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Indigenous technical knowledge (ITK) used in agriculture by selected ethnic communities of Assam

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The role of Indigenous Technical Knowledge (ITK) in a range of sectors is being talked about. Over the years, people have tried to develop new farming techniques based on their experience and age old experiments for their farming operation. Assam consists of a large number of ethnic groups that have different ITKs relating to agricultural sector. The present study attempts to document the ITKs used by four major ethnic communities of Assam *viz*., *Ahom, Mishing*, *Deori*, and *Karbi*. Twenty respondents from each community were selected and data were collected by different Participatory Rural Appraisal tools from Sivsagar, Majuli and Karbi Anglong districts of Assam during 2020. Different ITKs such as, broadcasting goat's excreta on the standing crop of paddy to control hispa, dried leaves of 'Neem' kept with rice grains in for its insecticidal properties, etc were used in agriculture. Most of the identified indigenous practices were found to be of biological origin. The documented ITKs need to be scientifically validated to be recommended at the state level. The result of the study is expected to help in a technology blending programme for generation of low-cost, eco-friendly and location-specific technology by modifying already existing technologies. Further, the documented data might help in national-level data bank management on ITKs.

Keywords: *Ahom,* Assam, *Deori,* ITK, *Karbi*, *Mishing*

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Assam a state of North-eastern India is situated in the South of the Eastern Himalayas, along the valleys of river Brahmaputra and Barak with more than 70% people depending on agriculture. The state has more than 115 communities and has rich traditions. Every ethnic group of Assam has some individual cultural characteristics[1]. The farmers belonging to different ethnic diversity of the state have developed their own system of cultivation of various crops. All these practices developed by farmers along the course of time and have been passed on to the next generations are commonly known as Indigenous Technical Knowledge (ITK). Over the years, people have tried to develop new farming techniques based on their experience and age old experiments for their farming operations. This knowledge is based on many generations of insight gained through close interaction within the natural and physical micro-environments[2,3]. ITKs consist of technologies developed by farmers over decades of adjusting farming systems to local agroclimatic and social conditions[4]. ITK is a valuable asset to indigenous and local rural communities who depend on ITK for their livelihood as well as to manage and exploit their local ecosystem in a sustainable manner. Indigenous practices will be helpful in generation of technologies of greater benefit to the farming community. It has been observed that there is an instant need to document and preserve the ITKs of different communities, many of which are at the brink of extinction. The tribal farmers of Madhya Pradesh were reported to have rich traditional knowledge for treatment of malaria and other disease, however, this traditional knowledge is vulnerable due to the lack of interest by the younger generation[5]. As ITKs are verbally passed to the next generation, with the introduction of modern technologies, ITKs are somewhat diminishing with time, which leads to a need for collection, compilation and scientific evaluation of ITKs. Therefore, in this paper an attempt has been made to identify and document some of the ITKs followed by some selected major communities of Assam.

Methodology

The study was conducted in two agroclimatic zones *viz*., Upper Brahmaputra Valley Zone (UBVZ) and

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Hills Zone (HZ) out of six agroclimatic zones of Assam. Two districts (Sivsagar and Majuli) under UBVZ and one district under HZ (Karbi Anglong) were selected randomly (Fig. 1).

Four ethnic communities namely, *Ahom, Mishing, Deori* and *Karbi* were selected from these three districts randomly. Out of all the communities of the state, the reason behind selecting only four communities is that these communities' culture and livelihood is intimately connected with their surrounding and environment. People of these communities are deeply correlated with nature and major proportion of these communities population is engaged in agricultural and allied activities from generations. Also for the tribal communities like *Karbi*, *Deori* and *Mishing*, it has been observed that they majorly rely on natural sources instead of chemical-based products.

