



Identification and Documentation of Agricultural Indigenous Technical Knowledge among Yimkhiung Tribe, Nagaland, India

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HIGHLIGHTS

- Thirty-five indigenous technical knowledge practices were documented, with maximum practices in harvesting and post-harvest management.
- A total of 18 ITKs perceived effectiveness was measured, 17 were highly effective and one was rated effective.
- Traditional knowledge and craftsmanship are declining, highlighting the urgent need for documentation and youth involvement.

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ABSTRACT

Nagaland, inhabited by 17 major tribes, possesses rich agricultural knowledge, with each tribe maintaining distinct customs while sharing a deep connection to nature and biodiversity. All the tribes have been practicing traditional methods of agriculture. Thus, the study was conducted out in the year 2025 with the objective to identify and document the agricultural Indigenous Technical Knowledge (ITK) among the Yimkhiung tribe of Nagaland, India. The research was carried out in the Kiphire district covering Pungro and Khongsa blocks selected purposively, and three villages from each block were chosen randomly, namely Pungro, Old Vongti, Luthur, Longkheimvong, Khong, and Mimi, with a sample size of 120. Multistage random sampling method and descriptive research design were adopted. A total of 35 agricultural ITKs were identified and documented. Assessment of Effectiveness of 18 ITKs were also measured using PEI (Perceived Effectiveness Index). However, the preservation of ITK faces obstacles, including language barriers, ethical considerations, and resource limitations. Despite these challenges, documenting ITK is essential to safeguard this invaluable knowledge and facilitate its integration into contemporary practices. Through respectful collaboration, ITK can contribute to a more resilient, culturally rich, and sustainable future for Northeast India and beyond.

INTRODUCTION

Indigenous Technical Knowledge (ITK) are time tested knowledge and experiences of the people in dealing with situations and problems in varying aspects of life, and such knowledge and practices are special to a particular culture (Rai et al., 2019). ITK is a distinctive form of traditional, localized knowledge shaped by the specific circumstances of men and women indigenous to a given geographical area (Grenier, 1998). Measures such as documentation,

registration, innovation patent systems, and the creation of a sui generis framework are necessary to safeguard ITK (Rao, 2006).

Effective communication is essential for preserving, enhancing, and transmitting this wisdom. Over thousands of years, farmers have developed cost-effective methods that support national economic growth and sustainable agricultural development (Lenka & Satpathy, 2020). Over time, ethnic groups have created indigenous knowledge based on necessity, experimentation, curiosity,

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and observation in order to lessen the immediate situational issues (Talukdar et al., 2012). These eco-friendly and time-tested practices, passed down through generations, reflect deep respect for nature. Preserving them through awareness and documentation is vital before they are lost. Additionally, there are insufficient connections between indigenous knowledge and practices and contemporary technologies. ITKs contribute to agricultural goods free of pesticidal residues because they are environmentally friendly and even compatible with other management techniques (Boruah et al., 2020). By building a bridge between modern and traditional knowledge, better agriculture can be performed along with a clean, green and safe environment to live in and flourish in (Sindhu & Malik, 2020), similarly economic effect of the farmers' innovations in terms of changes in income, change in savings of stakeholders, change in capital owned and change in credit availability were observed (Nain et al., 2024).

In Nagaland main occupation is agriculture, and rice is the staple food. The Naga tribes possess a spectacular wealth of indigenous knowledge. Since time immemorial, farmers have been practicing traditional methods of agriculture (Nagi et al., 2023a). The locations of these different sites force the farmers to develop and adapt practices that suit the site's requirements. More than 73% of the state's total arable land is used for jhum farming (Vision, 2025) and has been blended into the tradition of hill's tribes (Priyadarshni et al., 2021). Development initiatives in the state should build on the traditional practices, many of which are celebrated through stories, songs, and harvest festivals. Preserving Nagaland's ITK requires systematic documentation from villages across the state. Indigenous farming methods, passed down orally and through practice, remain vital for sustaining the community (Roy et al., 2020). For decades Yimkhiung tribe in Kiphire district has been practicing ITK in their farming and which has sustained them through generations, but these methods are still largely undocumented and are often confined to the older generation. Thus, ITK is being gradually eroded and forgotten which poses a great loss to future generations. To address the lacunae, this study is undertaken to document the significance of indigenous knowledge for sustainable agriculture and its long-term practices.

