Indian Journal of Traditional Knowledge
Vol 20(4), October 2021, pp 1065-1074

Documenting the agriculture based indigenous traditional knowledge in Manipur State of North Eastern India

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Received 08 March 2020; revised 23 August 2021

The North Eastern Region (NER) is bestowed with unique ethnicity and rich biodiversity (flora and fauna) that are inherent to this region and inquisitive traditional practices. The region is a reservoir of indigenous knowledge and practices. NE agriculture has its own merit, demerit, diversity and heterogeneity which distinguish it from the agriculture of the rest part of the country. Indigenous knowledge's used in agriculture in various parts of Manipur state of NE India is still not fully explored explored. Given this background, a survey was carried out in 15 villages of Manipur for identification and documentation of different indigenous traditional knowledge (ITK) used in agriculture. Initially the detail information was collected from respondents and further validated. All total 15 numbers of ITKs were documented and validated by triangulation method. These includes seedling raising of crops (1), crop protection from birds (2), crop protection from insect-pest and diseases (10), soil management (1) and poultry farming (1). There is a great need to document and validate ITK before it vanishes with the passage of time. Hence, folk wisdom and modern scientific approach may be combined to achieve the "technology blending" for the evolution of new technology.

Keywords: Manipur, Traditional crop management, Traditional knowledge, Traditional pest management, Traditional soil management

IPC Code: Int Cl.[21]: A01G 22/00, A01P 17/00, A01G 13/10, B09C 1/00, C05G 3/80

The North Eastern Region (NER) comprises of eight states i.e., Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura. It spans 8.3% of the country's land area and has ~ 4% (45 million) country's population. It is also known for its natural beauty, diversity, ethnicity, rare and unique wildlife, people and culture. North East India is the home of different ethnic tribes. There are 145 tribal and ethnic communities of which 78 communities are large in nature each, with more than 5000 population. Manipur is a small but an important state of NER which share international boundary with Myanmar and falling under the Indo-Myanmar biodiversity hotspot region[1]. The agriculture in the state is primary source of livelihood and land characterized by altitudinal variations, rugged topography, wide variations in slopes, absence of land tenure systems and traditional cultivation practices. The ethnic farming community highly depends on enhancing the productivity with sustainable utilization of available natural resources. The acquired traditional knowledge of ethnic communities of Manipur are being used from generation to generation, which will help in crop, water and pest management for higher productivity without harmful effects of any chemicals. Traditional knowledge is a precious resource that can be passed down through generations. However, many of the useful indigenous traditional knowledge (ITK) has been lost over the time. Therefore, there is a need for documenting traditional knowledge which can act as foundation for creation of modern technology.

ITKs are giving the real information about a location specific population that reflects the experiences of generation to generation based on indigenous practices[2]. It serves as the framework for decision-making at the local level in crop management, soil management, pest and disease

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management, preparation of local cuisine, health care and other natural resource management (NRM) and a basis of different activities in tribal societies[3]. ITK is the unique and ethnic knowledge passed down through generations among rural people and created in response to the unique conditions of indigenous society in a certain geographic area. The North East of India is a gold mine of rich cultural, social and traditional knowledge, which is the region's most valuable resource. The different ethnic tribes who live in a specific location determine how the region's abundant natural resources are used[4]. Though, local residents have accumulated, developed, and transformed a vast reservoir of knowledge on the utilization of flora and fauna to meet the necessity and requirements of daily life over many years of living in the lap of nature. Agricultural ecosystem and farming practices in the NER are quite different from other parts of the country and have many unique features like *jhuming*. It has its own merit, demerit, diversity and complexities which distinguishes it from mainland agriculture of the country. Hence, agriculture in the NER is characterized as complex, diverse and risk prone[5]. To overcome such multifaceted challenges, the forefathers of present days invented and developed a variety of tactics and methods for growing food and ensuring food security. Farmers in this region, and specifically in Manipur state, have a long history of using a variety of ITKs that have been passed down from generation to generation.

