, and group discussions with people, for whom agriculture was the mainstay. The study examines in details the various cultivation methods employed by the Chakhesang tribe, including permanent farming, shifting cultivation, 'zabo', and agroforestry. It also explores the traditional land use patterns, tools and storage techniques employed, highlighting their significance in sustainable agriculture. The paper describes the interwoven features lying between culture and agriculture in the context of Chakhesang tribe. Further, it emphasises on the potential benefits of these practices, including environmental conservation, organic farming, soil fertility preservation, and women's empowerment.

Keywords: Indigenous knowledge, Agriculture, Chakhesang Nagas, Customary laws, Culture, Environment, and Sustainable development.

Introduction

Traditional Agricultural Practices (TAPs) in a localized setting are no less important for promoting the cause of natural conservation as has been demonstrated by some

indigenous communities. TAPs, owing to their adaptive capacity to the local environment and being based on indigenous knowledge, allow more flexibility than other technology-oriented agricultural methods. One is prompted to believe that the traditional farming system is designed along the ecological principle of maintaining the natural balance, where the interaction between the human and existing natural resources is mutually beneficial and exploitation-free. The uniqueness of conventional agriculture lies in its ecologically benign nature, public acceptability, and environmental and economic feasibility (Wezel *et al.,* 2009, as quoted in Patel *et al.,* 2020, pp. 253-254). Generation-wise transmission of this traditional system sustains the relationship between living beings and their environment (Berkes *et al.,* 2000). Actually, it sustains productivity by utilising available local resources and developing site-specific agriculture practices compatible with the regional climatic conditions and spatial and sequential diversity (Lincoln, 2019). Many rural communities survive on home-yard farming, which contributes to more than half of global food production (FAO & IFAD, 2019).

Some of India's prominent conventional farming practices are double cropping, mixed cropping, crop rotation, agroforestry, and the use of local varieties and resources with host-pathogen interaction. Such practices have a significant role in achieving the sustainability of agriculture by improving nutrition quality (Patel *et al.,* 2020). Like mixed cropping, traditional farming minimises the risk of pest and mono-crop failure sustainably (Singh & Singh, 2017). Agroforestry and shifting cultivation practices, which are ecologically nutrient-conservative, are primarily practised by the tribals of Northeast India, Orissa, and Maharashtra (Murthy *et al.,* 2013). Indigenous Traditional Knowledge (ITK) serves as the framework for decision-making at the local level in crop management, soil management, pest and disease management, preparation of regional cuisine, health care, and other natural resource management on the basis of different activities pursued by tribal societies (Warren, 1999).

India's northeastern region has a rich natural, cultural, and biological diversity, conserved by environment-friendly indigenous knowledge of more than 120 scheduled tribes (Chhetry and Belbahri, 2009). The Northeastern Region's (NER) agricultural ecosystem and farming practices are quite different from those of other parts of the country and have many unique features like Jhuming and *Zabo* cultivation. All these have their own merits, demerits, diverse manifestations, and complexities, distinguishing them from the mainland agriculture. Strictly analysed, NER's agriculture appears to be complex, diverse, and risk-prone (Ansari *et al.,* 2021). A steadily increasing number of studies all over the globe point particularly at the complexity of indigenous soil and water conservation technologies (Pandit and Balla, 2004:33-36).

Nene (1999) argues that for farmers with limited resources to improve their living conditions, they must acquire effective farming methods relying on the rather inexpensive, readily available inputs available in their area. For those relying on rainfall, the knowledge gained from the past experiences can help in scheduling their agricultural calendar. Singh (2004) pleads in favour of mixed crop-livestock farming, which is traditionally practised in India. Most traditional systems are highly efficient, self-sufficient, and sustainable. Combining livestock with crop production is an effective risk aversion mechanism practised for generations in arid and rainfed areas. The system is a good example of recycling all farming byproducts and household waste with little dependence on outside resources. It gives an appropriate and sustainable approach meant for use in remote rural areas, where outside resources or services are accessible with much difficulty.

The old practice of ploughing the field many times and exposing it to the scorching heat of sunlight before sowing or transplantation kills most pests like stem borers' larvae, rice weevil larvae, etc. This mode of cultivation is sustainable and adapted for cultivating various crops, as it helps eliminate the significant pests of cultivated crops. Among small-scale farmers in the Manipur valley, this is still in practice (Santosh and Chhetry, 2012). Farmers in Nagaland mainly rely on conventional wisdom, which promotes enriching the soil with readily accessible organic elements like leaf litter, animal dung, and crop leftovers. Due to these advantages, the area may easily turn into a hub of complete organic agricultural output without significantly changing the farming practices (Murry, 2019).