Currently, there are nearly 1.3 million *Ahom* people in Assam contributing to 35 million of the total population (2011 census). As per the 2011 Census of India, the population of *Mishings* in Assam is 6,80,424 which is 1.944% of the total population[6]. Nearly 43,750 *Deori*s are there in Assam as per the 2011 census[7]. With a population of around 4 lakhs 21 thousand as per the 2011 Census, the *Karbi*s constitute a large community in Assam. An equal

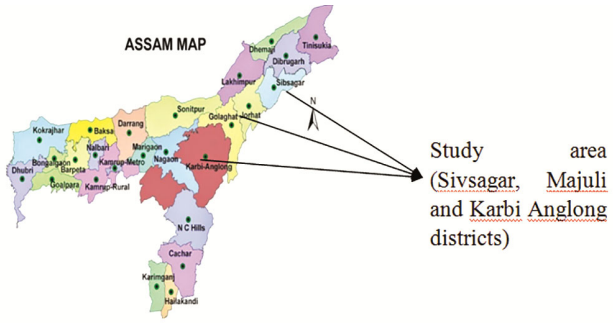

Fig. 1 — Study area

number of farmers (20 farmers) were selected for each community, randomly making a sample size of 80 respondents. Data for the study were collected by Participatory Rural Appraisal (PRA) techniques such as Focused Group Discussion (FGD) and Key Informant's Survey (KIS). Demographic data, types of ITKs used and rationale behind the use of these ITKs were collected and analysed. The results are mostly represented through tabular and percentage analysis along with pictorial presentation. The percentage of farmers practicing a particular ITK is calculated by simple percentage analysis as follows:

$$\text{Percentage of farmers} = \frac{\text{Number of farmers practicing a particular ITK}}{\text{Total number of farmers}} \times 100$$

The study period pertains to the year 2020.

Results and Discussion

Demographic profile

Table 1 represents the socioeconomic information of the selected respondents. It was found from the survey that the number of male respondents was higher than that of female respondents in all the communities except for the *Mishing* community. The average age of the both male and female respondents ranged between 38 years to 54 years. It has been recorded in the *Ahom* community that nearly 4% of males did not have any schooling, 84% had primary schooling and 12% had secondary schooling. For female respondents of the *Ahom* community, approximately 2% of them had no schooling, 85% possessed primary schooling and nearly 13% had secondary schooling. In case of the *Mishing* community, approximately 7% of males had no schooling, 84% had primary schooling and 13% had secondary schooling whereas in case of *Mishing* females 18 had no education, 60% had primary schooling and 22% had secondary schooling. For the

Table 1 — Socioeconomic characteristics of respondents

Community	No. of Respondents	Gender		Age (yr)	Education (%)			Farming as occupation (%)	
					NS	PS	SS	Primary occupation	Secondary occupation
Ahom	20	M	12	44.2	3.9	84.2	11.9	33.3	66.6
		F	8	38.3	1.8	85.0	13.2	75.0	25.0
Mishing	20	M	9	43.9	6.9	83.4	9.7	88.8	11.1
		F	11	45.6	18.0	60.0	22.0	81.8	18.1
Deori	20	M	18	42.5	4.1	85.5	10.4	83.3	16.6
		F	2	54.6	100.0	0.0	0.0	100.0	0.0
Karbi	20	M	16	41.2	16.0	73.0	11.0	68.8	31.3
		F	4	38.8	20.0	80.0	0.0	25.0	75.0

*NS, PS and SS refer to no schooling, primary schooling and secondary schooling

Deori community, nearly 4% of males had no schooling, 85% had primary schooling and 10% had secondary schooling but in case of females no one had primary or secondary education, 100% of them had no schooling. In the *Karbi* community, 16% of males had no schooling, 73% had primary schooling and 11% had secondary schooling whereas 20% females had no schooling and 80% had primary schooling. Among all the communities, the highest level of education for male respondents was reported to be in *Ahoms* (11.90%) and for females it was for *Mishings* (22%). For all the communities, agriculture was recorded to be the primary occupation for most of the respondents. (Fig. 2)

Common ITKs

Among various ITKs found in the study, some of them were found to be used by all the four communities in agriculture and related fields and are described below. The percentage of farmers using a particular ITK is given within the parentheses. Table 2 represents the common ITKs followed by the four selected communities. As rice (*Oryza sativa* L.) is the major crop of the state, most of the indigenous practices are related to rice crop, but other practices are also available related to horticultural crops, storage, poultry, etc.