The rapid rate of population growth cannot be sustained with the conventional food production system. Urbanization is rapidly catching up in the region and the younger generation is now looking for off-farm occupations in order to enjoy a more urbanized lifestyle than their forefathers. Therefore, it is critical to document and authenticate ITKs before they are lost to time. It would be a major loss for humanity if significant folk wisdom accumulated over the centuries was lost in this way. As a result, the current study was performed to collect data on Manipur's traditional crop, pest and soil management practices. So, indigenous wisdom and modern approach may be combined to achieve “technology blending” for the evolution of new technology.

Materials and Methods

Study area

Manipur, the study area, is located in India's north-eastern and shares an international border with Myanmar. Manipur is bordered on the east by Myanmar, on the north by Nagaland, on the west by Assam, and on the south by Mizoram. Manipur's recorded history dates back to 33 AD, according to the Cheitharol Kumbaba, the State Royal Chronicle. The state is located between the longitudes of 92°58'E and 94°45'E and the latitudes of 23° 50'N and 25° 42'N. The elevation ranges from 40 m (Jiribam) to 3114 m (Mount Iso) above sea level (msl)[6]. With its distinct physical character, Manipur has a steep landscape. The steep topography elongates and tapers towards the south, marked by solitary hillocks and surrounds a central valley. The hilly tract (9 districts) covers 90% of the overall geographical area of 22,327 sq. km, while the central valley covers the remaining 20% (6 districts)[6]. Farming and related activities employ over 80% of the state's entire population and they play a vital part in Manipur's social and economic life, which is projected to continue in the future. Low productivity, a broad food basket, rainfed farming, and traditional wisdom characterize Manipur agriculture. The gross cropped area of 3,55,620 ha, or around 15.92% of the state's total land area, supports the livelihoods of 5,55,234 households. Cultivated land covers around 10.46% of the state's total geographical area. The state has 28.56 lakhs population with sex ratio of 985 and a literacy rate of 76.94%[6]. It has an annual average rainfall of 1400 mm, with the most rain falling between May and September, with temperatures ranging from 0°C in the winter to 36°C in the summer. It ranges from tropical to subtropical to temperate mountain forests[6]. The state's most populous ethnic group is the Meitei, who live in the valley, while the hill areas are home to 29 ethnic tribes on a list that is dominated by Nagas and Kukis[7].

Methods

The research is based on a field survey that was done to gather data on traditional knowledge in 15 villages of 8 districts (Fig. 1 and Table 1) of Manipur with the objective to identify different ITKs used in agriculture. We have selected 15 respondents [Key Knowledge Holders (KKHs)] for each ITK. The KKHs included like farmers, village headmen/chief, village elders and local NGOs. We used a semi-directive interview style to organize group discussions (GDs) with the KKHs. The interviews were performed using an open-ended, discovery-oriented and semi-structured questionnaire, as well as free-flowing talks, in order to better understand and