In Sikkim, rotten forest litter or organic matter-rich topsoil is put into grooves or rock pieces lying strewn around the potato seeds. Alternately, farmers use forest litter as bedding material for compost production. Rice and Maize cultivation on terraces have been in practice for a long time, carrying some advantages. This method controls surface run-off, prevents rill formation, and controls the advancement of already existing gullies. The traditional large cardamom drying kilns (*Bhutti*) do not need highly specialised skills and any foreign input material. These kilns have locally available mud and stone masonry walls on four sides. The example of cucurbit seeds placed in fresh cow dung balls and then buried deep into the soil for better germination, growth, and yield (Musara & Chitamba, 2014) only confirms local ingenuity . The *Zabo* rice cultivation system is an excellent indigenous method of rainwater harvesting used by the Chakesang farmers of Nagaland. The Jhum farmers of Kohima and Phek districts of Nagaland usually plant alder trees in the Jhum cycle area along with traditional crops for soil fertility and prevention of erosion (Nagi et al., 2023).

Dkhar and Tiwari (2020) observe that Traditional Ecological Knowledge (TEK) is shaped by the ecosystem of the place, drawing from thousands of years of experience. It relates to comprehending the operation of surrounding natural ecosystems and works out the possible way of employing them sustainably. TEK is considered to be an intangible heritage and intellectual property of the community, which is orally transmitted through generations. It sometimes takes the shape of stories, songs, folklore, beliefs, cultural values, and practices and is closely held. Pimentel (2006) opines that the traditional ecological wisdom/knowledge can still play a crucial role in agricultural sustainability. That it produces the least disturbance in the eco-system, promotes potential soil organic matter accumulation, favours biodiversity, and uses site-specific and improved traditional varieties may not be contested outright. After all, this traditional and site-specific practice of agriculture has a sound ecological reasoning woking in its favour. Aich *et al.* (2022) further explain that prominent traditional practices are intercropping, agroforestry, cover cropping, crop rotation, organic composting, and integrated crop-animal farming. A mosaic of different land use pattern created by the traditional agriculture reflects on the efficacy of the traditional knowledge system nurtured by the local tribal communities, which enable them to combine soil, water, plant, and animal management at a landscape scale. Indigenous farming practices are varied, flexible, eco-friendly, and fruitful, but their time-tested means of subsistence are now threatened by climatic change. As a result, the earlier benefits of traditional practices in the form of increase in agricultural and tree diversity, enhancing the conversion of CO_2 to organic form with its known effects of mitigating global warming and reducing the likelihood of pests, diseases and crop failure with the possible introduction of mixed cropping, may no longer be available.

Thus, there is an urgent need to document and preserve the ITKs of different neighbourhoods, many of which are on the brink of extinction (Borah *et al.,* 2023). Keeping this in view, the present study describes the various indigenous agricultural practices still followed by the Chakhesang tribe of Nagaland.

Research Procedures Followed

The State of Nagaland is located in the northeastern region of India, bordering Arunachal Pradesh on the north, Manipur on the south, Assam on the west, and Myanmar on the east. There are altogether seventeen districts in Nagaland. The Chakhesang tribe are occupants of the Phek district of Nagaland. They mainly speak two dialects, *Chokri* and *Khezha*, apart from other dialects like *Sapu* and *Sumi*.

Figure 1. Maps of India and Nagaland, along with that of Phek district (The study area is shown in yellow).

Map of India & Nagaland

Map of Phek District

For this study, the respondents were selected through a multi-stage sampling method. Initially, eighteen (18) villages and four (4) small towns were proportionately identified from the four ranges of the Chakhesang tribe in Phek district, namely, the Sakraba range, Chizami range, Razeba range, and Pfutsero range. From the selected villages and towns, 280 households were selected on a simple random basis during the fieldwork. The study utilised multiple data collection methods to ensure comprehensive and full-scale data. Firstly, personal interviews were conducted with all the respondents in the study, using a semi-structured interview schedule. The questions covered in this data collection tool included land use patterns, cropping patterns, agriculture cycle, customary laws, and regulations relating to land management. The interview schedule was administered in a face-to-face situation during household visits, ensuring accurate and detailed responses. Due to the constraints imposed by the COVID-19 pandemic, a few telephonic interviews were conducted again in 2020 to supplement the data already collected from the personal interviews during the fieldwork. Observations were systematically recorded during field visits, focusing on various activities involved in agriculture, including clearing forests, preparing soil, transplanting and maintaining crops, and harvesting. Detailed field notes and photographic evidences were collected to supplement the data collected through personal interviews. Secondary data were obtained from various sources, including books, journal articles, and official reports. It provided additional context and background, supporting the primary data and offering a broader perspective on the agricultural practices followed in the study area.