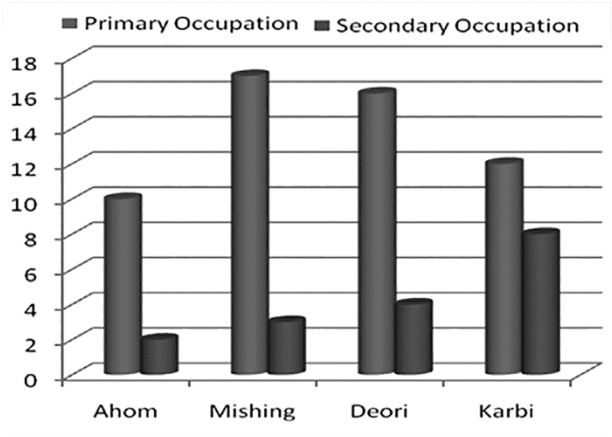

Fig. 2 — Agriculture as occupation of the respondents

Application of wood ash in vegetables to control major vegetable pest as repellent (98.7%, Fig. 3a): Farmers take enough amount of ash that can cover all the foliage of the crop. It is usually done when some symptoms of pest feeding on foliages appear. Ash forms a physical barrier between the plant and pest due to which the pest is unable to feed on the crop. Similarly, red pumpkin beetle can be managed effectively in cucurbits during initial crop stage, which is most susceptible as far as economic damage by this pest is concerned, with dusting of dung ash on the plants 3-4 times at weekly intervals starting from seedling stage[8].

Smoking in cucurbits to control fruit fly as a repellent (96% Fig. 3b): After fruiting in cucurbits, farmers apply smoke to the crop on every alternative day till the final harvest. Here smoke acts as a repellent to the fruit flies as they feel suffocated and uneasy due to smoke.

Straw wrapped around the tree trunks to control insects from crawling upward as a physical barrier for insects (43.7%, Fig. 3c): Farmers wrap straw around the trunk of tree in order to prevent the insects from crawling upward. This practice is also very common

Table 2 — Common ITKs followed by all the four communities

ITKs	Purpose	Remarks	Frequency of adopter farmers (%)
Use of dry neem (*Azadirachta indica*) leaves in storage structures	To protect grains from stored grain pest	Neem act as anti-feedant	100.0
Application of wood ash in vegetables	To control major vegetable pest	Acts as repellent	98.7
Cutting of tips of rice seedling before transplantation	To control stem borer	Prevents carrying of eggs to main field	97.5
Smoking in cucurbits	To control fruit fly	Acts as repellent to fruit fly	96.2
Lightning of diyas/lamp in rice flied at night	To control rice pest	The fire acts as attractant for Gandhi bugs	83.7
Application of chopped pieces of colocasia (*Colocasia esculenta*) in the rice field	To control case worm	Colocasia develops an anaerobic poisonous condition in rice microclimate	67.5
Application of bamboo T-perches in rice field	To control rice pest	Birds perch on the branches and acts as predators on insects	63.7
Keeping scarecrow in nursery as well as main field	To control bird pest	Frightens birds and prevents the birds from eating up the seeds	60.0
Hanging dead frog in rice field	To control rice Gandhi bugs	Acts as an attractant	60.0
Straw wrapped around the tree trunks	To control insects from crawling upward	Straw acts as physical barrier for insects	43.7