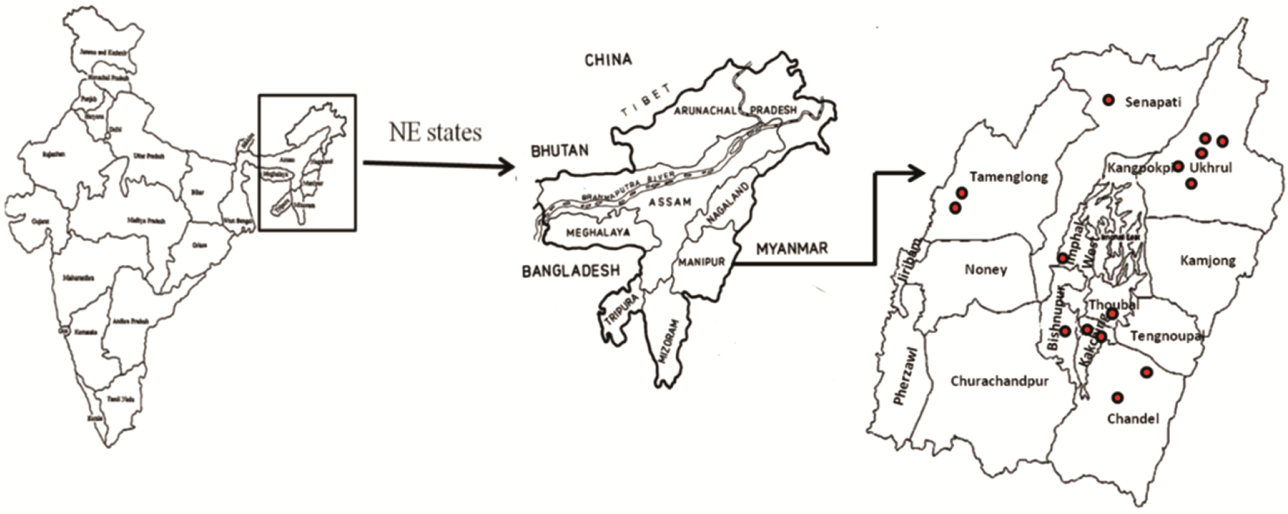

Fig. 1 — Manipur and its districts are shown on a map, with the study area highlighted by a circle (Courtesy: https://d-maps.com/)

Table 1 — List of indigenous traditional knowledge with respective locations and geographical coordinates

S. No.	Name of ITK	Location	Geographical Coordinates
1.	Pit nursery for raising seedlings in moisture scarce condition	Sihai Kahaophung, Ukhrul	25°16' N 94°46' E
2.	Maize protection from parakeets	Sihai Khullen village, Ukhrul	24° 38' N 94° 45' E
3.	Chinese mustard used as trap crop for insect in Cole crops	Sihai Khullen village, Ukhrul	24° 38' N 94° 45' E
4.	Use of *Artemisia parviflora* to protect from pest	Lungshang Village, Ukhrul	24° 09' N 94° 36' E
		Lamlang Village, Ukhrul	24° 09' N 94° 26' E
5.	Chasing away birds from crop by using plate hanging on the tip of bamboo stick and grazing on a bamboo mat (waphak)	Chandanpokpi village, Chandel	24° 32' N 93° 99' E
6.	Planting of bamboo near to the *Parkia* plant to protect from diseases and pests	Laikot village, Senapati	25° 27' N 94° 02' E
7.	Burn the dried leaves of *Goniothalamus sesquipedalis* (Leikham) and *Plectranthus ternifolius* (Khoiju) to protect pest in stored grain	Moirang, Bishnupur	24° 49' N 93° 78' E
8.	*Clerodendrum serratum* used for pest control in paddy field	Makha Leikai, Kakching	24°68' N 94°07' E
9.	Ducks rearing up to panicle initiation stage in paddy field for pest control	Ukhongshang village, Thoubal	24° 65' N 93° 99' E
		Sangaithel, Imphal West	24° 77' N 93° 92' E
10.	*Nishinda* twigs used for protection from rice hispa in paddy field	Mayai Leikai, Kakching	24°86' N 93°95' E
11.	Gundi bug management in paddy field	Sihai Khullen, Ukhrul	25° 38' N 94° 46' E
12.	Ash used for protection from powdery mildew and other sucking pest	Sihai Khullen, Ukhrul	25° 38' N 94° 46' E
		Lunghar Village, Ukhrul	25° 17' N 94° 43' E
13.	Management of rat menace by tribal farmers in Jhum areas	Tamei village, Tamenglong	24° 98' N 93° 49' E
14.	Used of wooden log to check soil losses and to form the bench trace in sloppy soils	Phunchong village, Chandel	24° 33' N 93° 99' E
		Haochong village, Tamenglong	24° 98' N 93° 50' E
		Sihai Khullen village, Ukhrul	24° 38' N 94° 45' E
15.	Rearing of poultry birds in mulberry plantation	Chandanpokpi village, Chandel	24° 32' N 93° 99' E

document the ITKs used in agriculture. A joint field study with chosen farmers and KKHs was also done to validate the documented material as well as the practical knowledge. During the field survey, photographs and specimens of ITKs were taken. More than 15 visits were made to the study locations for interacting with the KKHs. Photographs of each ITK were digitally captured and used together for confirmation and record. Using the method of enquiry during the study, all necessary features of traditional knowledge about folk practices used in agriculture and usage for each ITKs were documented.