Culture and Agriculture

Like many other Naga tribes, the Chakhesang Naga people could be distinguished by their belief systems and customary practices as markers of their cultural identity. These

customs used to be strongly linked to their agriculturally-oriented way of life, as reflected in agricultural rites and activities suggestive of their deep connection with the natural world (Yekha-u & Marak, 2021). The Chakhesang community life mainly revolves around farming practices, which include activities carried out by the people in different agricultural seasons. Each and every practice is guided by strict observance of restrictions and taboos (Singh & Theluo, 2016). Traditional agriculture in Nagaland is a highly complex system. Families dependent on agriculture have to adopt and maintain diverse agricultural practices to sustain their livelihood, of which terrace rice cultivation (TRC), shifting cultivation, home-gardening, and plantation in Firewood Reserve Forest are important. The locations of these sites are so varied that the farmers are compelled to adopt and adapt practices that suit them best. The site factors, like the altitude, temperature, precipitation, soil, and biotic and abiotic factors, play essential roles in combining traditional cultural practices and conserving agrobiodiversity. As a result of these adoptions and adaptations, conventional farming systems display a high degree of agro-biodiversity, which is one of the distinguishing features. Centuries of cultural and biological development have given shape to these traditional agricultural methods, resulting from indigenous farmers' cumulative experiences of interacting with the environment, without having direct access to contemporary scientific knowledge, capital, or outside inputs (Nakro, 2011).

Among the several indigenous cultivation practices followed in Northeast India, wetland rice cultivation of the Apatani tribe of Arunachal Pradesh, the alder and *zabo* farming in Nagaland, large scale cardamom plantation in Sikkim, traditional mixed cropping, bamboo drip irrigation in Meghalaya are few examples. Such practices are still in vogue in organic agriculture, which are sustainable, eco-friendly, viable and cost-effective (De, 2021).

Although farmers are increasingly inclined towards commercial agriculture, they still practise traditional agriculture, such as terrace paddy cultivation, jhum cultivation, and *zabo* cultivation. The farmers with a rich indigenous knowledge system maintain the continuity of indigenous farming practices. Even the implements used are the traditional ones, such as *dao*, spades, wooden hoes, bamboo baskets, bamboo-made *dao* and sickles. Their methods and ways of farming are still based on indigenous practices and they have faith in them. In course of an interview one respondent commented, "*Whether we are backward or not, whether we are given modern farming tools like power tiller and various hybrid seeds, we always cultivate in the indigenous way.*"[1] Another farmer responded, "*Due to the topography and economic problems, modern heavy machines are difficult to operate conveniently, and as we are not comfortable with them, our reliance*

on the indigenous agricultural practices continues."[2] Yet another farmer expressed, "*Our agricultural practices are our heritage, and we are used to it. We survived and maintained our livelihood by conserving our traditional agricultural system*."[3] The responses from the cultivators in the study area highlight the geographical and cultural factors motivating them to maintain the indigenous cultural practices.

Indigenous tribal communities always maintain a harmonious relationship with their land, which is intertwined with their social, cultural, and spiritual lives. Among the Nagas, including the Chakhesang, land is considered to be the primary source of life, which is reflected in the strong relationship existing between land and the people. It is not simply a space or material property, but a gift from God, and is considered sacred. It is holy because their ancestors lived and worked on the same land, which is handed down to them to be transmitted to future generations (Jamir, 2015). The relationship between the Chakhesang culture and their land has an ancestral root. Honesty and respect for Mother Nature are undoubtedly the two best features of this relationship, as they protect and preserve their land, remaining true to their values. Land gives them plentiful resources in the form of dense forest, extensive flora and fauna, fertile soil, and bountiful crops, satisfying their needs.