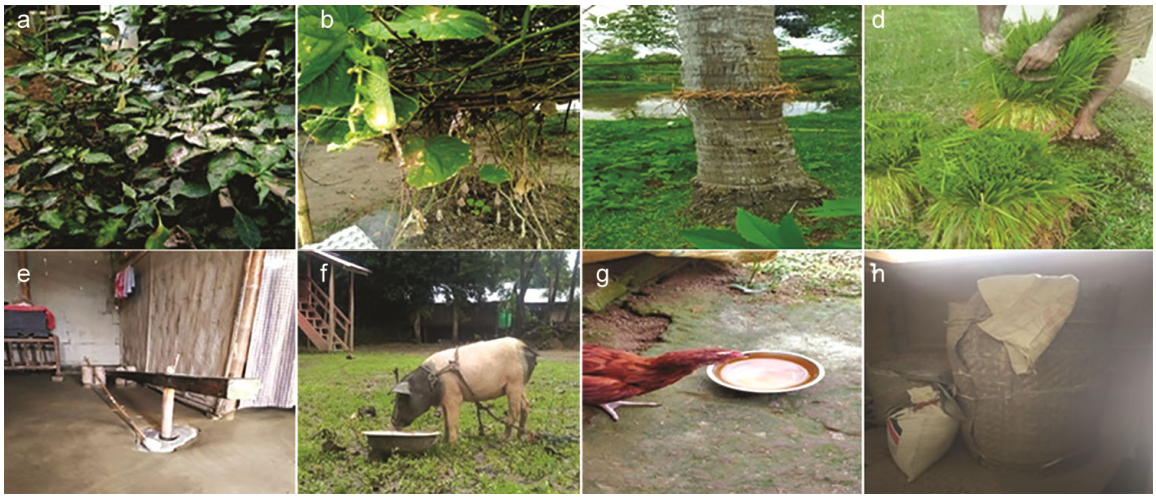

Fig. 3 — ITK's used by the farmers, (a) Application of wood ash, (b) Smoking in cucurbits, (c) Straw wrapped around the tree trunks, (d) Cutting of tips of rice seedling before transplantation, (e) *Dheki*, (f) Feeding Manimuni (C*entella asiatica*) paste to pigs, (g) Feeding turmeric water to poultry and (h) Sok Ankro.

in Japan and there these straw belts are known as komomaki or waramaki.

Cutting of tips of rice (*Oryza sativa*) seedling before transplantation as a plant protection measure towards stem borers (*Scirpophaga incertulas, Scirpophaga innotata, Scirpophaga inferens*) and hispa (*Dicladispa armigera*) (97.5% Fig. 3d): This practice is also scientifically accepted, it has been known that rice stem borer and hispa lay their eggs on the tips of leaves of rice seedlings, this practice helps to eradicate those eggs laid on the leaf tip from further spreading to the main field.

Use of dry neem (*Azadirachta indica*) leaves in storage structures to protect grains from stored grain pest as anti-feedant (100%). The most significant component of neem is azadirachtin, which has been proven to be an effective insecticidal ingredient. It works as an anti-feedant, repellent and repugnant in insects, causing sterility by blocking oviposition and stopping sperm production in males. Spraying the crop with manually prepared extract of old neem leaves gives admissible protection against aphids in the field. In this approach of aphid control, farmers manually collect the old neem leaves from the vicinity and obtain an extract through grinding of leaves with water in 2:1 ratio (leaves: water) and then the extract is filtered through the muslin cloth to obtain 100% leaf extract. On aphid initiation, the crop is sprayed with prepared 10% solution two times at 7-10 days intervals to manage its infestation[9]. Lightning of diyas/lamp in the rice field at night to control rice pest as fire acts as an attractant for gandhi bugs (*Leptocorisa acuta*) (83.7%): Insect pests are attracted to light at night, and when they get close enough to the light, they are killed by the heat. For one hectare of cropland, farmers set up 10 to 20 lamps.

Application of chopped pieces of colocasia (*Colocasia esculenta*) and fresh cow dung in the rice field to control pest like case worm (*Nymphula depunctalis*) as Colocasia develops an anaerobic poisonous condition in rice microclimate (67.5%): Farmers prepare cow dung slurry and then add chopped colocasia pieces to it, putting 7 to 8 buckets of this combination per acre of land.

Application of bamboo T-perches in rice field to control rice pests, here birds' acts as predators on insects (63.7%): Birds come to rest on these perches, and they can readily view and feast on insects from these perches, thereby this practice helping in reducing pest population.

Keeping scarecrow in nursery as well as in main field to frighten birds that prevents the birds from eating up the seeds (60%): Farmers set 4 to 5 number of scarecrow in a hectare of land, which is mainly made up of paddy straw, bamboo and mud pot etc. Scarecrows that are humanoid in appearance are typically dressed in old garments and placed in open fields to deter birds from disrupting and feasting on newly cast seed and growing crops. Scarecrows are a prominent emblem of farms and the countryside in popular culture, and they are utilised by farmers all over the world.

Hanging dead frog in rice field to control rice gandhi bugs as dead frog acts as an attractant (60%).

The odour of a dead frog attracts insects, particularly gandhi bugs, in paddy fields, and when the insects congregate around the dead frog, farmers catch and kill them.

These were some of the ITKs that were found to be used by all four communities. Raw cow dung mixed with water is sprayed in the rice field to control the thrips (*Thrips oryzae*) infestation[10].

Community-wise ITKs

It was observed during the survey that there were differences in ITKs used by different communities in the study area. Table 3 shows the ITKs that are specifically used by the *Ahom* community.

Use of *Dheki* an agricultural tool used for threshing: It also used to make rice powder from rice with this rice is dehulled by continually raising and then dropping the heavy head or pestle of the pounder into a block or mortar and electricity is not needed (80% Fig. 3e).