Results and Discussion

Seedling raising

Pit nursery for raising seedlings in moisture scarce condition

This is practiced by tribal farmers of the Ukhrul district. Maintaining moisture in the nursery is

Fig. 2 — Pit nursery for raising seedlings in moisture scarce condition

important during seedling growth stage. Water is scarce especially during off monsoon season, so maintaining optimum soil moisture in root zone is difficult when the low relative humidity and availability of water is limited in the hill top. The soil moisture remains high in the lower soil profile than top soil profile. To raise a nursery a pit of depth of one meter was dug out and the top of the soil is spread in the bottom of the pit and at the top is cover with the colour polythene which allow a small amount of sunlight (Fig. 2). The nursery is raised in the bottom of the pit and moisture is applied, the wall of the pit also raises the humidity in the nursery area thus benefiting the nursery crop by reducing the water requirement and prevents evapotranspiration loss. Diffused medium light helps in faster growth of seedling. According to previous studies in Africa and Asia, traditional communities have created a range of local water collecting and management strategies that are still in use today[8].

Crop protection from birds

Maize protection from parakeets and other birds

Maize is the second most significant crop in the region. During grain filling stage birds especially, parrot damage is common in maize, its loss may extend up to 60-70 percent. The people of Sihai Khullen and nearby villages of Ukhrul district keep paper near the cob and stem area or wrap around the cob during the silking period (Fig. 3). This prevents the bird damage to almost nil. The key informer explained that the diverted with the paper and never damage the maize cob. It's worth noting that only 5 out of roughly 1000 bird species present in India (or 2.1%) have been observed to cause crop damage, where maize is the important crop damaged by parakeets and other birds in different parts of the India[9]. Many researchers

Fig. 3 — Paper near to maize cob at silking stage to protect from parrot and other birds

observed that the extent of losses from parakeets in India from 2.1 to 87.5%[10-14].

***Chasing away birds from crop by using plate hanging on the tip of bamboo stick and grazing on a bamboo mat* (*waphak*)**.

This is common practice in Chandanpokpi village of Chandel District. Farmers are using bamboo stick by connecting the plate and bamboo mat with rope. During the wind, bamboo mat and plate produce a sound (Fig. 4). Therefore, most of the bird's escaped from the crop field. Other authors also highlighted that the farmers cover the cobs with polythene or cloth, etc. to protect the crop (cob/panicle) from the birds and animals[15].

Crop protection from insect-pests and diseases

Use of Artemisia parviflora to protect from pest

Rice is major crop of Ukhrul district which are cultivated in the both wet terrace and *jhum* land. Stem borer and Gall midge are the major pests of wet land rice cultivation. During the off season both pests remains in the alternate host and attack during the maximum tillering stage of rice. Tangkhul community in Ukhrul district of Manipur uses *Artemisia parviflora*, a widely growing plant in Manipur, to

protect crops from insect pests in the field and storage. To prevent the insects, farmers of Phalang village, Ukhrul district incorporate the fresh leave/branches/ whole plants of *Artemisia* sp. in puddle soil or also put in and around the paddy field. They have randomly spread the *Artemisia parviflora* leaves after rice transplantation (Fig. 5). They are advocating that, this help in the avoiding laying of stem borer and gall midge egg in the rice plant and avoid pest infestation. In Ukhrul, the potato moth is a prominent store pest, so dried branches/leaves are combined with potato tuber seeds to prevent this pest. This efficiently eliminates storage insect pests and post-harvest diseases. In the valley areas, the leaves of *Artemisia nilagrica* are also used by the farmers belong to Meitei's community for protection against stored grain pests by mixing the leaves with the grains. To prevent the occurrence of numerous insect pests, fresh leaves, branches, or the entire plant of *A. nilagrica* is planted in and around rice fields. The major derivatives phenols, flavones, steroids, terpenes, tannins, and volatile oil are the principal compounds found in *Artemisia parviflora* extracts, all of which exhibit antibacterial and antioxidant activities[18].