In the Chakhesang region, agricultural activities continue throughout the year, accompanied by rituals and festivals. They not only cultivate crops but simultaneously cultivate virtues like benevolence and loyalty to the land. A man full of energy and devotion to work is much appreciated. They sing some songs in *Tshele* (folk tunes), while working in the field as a complementary part of work culture. When a person works alone, the music will be in a solo voice, and when two men perform, the song is sung with one man rendering a part of it and the other responding with the next. When the song is performed in a slow rhythm, it is adjusted to the beat with slower action by the workman, as is indicated by his raising and lowering the implement in hand. When the song is faster, the act becomes more rapid. The tradition of reciprocal exchange of labour by forming groups with individuals working in each other's fields till the completion of the roster is a characteristic feature of the Chakhesang culture, as it is of some other tribal communities of Northeast India.

In the traditional Chakhesang Naga society, three ethical standards connected with *kenyi* (taboo), *menye* (shame), and *metha* (fear) play a significant role in making them perfect. These ethics mould one's mind, control emotions, guide human behaviours, and shape attitudes. Proper maintenance of culturally defined ethical standards will strengthen the socio-cultural base of the community. Land for tribal people is the immortal gift for their sustenance and continuity of the uniqueness of their culture. To the

Chakhesang people, land is of value not only in agriculture but also in functions like recreation, habitation and transportation.

Much importance is attached to culture's role in fostering the identity of a tribe. Arts and crafts, dance and music, language and actions, festivals and customs, food habits and lifestyle, rituals and taboos, beliefs and values are part of the rich tribal culture and the heritage it symbolises. Culture connects them with their past and adds new meanings through its present incumbents, in the process strengthening community unity and creating a sense of belonging and self-pride. Material prosperity of the tribal people depends a lot on their linkage with the land as a collective resource, where tribal culture has its own role to play. Culture here symbolises 'social rather than individual, local rather than universal, learned rather than spontaneous, historical rather than biological, evolved rather than planned, distributed rather than centralised, and cultivated rather than coarse' (Richland, 2013). Hence, preserving and promoting culture is of vital importance to maintaining the spirit of tribal way of life.

The Chakhesangs are experts in crafts, pot making, baskets, sculptures, and wooden furniture. Mutakhru, one of the Chakhesang villages, is known for salt-making. Some of the cereals and vegetables cultivated by them are plain rice, sticky rice, millet, job's tear, yam, maize, pumpkin, sweet potato, colocasia, ginger, Naga dal, soybean, oilseed, mustard leaf, long bean, flat bean, winged bean, pea, chilly, garlic, tomato, gourd, chow chow (squash), cabbage, bamboo-shoot, cucumber, ladies finger, brinjal, egg plant, green onion; among the fruits banana, sugar cane, orange, passion fruit, pomegranate, plum, guava, peach, lemon, mango, gooseberry, papaya, pear may be mentioned.

Indigenous Agricultural Tools in use

Some of the important traditional agricultural tools primarily used in agriculture are given in the table below.

Table 1. Indigenous Agricultural Tools

Tool Name	**Usage**	**Used by**
Eza (dao/machete)	Cutting and slashing	Men
Kapfu (spade)	Digging and plowing	Men & women
Kavu Chuza (bamboo dao)	Clearing grass	Men

Kathi (pickaxe)	Digging	Men
Kewu (wooden/bamboo rack)	Dragging and collection of trash	Men & women
Nopfo (bamboo flat basket)	Picking up trash and mud	Men
Thecu (sickle)	Trimming and cutting the harvest	Men & women
Nodekhubvo	Breaking of soil clods in the field	Women
Tsuhthru (bamboo hat)	Headgear for protection against heat and rain	Men & women
Ehnhi (grass coat)	For protection from heat and rain	Men & women
Lashe (piece of cloth)	Collection and carrying of the harvest woven around the body	Men & women
Eche (bamboo basket)	Carrying the crops	Men & women
Mehe (bamboo basket)	Measuring and collecting paddy	Men & women
Echupharu (bamboo winnower)	Winnowing and cleaning grains	Women
Ebu (bamboo storage basket)	Paddy storage	Men & women
Ezu (bamboo mates)	Drying of the harvest	Women
Pakhu and Khumi (wooden paddy pounder)	Pounding of paddy, maize, etc.	Women

Figure 2: Traditional tools commonly used by the Chakhesang

(a) Eza (dao/machete)

(b) Kapfu (spade)