METHODOLOGY

The study was conducted in the state of Nagaland, having 16 districts, of which Kiphire district was selected for the study because the main occupation in agriculture is 70 per cent (2011 census). The traditional practices of the local, Yimchungrü/Yimkhiung tribes are closely linked to sustainable forest management, traditional agriculture, and biodiversity conservation. The district, being relatively remote and less influenced by modernization, retains a higher degree of traditional practices, making it a suitable site for documenting authentic ITKs (Kiphire District Administration, 2025). There are 5 administrative blocks in Kiphire district. Out of these blocks, Pungro and Khongsa blocks were purposively selected for the present study, because majority of the Yimkhiung tribes reside in these two blocks, where they still practice traditional ways of cultivation. In this study a total of 120 farmers were randomly selected for the present study. To identify

and document the ITKs practices. Traditional knowledge-associated information was collected from the older generation with Prior Informed Consent (PIC) applying participatory tools such as focus group discussion, semi-structured interview method, observation and key informants' interviews.

Effectiveness or efficiency can be defined by the degree of relative usefulness of the ITKs as perceived by the farmers and measured by using the perceived effectiveness (PEI) methodology (Sundaramari, 2001) with slight modification. The index consisted of four attributes *viz.*, cost effective, easy availability/accessibility, observability and sustainability, which their relevancy weightage was calculated by using the formula given below:

$$R = \frac{\sum riwi}{w\sum ni}$$

Where, R is the relevancy weightage of selected ITK, w is maximum of point continuum, n is number of respondents, r is four attributes

The respondents were asked to rate each identified ITK practice based on the four attributes on a three-point continuum: "Agree", "Undecided" and "Disagree", which were assigned the scores "3", "2" and "1" respectively. It was unrealistic to assume that every respondent would have embraced every ITK listed in this study. However, even if the respondents thought it was effective, the least popular approach could not be considered effective. As a result, only selected 18 ITKs was assessed to measure their perceived effectiveness index (PEI). The Perceived Effectiveness Index (PEI) score of a particular ITK practice was calculated using the formula.

$$PEI = \frac{W1R1 + W2R2 + W3R3 + W4R4}{R1 + R2 + R3 + R4}$$

Where, R1, R2, R3 and R4 were relevancy weights of the four attributes and W1, W2, W3 and W4 were scores obtained for the attributes of ITK practice from each respondent.

The perception of the farmers who adopted the ITKs was expressed as mean perceived effectiveness index (MPEI). To obtain the Mean Perceived Effectiveness Index (MPEI) for a particular ITK, the mean score of PEIs obtained from all the respondents for a particular ITK was calculated. Based on the MPEI score, all the ITK practices were categorized into three categories and considering their individual total scores, the respondents were then categorized on the basis of mean (μ) and standard deviation (σ)

$$MPEI \text{ Score} = \frac{\text{MPEI score of Individual farmer for each ITK}}{\text{Total sample size}}$$

MPEI of 3 was regarded as the most effective while MPEI of 1 was regarded as ineffective. ITK with MPEI less than 2.0 were considered less effective. ITK with MPEI between 2-2.5 were considered as effective whereas MPEI of greater than were regarded as highly effective (Table 2). Highly effective ITKs are scientifically valid, strongly adopted and practiced and hence can be propagated without any doubt.

Table 1. Weightage scores of various attributes of ITK practice

Attributes	Relevancy weight
Cost effective	0.86
Easy availability/accessibility	0.90
Observability	0.93
Sustainability	0.96

Table 2. Distribution of selected ITK practices based on their perceived effectiveness

Category	Frequency	Percentage
Ineffective (1)	0	0
Less effective (<2)	0	0
Effective (2-2.5)	1	5.56
Highly effective (>2.5)	17	94.44
Most effective (3)	0	0
Total	18	100.00

RESULTS

Description of the documented ITKs

A total of 35 ITKS were identified and documented. The ITKs were documented and categorized under nine major agricultural practices, namely field preparation; seed selection; sowing operations; cropping pattern; plant protection; intercultural practices; harvesting and post-harvest management; weather forecasting; and livestock management.