Chinese mustard (Brassica juncea) used as trap crop for insect in Cole crops

Cole crops are one of the important crops grown in Manipur. Chinese mustard used as trap crop by tribal farmers of Sihai Khullen village of Ukhrul district. Ukhrul is a hilly place with temperate climatic condition and cabbage is grown throughout the year. To prevent the cabbage from pest infestation, Chinese mustard were planted in the inter row of the cabbage or as border crop (Fig. 6). The pest like cabbage web worm, mustard aphids, flea beetles etc. are attracted towards the Chinese mustard and later the Chinese mustards is uprooted and kept in the pit for killing of the pest. Thus, the cabbage crop escapes the pest damage. According to a study conducted in Andhra Pradesh, using Chinese cabbage as a trap crop reduced

Fig. 4 — Chasing away birds from crop by using plate hanging on the tip of bamboo stick and grazing on a bamboo mat (waphak)

Fig. 6 — Chinese mustard (*Brassica juncea*) used as trap crop for insect in cole crops

Fig. 5 — Use of *Artemisia parviflora* to protect from pest in rice field

head damage by 9.32% while increasing yields[16]. The crop preferences of *Plutella xylostella* have been used to define the possibility of utilizing Indian mustard as a trap crop in various research[17]. They conducted laboratory tests on cabbage (*Brassica oleracea* var. *capitata* L.), cauliflower (*Brassica oleracea* var. *botrytis* L.), broccoli (*Brassica oleracea* var. *italica* L.), Chinese cabbage (*Brassica pekinensis*) and Indian mustard (*Brassica juncea*) and found that Female moths preferred to oviposit on Indian mustard[18]. Similarly, Mohapatra *et al.* reported that *P. hydropiper* at 5%, showed better results in reduction of aphid population in cowpea[19].

Planting of bamboo near to the Parkia plant to protect from diseases and pests

Tree bean is important legume tree which has enormous potential to use in *jhum* improvement. The pods are used in local cuisine and fetch good profit to the farmers. Since last decade, tree bean plantations started dying across the state and its production has been seriously affected. The research work has been initiated; however, till date rejuvenation package has not been developed to save the plantation from decline[20]. Farmers used to produce tree bean plants with bamboo grooves to manage insect pests and diseases in tree beans. Farmers of Laikot village, Senapati district strongly believe that the plantation of tree bean along with bamboo maintain a healthy plantation and protect the plants from insect-pests and diseases (Fig. 7). The bamboo shoots have antibacterial and antiviral properties, as well as antioxidant properties due to the presence of phenolic compounds[21]. According to reports, carefully maintained bamboo plantations can change the structure and abundance of the fungal community, which is linked to soil organic carbon chemical form and soil quality[22].

Burning of dried leaves of Goniothalamus sesquipedalis (Leikham) and Plectranthus ternifolius (Khoiju) to protect pest in stored grain

Goniothalamus sesquipedalis and *Plectranthus ternifolius* used by the Manipur farmers to create smoke in storage to reduce the insect pests and diseases incidence. The fumigants in the smoke produced by burning dried leaves kills storage pest (Fig. 8). According to Bhattacharjee and Ray (2010), various plant leaves can be used to protect rice

Fig. 7 — Planting of bamboo near to the Parkia plant to protect from diseases and pests

Fig. 8 — Protect stored grain from pests, burn dried leaves of *Goniothalamus sesquipedalis* (Leikham) and *Plectranthus ternifolius* (Khoiju)

from storage pests like *Sitophilus oryzae*[23]. In Manipur, the rice weevil is a major storage pest that causes significant damage to rice grain. Bay leaf (*Cinnamomum tamala*), Heigri (*Dillenia indica*) and Neem (*Azadirachta indica*) are also used by the Meitei community to preserve stored rice grains against this insect. Rice moth (*Corcyra cephalonica*) causes significant damage to rice grain, hence people store rice seeds with *Polygonum hydropiper* leaves to prevent infestation[23].

Clerodendrum serratum used for pest control in paddy field

Another plant used by farmers in the state is *Clerodendrum serratum*. Some parts of *C. serratum*, or even the entire plant, is uprooted and promptly put on bunds as bird perches around paddy fields, providing support for birds to perch and hunt on caterpillars and adult insects, ensuring natural insect pest control. To defend against the rice gundhi bug, twigs of *C. viscosum* are scattered across the affected areas[23].