(c) *Kavu Chuza* (bamboo dao)

(d) Kathi (pickaxe)

(e) Kewu(wooden/bamboo rack)

(f) Thecu (sickle)

(g) Nodekhubvo

(h) Tsuhthru (bamboo hat)

(i) *Ehnhi* (grass coat)

*(j) Eche (*bamboo basket)

(*k) Mehe* (bamboo basket)

(*l)Echupharu (bamboo winnower)*

(m) *Ezu (bamboo mat)*

(n) *Pakhu and Khumi (wooden pounder)*

(o) *Nopfo (bamboo basket)*

Source: Fieldwork (a-o)

Indigenous Agricultural Practices Adopted

A traditional agricultural system allows cultivation of land of various sizes for livelihood support. These methods have been helping farmers for generations, fostering community values of equity and justice, giving equal access to wholesome food, and encouraging people to sustain indigenous agricultural practices. The Chakhesang Nagas practise agriculture adopting various traditional methods and environment-friendly approaches such as soil management, water management, pest management, agroforestry, organic farming, environmental protection, which contribute to sustaining indigenous farming and agricultural activities. The major indigenous agricultural practices of the Chakhesang Naga, which are sustainable and carry much significance in the community life, are described below.

The land is hilly terrain in nature, and the weather is tropical. Villages are located primarily on the hilltops, with agricultural fields and patches of forest all around. Farmers cultivate land stretched along the habitation area to the river site, down the mountain bed. Fields (*ekhulo*) are primarily in areas with slopes and forest-cleared regions, and the cultivators have to traverse long distances on foot along narrow, winding roads to reach them. Land among the Chakhesang Nagas can broadly be classified into forest land and agricultural land. The villagers usually keep the forest land in reserve to be used only when there is a genuine need for more land for cultivation. Depending on the method of cultivation followed, land can further be subdivided into the following categories: *Ekhulo* (Terrace field), land for *Zabo* farming, *Meluloh* (Jhum field), *Chükhe* (Agroforestry), and *Kecü* (Kitchen Garden).

(a) TERRACE FIELD (*Ekhulo)* cultivation:

Figure 3: *Ekhulo* (Terrace field)

Source: Fieldwork.

The terrace fields are of two types: wet (*kedaloh*) and dry (*ketsholoh*). Terrace is a permanent field for the cultivation of paddy. Terrace fields are individually owned and are cultivated individually at the household level. Terrace field cultivation helps in soil management as there is a greater opportunity for organic matter to be added to the soil, consequently increasing the soil fertility. It improves the soil quality, paves the way for organic cultivation and reduces soil erosion. Crop rotation helps improve the health of the soil.

Figure 4: *Kedaloh* (wet terrace paddy field)

Source: Fieldwork

Kedaloh is a terrace field where water is retained throughout the year. The wet terrace

fields are prepared near the water sources, as the water of the stream could be channelled directly into the field. These fields are owned by the villagers individually. Such lands near the water sources are primarily owned by wealthy farmers who can boast of considerable land-based wealth. Farmers also practise aquaculture, keeping fish and snails in the terrace fields. These are prized possessions and are much in demand, since cultivating them is much easier and there is always the prospect of producing more harvest and thereby, accumulating more wealth.

Figure **5: *Kethsoloh* (dry terrace paddy field)**

Source: Fieldwork

Ketsholoh depends on the monsoon rain and is required to devise alternative ways of tapping other water sources lying at a distance by creating something like a watershed management system for cultivation, whereby water channels can be brought to the fields from the available water streams.

The significant differences between wet and dry terrace field cultivation stem from the fact that in dry terraces farmers can grow lots of seasonal crops like bean, cabbage, potato, pumpkin, pea, etc., but cannot cultivate paddy if it does not rain during the season, usually in June- July. In the wet terrace fields, farmers can grow additional crops even after cultivating paddy and practising aquaculture, as water is retained. The work is more challenging for those cultivating in dry terraces as they have to till and plough the land for several days at a stretch before it could be filled with water for paddy cultivation. The land is then kept submerged in water for four to seven days. After properly levelling the mixed soil, paddy saplings are transplanted into the field. Water is to be adequately retained till the paddy is harvested. Paddy harvesting of both types of terrace field is done in October.