Applying a layer of cow dung in storage bin to control rice moth (*Corcyra cephalonica*) as cow dung covers the cracks and crevices of storage bin (100%): Farmers prepare a mixture using cow dung and soil, preferably red soil, in a 1:1 ratio, and then coat the bamboo storage structure with this paste, which kept even the tiniest storage pests out. When the plaster peels off over time, farmers re-plaster it with a new layer and it is ready for use.

Cutting the edge of the border of rice field to control rice pest which will reduce pest population by reducing alternate hosts (90%): Many pest insects make their home near the main crop on an alternate host. By preserving cleanliness and hygiene, these alternate hosts that were growing on the outskirts of the primary crops were destroyed, resulting in a decrease in pest population.

Broadcasting of goat excreta in rice field to control rice insect pest, here goat excreta acts as repellent (62%): Farmers have observed that applying 0.5 to 1 kg of goat excrement reduces the occurrence of insect pests. Some studies also demonstrate that goat excreta have a mycelial growth inhibitory function, which helps to prevent the spread of various fungal diseases. Goat dung and goat urine shows a mycelial growth inhibition but in lesser extent than cow urine and dung respectively[11].

Kerosene oil dipped rope running over standing crop in the rice field to control rice case worm (*Nymphula depunctalis*) as kerosene acts as toxicant (50%): Farmers dip the rope in a bucket full of kerosene oil in such a way that whole rope gets covered with kerosene and then dislodge the cases by passing a rope through the crop in one direction and manually collect the cases and destroy them.

Injection of kerosene/diesel in citrus stem to control trunk borer as these chemicals are toxic to the insects (35%): Oil-based products, regardless of their source or nature, have a similar method of action. Insecticidal oils kill insects by interrupting gas exchange (respiration), cell membrane function, or structure when they come into touch with them.

Placing long hair of women in the crown portion of coconut tree to control rhinoceros beetle as beetles engulfed with long hair due to which they cannot move (25%): Farmers believe that by putting long hair on the crown of a coconut tree, beetles get entangled and unable to move, and as a result of their inability to move for days, they die of starvation.

Table 3 — ITKs followed by the *Ahom* community of Assam

ITKs	Purpose	Remarks	Frequency of adopter farmers (%)
Applying a layer of cow dung in storage bin	To control rice moth	Cow dung covers the cracks and crevices of storage bin	100.0
Cutting the edge of the border of rice field	To control rice pest	Reduces pest population by reducing alternate hosts	90.0
Dheki	An agricultural tool used for threshing , also used to make rice powder from rice	Rice is dehulled by continually raising and then dropping the heavy head or pestle of the pounder into a block or mortar. No use of electricity.	80%
Broadcasting of goat excreta in rice field	To control insect pest	Acts as repellent	62.0
Kerosene oil dipped rope running over standing crop in the rice field	To control case worm	Kerosene acts as toxicant	50.0
Injection of kerosene/diesel in citrus stem	To control trunk borer	Acts as toxicant	35.0
Placing long hair of women in the crown portion of coconut tree	To control rhinoceros beetle	Beetles engulfed with long hair due to which they cannot move	25.0

These were some ITKs followed by the *Ahom* community of Assam.

Table 4 shows the ITKs that are specific to the *Mishing* community.

Feeding Manimuni (*Centella asiatica*) paste to pigs to prevent diseases because Manimuni has medicinal properties (90%, Fig. 3f): About 50-100 mL of plant extract in water is prepared and drenched orally twice daily for 5-7 days[12].

Feeding bark of Amora (*Spondias pinnata*) to pigs to prevent swine dysentery: It is effective as Amora has medicinal properties (80%), farmers used to make a paste of 2 to 4 inch long bark of the tree and mixed it with water and gave it to pigs once in a day till dysentery is cured. The English name of *Spondias pinnata* is wild mango or hog plum. Beta-amyrin, oleanolic acid, and amino acids like glycine, cystine, serine, alanine, and leucine are all found in the fruit, as well as polysaccharides. Lignoceric acid, 24-methylenecycloartanone, stigmast-4-en-3-one, beta-sitosterol, and its glucoside were all found in aerial portions, due to which it has many medicinal properties one of which is curing dysentery.