Ducks rearing in paddy field for pest control

Ducks rearing is a common practice in Manipur. Farmers released their ducklings at seedling stage to pre-panicle initiation stage in paddy field. Ducks in Manipur's valley areas found among rice plants and fields and feed/graze the insects, as well as floating rice case worms on the water hidden in their cases (Fig. 9). This type of insect-pest management complements the ecosystem's natural biological control mechanisms. In a finding of Mekong Delta, Vietnam study, it was reported that the duckling was allowed in the rice field (rice- duck integration) up to pre-flowering stage to control the insect-pests and weeds[24].

Nishinda twigs used for protection from rice hispa in paddy field

Nishinda (Chaste Tree) plant (*Vitex negundo* L.) is known as Urik shibi in Manipuri. Farmers used twig of the plant and used in rice fields to protect from rice hispa (*Dicladispa armigera*). The foul smell of the plant repels the pest[23].

Gundi bug management in paddy field

Rice gundhi bug is considered as a major pest of rice. The insects attack the plants during the milky stage of grain filling. Utongthangmei (Hollow bamboo torch) are commonly set in the four corners of rice fields and rags are burned to suppress this insect (fire used as trap to *Leptocorisa acuta*). Farmers also use rotten crabs to control the gundhi bug in their paddy fields, which significantly reduces the insect's prevalence. The stench of rotten crab attracts the bugs, and it is utilized to lure them into the trap. Chandra *et al*. 2017 reported that lures like fermented fish (*Puntius* spp.), dry fish and rotten crab, depending on their trapping potential and ease of availability, can be used for mass trapping of gundhi bugs[25].

Ash used for protection from powdery mildew and other sucking pest

Throughout history and across civilizations, ashes and various dusts have been used as pesticides[26]. Manipur farmers broadcast or spray ash on the vegetable crops to protect from the powdery mildew and other sucking pest. They observed that broadcasting of ash effectively reduces the disease incidence and prevents losses. Farmers also spray ash early in the morning, while the plants are still damp with dew, to control aphids and other sucking pests. The ash becomes wet after sticking to the dew-covered plant. It slightly alters the pH of the plant surface, altering the microclimate and making the environment uninhabitable for the insect pest. There have been instances of utilizing washed ashes to manage stored product beetles *Sitophilus granarius* (Linnaeus), *Cryptolestes jerrugineus* (Stephens), *Tribolium castaneum* (Herbst) and *Tenebrio molitor*

Fig. 9 — Ducks rearing in paddy field for pest control

(Linnaeus) larvae, as well as a blowfly species, *Calliphora vomitoria* (Linnaeus)[26].

Management of rat menace by tribal farmers in Jhum areas

Farmers manufacture baits out of flour or maida (200 g) and cement (500 g) and set them near the burrows to control rat dangers in crop areas. Rats die in a few hours after ingesting these baits due to choking in their digestive systems. The *Jhum* farming is a type of farming done by hill farmers in Manipur. *Jhum* land production is low and jhumias suffer a major difficulty during bamboo flowering, which is linked to starvation caused by a sudden increase in rat population. It thrives in Manipur's hills and valleys, where it grows lushly. In the area, there are about 29 species of bamboo. The majority of bamboo species flower and die once every 50 years, resulting in a rat population epidemic, which has a negative impact on shifting agriculture. The causal link between bamboo flowering, rat swarms and crop failure in shifting agriculture has been established[27]. The bamboo blossoming and subsequent fall of bamboo seeds provides abundant food for the rats, resulting in faster body growth and breeding, as well as an increase in rat population, migration to the adjoining *jhum* field, and significant crop destruction[28]. It causes rodents to destroy crops, resulting in starvation and social turmoil in the area. The relevance of traditional knowledge in combating the threat has been stressed by the elders of the villages, who have been closely observing shifting cultivation and have had past experience with the phenomenon more than once throughout their lives. They utilized a variety of techniques to keep rodents from causing too much harm. These methods entail the use of specific cultural tactics in *jhum* fields after bamboo flowering. Cutting bamboo from *Jhuming* areas is one approach. Only the bamboo groves are targeted for *jhum* cultivation during the bamboo flowering season, leaving the remaining forest space to recoup fertility and rejuvenate the forest. This method, to a considerable extent, prevents the bamboo from flowering and thereby reduces rat population and prevents crop loss caused by rats. When modern technologies find it difficult to manage the rate menace in the field level especially during bamboo flowering, farmers' traditional wisdom, at the very least, gives a plan for minimizing damage. Traditional wisdom has stood the test of time and continues to be relevant today.