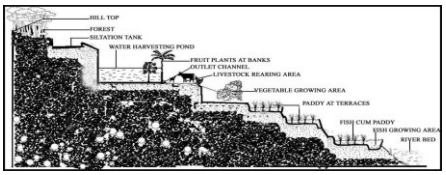
Indigenous Methods for Preserving Soil Fertility

As the farmers do not use chemicals or fertilisers in cultivation, soil preservation becomes a natural process. Nevertheless, some practices they follow under soil enrichment programme speak of their ingenuity. Of these, mention may be made of

spread of domestic animal waste (*etshukhunibruh*) and fire ashes (*pavuno*) into their fields, burning and burying of leaves and twigs, branches and grasses called green manure, rotation of crops when they cultivate a number of dissimilar types of crops in the same area in seasons in a sequence, for instance, maize and pea. They also do mixed cropping by growing different varieties of crops like potato, chillies, yam, Nagadal, bean, and maize. And it involves intercropping as well when the cultivation of two or more dissimilar types of crops is pursued simultaneously in the same area in the same season, for instance, garlic, pea, and tomato. Organic input in terms of crop residue and farm yard manure is an excellent alternative to restoring soil fertility at an affordable input cost (Vanlauwe *et al.,* 2010).

(b) ZABO System of cultivation:

Illustration: *Zabo* farming



Source: R. K. Singh et al., 2012

Figure 6: *Zabo* farming in Kikruma village

Source: Fieldwork

The Chakhesang tribe of Nagaland uses *Zabo*, which means 'impounding water,' an indigenous method of catching rainwater from running off the mountains (Pandey *et al.,* 2017). *Zabo* is derived from the word *zabö,* which refers to "impounding run-off water" in the Chakhesang dialect. *Zabo* is also known as the *Dzüdü* or *Ruza* system in other parts of the region. It combines forest, horticulture, agriculture, fishery, and animal husbandry with a well-founded soil and water conservation base (Singh *et al.,* 2012). One of the outstanding indigenous integrated farming practices of this tribe, specifically at Kikruma village, is *Zabo* farming, where a vast forest area is conserved for cultivation. The ecosystem approach is a strategy for the integrated management of land, water, and

living resources that promotes conservation and sustainable use in an equitable way (Raj & Singh, 2021).

The forest hilltops are kept as water catchment areas, and at the next level, ponds are dug for collection of water, which serve as reservoirs. Water is then channelled through cattle yards and to the paddy fields below. This water carries the cattle's dung, urine, and wastes to the field areas and fisheries, adding nutrients to the soil in the process. Crops like maize, pumpkin, cucumber, Naga Dal, chillies and bean are also cultivated in them. A farmer responded, "*Our agriculture is rain-fed, and this indigenous Zabo practice is the best farming method, best suited in this environment and climate."*[4] *Zabo* reduces the need for chemical inputs, protects the environment, conserves water, and maintains soil quality and erosion. It minimises waste and optimises resource use. It also promotes composting and agricultural recycling. This system was primarily devised to meet the irrigation needs of paddy cultivation on terraces. *Zabo* is a distinctive and time-tested farming system, an example of the uniqueness of indigenous practices and knowledge about the sustainable utilisation of land, water, soil, forest, livestock, and fish resources (Singh et al, 2018).

(c) JHUM (*Melulo*) cultivation

Figure.7: *Melulo* (Jhum cultivation)

Source: Fieldwork at Tsupfume Village

Melulo or Jhum fields are temporary cultivation sites; they are cultivated for two or three years, and then the plot of land is left fallow for a period of about ten years or more. Jhuming is usually done in forests and areas with slope where terrace cultivation is not practised, and which are generally far from home. Commonly known as slash-and-burn method of cultivation, it uses the ashes accumulated from the burnt area as the fertiliser or manure to be added to the Jhum field. Burning also eliminates pathogens and other pests from the surface area. Zero tillage method, such as stick dibbling, is the traditional way jhum cultivation is done. Felled trees are laid on the field as contour bunding to check soil erosion.

Upland paddy is often mixed with other crops primarily to create a physical barrier for easy movement of insect pests and pathogens. Secondly, this practice provides a dependable food source to the farmers throughout the year (Kuotsuo *et al.,* 2014: 23). It has also been observed that job's tears (*Coilacryma jobi* L) is sparsely cultivated in patches over the paddy field to deter birds and rodent pests. These plants produce disturbing and loud sound when the wind blows, which prevents rodents and birds from entering into the field (Ibid: 24). After the harvest, the field is left fallow for around ten years, during which time it regains its fertility. Meanwhile, the farmers move to another spot to continue with jhuming.