Field preparation

A total of four ITKs were identified under field preparation, reflecting farmers' adaptation to local environmental conditions. In shaded areas (*Müzüing*), slashing is carried out during November and burning in February to allow sufficient drying of biomass, whereas in sunlit areas (*Kelim*), these operations are delayed to ensure effective burning. Traditional tools such as *Thuh* (hoe) and *Nuk* (machete) are widely used for land preparation. Additionally, terracing is practiced in jhum fields using logs and stones along slopes to prevent soil erosion and conserve moisture. Collection of debris and stubble using *Woyak* further facilitates land levelling and nutrient recycling.

Seed selection and storage

Five ITKs were documented under seed selection and storage. Farmers carefully select healthy and robust planting materials, particularly in paddy, which are sun-dried and stored in bamboo structures (*Tram*). Seeds of vegetable crops such as chilli, pumpkin, and cucumber are extracted, dried, and stored in bamboo or bottle gourd containers (*Keluh*) placed above fireplaces to prevent moisture and pest damage. Tubers such as yam are sorted based on size, with larger ones stored near fireplaces and smaller ones kept in bamboo baskets (*Mülök*) and storage houses (*Jakam*). In some cases, maize cobs are stored in earthen pots or hung near fireplaces to enhance shelf-life and prevent fungal infestation.

Sowing operations

Five ITKs related to sowing operations were identified, highlighting crop-specific and time-bound practices. Soybean is

cultivated during May–June to ensure better pod formation, while kholar (kidney beans) is grown twice a year for both consumption and commercial purposes. Crop-specific planting techniques, such as slanted planting of tapioca and vertical or whole planting of taro tubers depending on size, are followed to enhance growth and yield. Sowing is generally carried out using a traditional implement known as *Kejinglim Thuh*, which is simple and efficient.

Cropping pattern

Three ITKs were documented under cropping pattern, emphasizing both ecological indicators and mixed cropping systems. Farmers rely on natural indicators such as the budding of plants like *Thüvepün* (*Bauhinia variegata*) and *Yapmapün*, as well as the call of the hawk cuckoo (*Hierococcyx sparverioides*), to determine the appropriate time for sowing. Mixed cropping is widely practiced, with rice, maize, and yam grown together in jhum fields. Creepers such as cucumber and pumpkin are planted along field boundaries, while chilli and king chilli are grown within bunds. This spatial arrangement ensures efficient utilization of space, nutrients, and moisture, while minimizing competition among crops.

Plant protection

Four ITKs were identified under plant protection, primarily based on traditional and eco-friendly approaches. Scarecrows made from bamboo and cloth are used to deter birds, while a bamboo device (*Ke Kak Kak*) produces sound to repel animals and rodents. Manual handpicking of visible pests and disposing of them in water is also practiced to reduce infestation. Additionally, ash is applied in fields as a natural pesticide, reducing reliance on chemical inputs.

Intercultural practices

Only one ITK was documented under intercultural practices, which involves timely weeding operations. The first weeding is carried out in May using the traditional tool *Thuh*, while subsequent weeding is done manually or with the same tool as needed. This practice helps in reducing competition for nutrients and supports healthy crop growth.

Harvesting and post-harvest management

A total of ten ITKs were identified under harvesting and post-harvest management, making it the most prominent category. Harvesting is often done manually, such as pinching in millets to select healthy seeds, or using tools like *Woyi* (sickle) for paddy. Crops like soybean and kholar are processed through traditional threshing and winnowing using bamboo mats (*Phiak*) and winnowers (*Phürü*).

Post-harvest practices include sun drying and storage in bamboo structures (*Tram*) to reduce moisture and enhance shelf-life. Tubers are stored in traditional storage houses (*Jakam*) that allow proper aeration. Maize is initially stored in temporary field structures (*Manji Yam*) to ensure adequate drying before being transferred to permanent storage, thereby preventing spoilage. In some villages, crops are also stored in earthen pots for long-term preservation. Cultural festivals such as *Tsak ra nean* and *Tsüngkamneo* are associated with harvesting and reflect the socio-cultural significance of these practices.

Weather forecasting

One ITK related to weather forecasting was documented. Farmers predict weather conditions based on observation of the night sky; clear skies with visible stars indicate fair weather, while cloudy skies without stars suggest the likelihood of rainfall. This reflects traditional ecological knowledge developed over generations.