Soil management

Used of wooden log to check soil losses and to form the bench trace in sloppy soils

Soil is an important resource in hill agriculture, to conserve soil loss from soil erosion bench terracing is a good practice. Famers of Ukhrul and Chandel (Phunchung village) form small size bench terrace with the help of wood log (Fig. 10). They first erect the post to hold the terrace and tie wooden log with the erected post and top soil is filled between the wood log and hill slope to make a flat surface. The crops are raised in the flat surface thus preventing the soil. After 3-4 year the soil will get stabilize permanently as bench terrace. According to Dey and Sarkar, 2011 tribal farmers in Jharkhand level their land sand build earthen bunds across the slopes, which they reinforce with locally available tough weeds and plants. The bunds have been found to be quite effective in terms of soil, nutrient, and water conservation[29]. In another study from Himachal Pradesh, it is reported that *Pinus wallichiana* (Pine tree or Kyle tree) leaf small bundles spread on the sloppy lands to check the runoff leading to soil erosion[30].

Fig. 10 — Used of wood log in Ukhrul and Chandel (Phunchung village) district in Jhum sloppy land

Fig. 11 — Rearing of poultry birds in mulberry plantation in Chandanpokpi village of Chandel District

Backyard poultry in mulberry plantation

Rearing of poultry birds in mulberry plantation

Mr. Kh. Samuel, Chandanpokpi village of Chandel district reared the birds in simple huts built of locally accessible products, such as pine wood, bamboo and mud. During day time, the birds were let free in open backyard bordered by mulberry trees (Fig. 11). The feeding trays and water containers were attached to the trees and moreover the trees also give shade to the birds. The primary source of food was broken rice, husk and mulberry fruits. The farmers informed that the he sold chicken for meat and particularly his chicken meat were in high demand in the local market. He assumed that the good taste might be due to the feeding of mulberry fruits to the birds.

Conclusion

Indigenous knowledge unless documented is set to be lost or forgotten. As a result, many indigenous knowledges that have proven to be productive in one society or community can be applied to a similar agro-ecosystem in another society or community. Hence, documentation of indigenous knowledge can help to compare and create a difference with international knowledge system. Through modern scientific technology, improvement of the beneficial aspect of the indigenous knowledge system could be made. So, indigenous wisdom and modern scientific approach may be combined as so called "technology blending" for the evolution or innovation and more effective technology. In spite of advancement of scientific knowledge in agriculture, the indigenous knowledge practices still remain in use by farming communities in resource poor remote areas, without scientific validation. Hence, it is very important to do scientific research to gain functional understanding of indigenous knowledge, which includes identification, collection and assessment (validation) of such indigenous technical knowledge. Only by doing so will the documentation and validation for protection of our ancient indigenous technical knowledge as a whole be assured.

Acknowledgement

The project National Mission on Sustaining the Himalayan Ecosystem – Task Force on Himalayan Agriculture is gratefully acknowledged by the authors (NMSHE-TF 6). We are grateful to the employees of the concerned ICAR-KVKs and project staff who assisted us in gathering essential information during our visits to several villages in Manipur. We are grateful to the key informants/knowledge holders for their consent for publication of ITKs along with photographs. We are also thankful to villagers who participated in the discussions with the authors and offered their traditional knowledge.

Conflict of Interest

There are no conflicts of interest declared by the authors.

Authors' Contributions

MAA: Conceptualization, Methodology, and Writing - original draft. SKS & SSR: Conceptualization, Formal analysis, Writing - review & editing. YR, SL & NAS:

carried out field survey and group discussion, SD: Formal analysis, Writing - review & editing, final editing. AN: Formal analysis, Writing - review & editing, NP: Supervision, Writing - original draft, provided physical support and helped in language improvement.

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