(d) CHÜKHE (Agroforestry)

Chükhe, which may be equated with agroforestry, refers to an agricultural land whose ownership can be individual or clan. There are various flora and fauna that the owners can freely collect from this type of land. Bamboo and trees having domestic or village-level use, are mainly grown there, which are equally shared by the clan members. Firewood is customarily cut twice in a year - once in January to meet the demand of the whole year and then in December for the *erünye* and Christmas festivals. *Erünye* is a paddy-based festival performed after the November harvest. Other than various construction works, creation of art, and wood crafts, the village people collect bamboo and wood for making houses, barns, furniture items, bamboo baskets, wooden plates and spoons, and other agricultural implements in their *Chükhe*.

Where the ownership of *Chükhe* rests with the clan, there is no hard and fast rule for its usage except that the extent of cultivation right or use of the *Chükhe* is allotted in turn to the household of the clan according to its need. The main uses are for firewood and bamboo harvest. Clan members can make use of it for foraging, collection of snails and crabs, and bird hunting, which of late has been discouraged by nature lovers and activists. Anyone outside of the specific clan is not allowed to cut trees without prior permission.

Chükhe provides shelter for animals, plants, and water resources. Its judicious use helps in environmental protection and conservation of natural resources. One respondent said, *"Agroforestry is a traditional practice of conservation of the environment. As population increases, demand for exploitation of natural resources becomes greater, be it wild birds and animals, trees and flowers, fruits and crops. Related activities are designed in such a way that they could help in environmental protection."*[5] At the root of it lies their desire to preserve and restore the ecological balance through such practices as are followed in indigenous agriculture.

(e) KECÜ (kitchen garden)

Every household owns its own *Kecü* or kitchen garden at the backyard of the house compound. They cultivate this *Kecü* normally in February and March and sow varieties of seeds for household consumption. Seasonal vegetables like mustard leaves, cabbage, garlic, cucumber, bean, chilly, eggplant, ginger, pea are grown here. Most of the households planted squash in this garden. *Kecü* also provides a space for the domestication of pig, fowl, rabbit, goat, and cow.

Preparation of Seeds

One of the most critical steps of cultivation is the preparation of seeds. The seeds are mainly prepared by womenfolk. Preparation is essential for a wealthy harvest, where the best and most healthy seeds free from any infection are selected for cultivation. The proper selection of seeds sustains crop production and provides staple food. The process of preparing seeds is as follows.

Seed Selection

The first step in seed preparation is selecting the right seed. Farmers usually prefer seeds from their previous harvest, which are well adapted to the local environment and have a high yield potential. The selected seeds should be healthy, disease-free, and contaminant-free.

Seed Treatment

Once the seeds are selected, they must be subjected to treatment to improve their germination rate and protect them from pests and diseases. The most common seed treatment method used in jhum cultivation for maize is soaking the seeds in water overnight, which will be planted the next day. This process helps to soften the seed coat and speed up germination. The seeds are also dried in the sun and stored in various baskets. Another seed treatment method is coating the seeds with cow dung and ash, as is the case with Naga Dal, potato, maize. The coating helps to protect the seeds from pests and diseases and provides essential nutrients for germination.

Seed Storage

After treatment, the seeds are stored in a cool and dry place until plantation time. Proper storage is crucial to maintain seed viability and prevent damage from pests and diseases. Farmers usually store their seeds in airtight containers made of bamboo or clay.

Figure. 8. Seed storage

(a) Kubatshe (Beans)

(b) *Tutshehbe* (Job's tear)

(c) Karhu (Naga Dal)

(d) Rasutshe (Sponge gourd)

(e) Hamutshu (Pumpkin seed)

(f) *Mekrita* (Maize)

(g) Etsube (Millet)

(h) *Pocu* (Sesame seed)

(i) Keni (Perilla)

Source: Fieldwork (a-i)

Storage of harvested crops

Apart from their private barn, there were no other storage facility as such. Farmers traditionally store their harvested paddy in a big bamboo basket/container *Ebu*. The bamboo strips are intertwined to form this basket and the end product is slowly made, heated, and smoked in the fire for three to four days or more, depending on the strength of the basket. Other crops like maize and millet are kept hung on horizontal bamboo poles of the house and the kitchen. Crops like potato, pumpkin, yam, Nagadal are stored in the cornered places, which are relatively cooler. Chillies are kept after they are dried in the sun, and bamboo shoots are fermented by drying in the sun and boiling them in water. They are stored or preserved inside jars. Leafy vegetables are also dried and kept for future use. One of the unique storage systems is the way squash/ chow-chow is stored. At a particular point, the earth is dug down for a few feet or meters and the squash is stored in the dug hole by covering it with the soil again.