Livestock management

Two ITKs were identified under livestock management. Farmers feed pigs with a mixture of maize and pumpkin to promote growth and weight gain and also provide local herbs such as Tulsi or mint to treat illness. In poultry management, hanging empty bee nests inside chicken coops is believed to enhance population and egg production. These practices reflect locally adapted and culturally rooted livestock management systems.

Perceived effectiveness of the eighteen selected ITK practices with their MPEI scores

Out of the documented 35 ITKs, a total of 18 selected ITKs perceived effectiveness were measured. Based on the perception of the respondents, 17 practices were perceived as highly effective and 1 was perceived as effective (Table 3).

DISCUSSION

Indigenous Technical Knowledge (ITK) continues to play a significant role in agricultural production and natural resource management. It reflects farmers' long-standing interaction with their local environment and contributes to sustainable farming systems. The present findings indicate that ITKs are widely practiced in the study area, supporting earlier observations that indigenous knowledge enhances both agricultural productivity and environmental conservation (Adedipe et al., 2004; Muthee et al., 2019). The reliance

Table 3. Perceived effectiveness of the eighteen selected ITK with their MPEI scores

Description of ITK identified	MPEI Score	Remarks	Farmer's rationale behind the use of the ITK
Land preparation using the local tool <i>Thuh</i> .	2.76	Highly effective	Helps in cutting, turning soil, uprooting weeds, and preparing seedbed.
Traditional terracing using logs and stones after burning.	2.88	Highly effective	Prevents soil erosion and retains nutrients.
Debris and stubbles are further cut using traditional daos/machetes called <i>Nuk</i> and collected using a traditional rake called <i>Woyak</i> and burned.	2.84	Highly effective	Facilitates leveling, controls pests and weeds, and adds nutrients.
Healthy and robust looking paddy plants are selected, dried and stored separately in bamboo storage structure <i>Tram</i> for the next cropping season.	2.63	Highly effective	Ensures better yield, drying prevents pests and mold.
Healthy vegetable seeds are extracted, dried, and stored in bamboo/gourd containers above the fireplace for the next cropping season.	2.70	Highly effective	Ensures good yield and prevents spoilage.
Healthy yam tubers stored near fireplace and smaller ones are kept in bamboo basket <i>Mulok</i> and store in storage house <i>Jakam</i> .	2.80	Highly effective	Improves shelf-life.
Maize cobs, garlic, millets etc are tied together and hung near the fireplace.	2.83	Highly effective	Heat prevents mold damage.
Seeds and tubers/rhizomes are sown using a small local implement <i>Kejinglum Thuh</i> .	2.89	Highly effective	Easier and efficient sowing.
Taro (<i>Colocasia esculenta</i>) tubers are cut and planted vertically.	2.78	Highly effective	Enhances germination.
Mixed cropping: Rice, yam, maize planted on bunds. Creepers on sides and chilli in between the bund structure.	2.90	Highly effective	Reduces crop failure risk, ensures efficient space and nutrient use.
Weeding is done using a local tool called <i>Thuh</i> .	2.88	Highly effective	Removes regrowth and prevents competition.
Millets are harvested manually and kept in harvesting basket <i>khishang</i> or <i>khituh</i> .	2.80	Highly effective	Helps select best seeds.
Yam, ginger etc., are harvested using <i>Kejinglim Thuh</i> and put in the harvesting basket <i>Jimsah hah</i> .	2.66	Highly effective	Prevents sprouting and quality loss.
Soyabean and kholar are harvested and collected in bamboo mat <i>Phiak</i> which is beaten to collect the seeds. The seeds are collected and winnowed using <i>Phürü</i>	2.84	Highly effective	Separates grains and cleans produce.
Paddy is harvested with local sickle <i>Woyi</i> .	2.78	Highly effective	Saves time and effort.
The harvested paddy is collected and beaten with a stick. The beaten seeds are collected and winnowed using <i>Phürü</i>	2.89	Highly effective	Separates grains and cleans produce.
Harvested crops are sundried and stored in a bamboo basket <i>Tram</i> .	2.93	Highly effective	Reduces moisture and increases shelf-life.
Clear sky with stars indicates good weather	2.49	Effective	Traditional weather prediction method.

on ITKs despite the availability of agrochemicals suggests that these practices remain relevant due to their cost-effectiveness, ecological compatibility, and adaptability to local conditions

The study documents a total of 35 ITKs across different agricultural operations, with the highest concentration observed in harvesting and post-harvest management (10), followed by sowing operations (5) and seed selection (5). This trend indicates that farmers place greater emphasis on minimizing post-harvest losses and ensuring food security, which aligns with findings of Sarkar et al. (2022), who report the extensive use of ITKs in post-harvest handling and storage in the Northeastern Hill Region (NEHR). The relatively fewer ITKs identified in weather forecasting suggest either a gradual decline in traditional predictive practices or a shift towards more observable and immediate indicators, although such practices still reflect deep ecological knowledge.