Feeding paste of Xilikha (*Termenalia chebula*) to pigs to prevent swine disease due to its medicinal properties (70%): Farmers make a paste of 5 to 6 fruits and mix it with the feed and feed it twice a day to pigs until they are cured. Antibacterial, antifungal, antiviral, antidiabetic, antimutagenic, antioxidant, antiulcer, and wound healing activities are all found in *Terminalia chebula*. It also protects the heart from injury and is used to treat renal problems. In traditional medicine, it is a moderate, safe, and effective laxative.

Fruits of Barun tree (*Crataeva nurvala*), a three-leaved caper tree) was fed to poultry to cure poultry diseases as Barun tree has medicinal properties (45%): Farmers used to prepare a paste out of 5 to 10 fruits, mix it with water, and feed it to poultry if they noticed any aberrant signs.

Crataeva nurvala (Buch-Hum) is a native herb that has long been used in South Asian traditional medicine to treat inflammation, rheumatic fever, gastrointestinal discomfort, and constipation: Mixing detergent solution with tobacco powder and spraying the mixture in vegetables to control vegetable pest as alkaline nature of tobacco (*Nicotiana tabacum*) acts as repellent (30%): Farmers take 10 g of detergent and 10 g of tobacco and mix it in 1 litre of water and fill it in a spray bottle and spray it to vegetable crops. Tobacco contains components that are harmful to insects, such as nicotine, phenolic compounds, and diterpene, particularly nicotine, which serves as a neurotoxin for most pest insects, animals, and birds.

Planting branches of Bhung (*Cannabis sativa*) in different places of the rice field to control gandhi bugs because Bhung act as toxicant against the insects (30%).

These were some ITKs followed by the *Mishing* community of Assam.

Companion planting or intercropping describes the sowing of two or more plant species in close proximity. This mimics the biodiversity of natural ecosystems, and enhances crop production via pest control and other mechanisms. Companion plants can be employed in an attract-and-kill (A&K) strategy-pests are lured to an attractant (usually a semiochemical and/or a visual cue), and then killed by a pesticide[13]. Several other classes of natural products are minor constituents of Cannabis, such as flavonoids (quercetin, apigenin, orientin, kaempferol, canniflavone, cannflavin), phenols (eugenol, cannabispiradienone), polyphenols (cannabispirone, canniprene, tannins), phytosterols (camesterol,

Table 4 — ITKs followed by the *Mishing* community of Assam

ITKs	Purpose	Remarks	Frequency of adopter farmers (%)
Feeding Manimuni (C*entella asiatica*) paste to pigs	To prevent diseases	Manimuni has medicinal properties	90
Feeding bark of Amora (*Spondias pinnata*) to pigs	To prevent swine dysentery	Amora has medicinal properties	80
Feeding paste of Xilikha (*Termenalia chebula*) to pigs	To prevent swine disease	Xilikha has medicinal properties	70
Fruits of Barun tree (*Crataeva nurvala*) (Three leaved caper tree) is fed to poultry	To cure poultry diseases	Barun tree has medicinal properties	45
Mixing detergent solution with tobacco powder and spraying the mixture in vegetables	To control vegetable pest	Alkaline nature of tobacco acts as repellent	30
Planting branches of Bhung (*Cannabis sativa*) in different places of the rice field	To control Gandhi bugs	Acts as toxicant	30

stigmasterol, β-sitosterol), amines (piperidine), lignanamides (cannabisin A-G), and fatty acids in seeds. Many of these compounds show insect repellency[14].

The ITKs that are specific to the *Deori* community are presented in Table 5 and are described below.

Feeding turmeric water to poultry in order to prevent poultry dysentery as turmeric have many medicinal properties (90%, Fig. 3g).

Application of goat and poultry excreta in rice field to control rice pest because goat and poultry excreta act as repellent (85%): Farmers take on an idea about 2 to 3 medium sized bucket of goat and poultry excreta and put it to a rice field of about 0.13 to 0.26 hectare of land. Goat excreta have insecticidal properties which was also seen for poultry excreta.

Beating empty drums in field to control bird pest: Here due to sound birds are frightened (80%).

Application of pumelo peel in rice field during vegetative stage to control rice pest as insects die when they come in contact with peeled rind of citrus, probably due to bitter, aromatic and pungent oil of pumelo repel insects (65%).

Application of milk in coconut tree trunk to control trunk borer by attracting ants that will feed on borers (30%): Farmers apply about a litre of milk to the coconut tree trunk which attracts ants and these ants are predators for trunk

Borers, which ultimately helps in eradicating borers.