Figure 9: Storage system

(a) *Ebu* (Bamboo basket for storing paddy)

Source: Fieldwork at Enhulumi village

(b) *Mekrita* (Hung maize shoots in the store room)

Source: Fieldwork at Pholami village

Discussion

The twenty-first century faces the dual challenges of sustaining environmental quality while meeting the food production needs of a growing population. The Green Revolution has increased food production, but it has also led to significant environmental degradation, including water pollution, soil contamination, climate change, and biodiversity loss (Patel *et al.,* 2020). In the Indian agricultural context, the development and adoption of water-saving technologies are crucial to addressing the declining availability of water for irrigation (Subramanian *et al.,* 2008).

Nagaland's economy is predominantly agricultural, contributing significantly to the State's overall economy. The State holds substantial potential for organic farming, necessitating an urgent exploration and promotion of organic farming methods. Emphasising on productivity through research and development, crop protection measures, soil mapping, crop diversification, encouraging rural non-farm activities, reducing monsoon dependency, and ensuring crop insurance are vital strategies for sustainable agriculture in the region (The Morung Express, 2017).

Agriculture in the Chakhesang community faces risks from poor marketing channels and adaptability to extreme weather conditions, which climate change exacerbates. Issues such as unpreparedness, inadequate or improper storage facilities, and reliance on mono-cropping hinder agricultural resilience. While indigenous agricultural practices are adaptable to some environmental changes, their low productivity renders them vulnerable. The rapid changes in the natural environment, economic growth, cultural shift, technological advancement, and the ageing population of indigenous agricultural practitioners pose significant threats to indigenous agricultural practices in

the Chakhesang region.

The indigenous food production system needs help to sustain the rapid population growth. Climate change, soil degradation, and introducing small-scale commercial farming with modern technologies pose challenges for indigenous agricultural practices. Urbanisation contributes to this shift, as the younger generation seeks off-farm occupations for a more urbanised lifestyle, viewing farming as low-status occupation due to its labour-intensive nature and limited profitability. As they are venturing out of their villages for education, they tend to lose contact with the indigenous farming system. This generational shift leads to a disconnect from indigenous farming knowledge, transmitted orally, and now endangered by the ageing and passing away of older farmers.

Despite these challenges, Chakhesang Naga farmers continue to preserve their age-old practices. Integrating innovative techniques with traditional knowledge can enhance and restore the benefits of indigenous agriculture. By incorporating indigenous wisdom with modern agricultural methods, a process termed 'technology blending' (Ansari *et al.,* 2021), it may be possible to develop innovative technologies that enhance farm productivity and sustainability. Studies have demonstrated the advantages of adopting and converting to organic farming in Nagaland, aligning well with the principles of organic agriculture (Murry, 2019). Although farmers of the Chakhesang Naga have been historically engaged with traditional agriculture without external inputs, they are well-positioned to promote and sustain organic farming.

Conclusion

The Chakhesang Nagas rely extensively on traditional knowledge, employing locally available natural resources as a part of sustainable agriculture. No doubt, it paves the way for the region's shift to organic agricultural production without bringing significant shifts in the existing farming practices. Therefore, it is imperative to document and authenticate Indigenous Traditional Knowledge (ITK) before it is lost with time. ITK represents a crucial asset for indigenous tribal communities, underpinning their livelihood and enabling sustainable management and exploitation of local ecosystem. The preservation and application of indigenous agricultural practices will significantly benefit an agricultural community like the Chakesang by giving stress on developing sustainable and effective agrarian technologies in the region. Indigenous agricultural practices carry a long tradition in the Chakhesang community and are still widely used, sustaining agricultural activities among them, which may inspire other such communities to go for preserving the values of such practices.

Endnotes

[1] Kekhrowe Tsido, Male, Enhulumi Village

[2] Vesato Lohe, Male, Sakraba Village

[3] Vevo Sakhamo, Male, Porba Village

[4] Mejomu Tetseo. Male, Pfutsero

[5] Vivo Mero, Male, Chizami Village

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