The widespread use of practices such as logwood lining across slopes to prevent soil erosion demonstrates a strong alignment with sustainable land management principles. This finding corroborates earlier reports by Das et al. (2025), emphasizing the importance of such techniques in jhum agroecosystems of hilly regions. Traditional slope management practices effectively reduce soil erosion and enhance nutrient retention in shifting cultivation systems (Vliet et al., 2012). This indicates that ITKs are not merely traditional but are grounded in sound ecological principles. Similarly, the use of ash as a natural pesticide confirms the observations of Hakbiji (2002), indicating that farmers continue to adopt low-cost and environmentally safe pest management strategies. Livestock-related practices, such as feeding pigs with a mixture of maize and pumpkin for weight gain and the use of tulsi (*Azadirachta indica*) for medicinal purposes, also show consistency with previous findings (Singh et al., 2019; Vásquez et al., 2025). Indigenous pest management practices are recognized for reducing chemical dependency and preserving biodiversity (Isman, 2006). Another important observation is the reliance on ecological indicators such as plant phenology and bird behavior for decision-making in cropping operations which shows that traditional ecological knowledge (TEK) plays a critical role in climate adaptation and seasonal forecasting (Berkes et al., 2000; Speranza et al., 2010). Such practices demonstrate farmers' deep understanding of ecosystem dynamics, which remains relevant under changing climatic conditions.

The dependence on traditional tools and implements across agricultural operations further reflects the adaptability of ITKs to the geographical constraints of Nagaland. The mountainous terrain limits the use of modern machinery, thereby reinforcing the continued use of indigenous tools. This observation supports the findings of Singh and Devi (2020), who note that traditional implements remain integral to farming in hilly regions. Moreover, these tools are designed to minimize soil disturbance, thereby contributing to sustainable land use, which is also consistent with the observations of Dutta et al. (2025). Despite their effectiveness, the study also reveals a concerning trend regarding the gradual erosion of ITKs. The knowledge and skills associated with traditional tools and practices are primarily confined to older generations, with limited transmission to younger individuals. This finding is in agreement with Benjontoshi et al. (2023) and Nagi et al. (2023b), who highlight the risk of loss of indigenous knowledge

due to generational shifts and changing socio-economic conditions. The decline in knowledge transmission may lead to the disappearance of valuable practices unless appropriate measures are taken for their documentation and preservation.

Overall, the findings demonstrate that ITKs remain highly relevant in ensuring sustainable agricultural practices, particularly in ecologically fragile regions. At the same time, the observed decline in their transmission underscores the urgent need for systematic documentation, validation, and integration of ITKs with modern scientific approaches to ensure their continued relevance and application.

CONCLUSION

The study establishes that Indigenous Technical Knowledge remains an integral component of agricultural practices among the Yimkhiung tribe, contributing significantly to sustainability, resource conservation, and livelihood security. The identification and documentation of diverse ITKs across farming operations indicate their continued relevance and adaptability to local ecological conditions. The predominance of practices in harvesting and post-harvest management highlights farmers' emphasis on minimizing losses and ensuring food security. The findings affirm that ITKs serve as effective, low-cost, and environmentally compatible alternatives that complement modern agricultural approaches. However, the gradual erosion of such knowledge due to generational gaps underscores the need for systematic documentation, validation, and dissemination. Strengthening the integration of ITKs with scientific innovations and promoting their transmission among younger generations emerges as essential for achieving resilient and sustainable agricultural systems.

DECLARATIONS

Ethics approval and informed consent: All authors concur with the submission, and informed consent was sought and received from all respondents.

Conflict of interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. The author declares that they have thoroughly reviewed, revised, and edited the content as needed. The authors take full responsibility for the final content of this publication.

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