These were some ITKs followed by the *Deori* community of Assam.

Use of pumelo peel and goat and poultry excreta in rice field to control rice pest[15].

Feeding of turmeric and mustard oil to dairy cattle was reported for control of gases derived from fermentation[16].

Among the recorded ITKs, the one particularly followed by the *Karbi* community is mentioned in Table 6 and described below.

Keeping grains in cylindrical structure made of bamboo called *Sok Ankro* and in its base *dhari* (bamboo mat) and banana leaves are put and then after filling it with grains dried neem leaves are put and then covered with banana leaves and then with a cover made of bamboo to prevent stored grain pest (85% Fig. 3h).

Table 5 — ITKs followed by the *Deori* community of Assam

ITKs	Purpose	Remarks	Frequency of adopter farmers (%)
Feeding turmeric water to poultry	To prevent poultry dysentery	Turmeric have medicinal properties	90
Application of goat and poultry excreta in rice field	To control rice pest	Acts as repellent	85
Beating empty drums in field	To control bird pest	Birds are frightened due to sound	80
Application of pumelo (*Citrus maxima*) peel in rice field during vegetative stage	To control rice pest	Insects dies when come in contact with peeled rind of citrus probably due to bitter, aromatic and pungent oil of pumelo repel insects	65
Application of milk in coconut tree trunk	To control trunk borer	Attracts ants that feed on borer	30

Table 6 — ITKs followed by the *Karbi* community of Assam

ITKs	Purpose	Remarks	Frequency of adopter farmers (%)
Putting Bamboo shoot randomly in rice field	To prevent damping off	Bamboo plant have some antibacterial properties which prevent damping off of rice	90
During summer covering pineapple fruits with dry tree leaves	To prevent sunscald	Layer of dry leaves provide shade to the fruits	85
Keeping grains in cylindrical structure made of bamboo called Sok Ankro with base dhari (bamboo mat). Banana leaves were put and then after filling it with grains dried neem leaves are put and then covered with banana leaves and then with cover made of bamboo	To prevent stored grain pest	Neem acts as anti-feedant	85
Sand cover over the stored potatoes	To control pest	Moth cannot lay eggs on potato due to sand	80
Feeding garlic water to poultry	To prevent poultry diseases	Garlic has medicinal properties	65
Feeding poultry rice mixed with lemon	To prevent poultry disease	Lemon has medicinal properties	60
Application of salt in coconut	To control trunk borer	Salt acts as repellent	45
Use of fish water in citrus	To control trunk borer	Fish water attracts predatory red ants	35

During summer, covering pineapple fruits with dry tree leaves to prevent sunscald, here layer of dry leaves provide shade to the fruits (90%).

Putting bamboo shoot randomly in rice field to prevent damping off because bamboo plants have some antibacterial properties which prevent damping off of rice (85%).

Sand cover over the stored potatoes to control pest as moth cannot lay eggs on potato due to sand (80%). Feeding garlic (*Allium sativum*) water to poultry to prevent poultry diseases as garlic has medicinal properties (65%): Farmers take 2 to 3 cloves of garlic and make paste of it and feed it directly to the poultry once a day till they are cured. Garlic is an aromatic herbaceous annual spice that has been used as traditional medicine from ancient times and is one of the oldest authenticated and most important herbs. Garlic plays important role to improve nutrient digestibility. Oxygenated sulphur compound, thio-2-propene-1-sulfinic acid and S-allyl ester available in garlic are antimicrobial, anti-inflammatory, anti-oxidant, immunostimulant and antiparasitic (organosulfur compounds -allicin)[17,18]. Garlic having multipurpose medicinal values can act as first aid for animal health in the scenario of high cost, side effects, drugs resistance and untimely availability of modern drugs. There is a need to popularise the validated medicinal use of garlic in veterinary ailment[19].

Feeding poultry rice mixed with lemon to prevent poultry disease due to medicinal properties of lemon (60%): Farmers mix some amount of lemon juice on an idea basis to rice and feed it to poultry once a day till they were cured. Lemons are high in vitamin C as well as flavonoids, which are antioxidants. Antioxidants aid in the removal of free radicals from the body, which can cause cell damage. These nutrients can aid in illness prevention as well as overall health and well-being.

Application of salt to coconut to control trunk borer as salt acts as repellent (45%): About 1 to 2 kg of salt is applied by the farmers at the base of coconut tree in a circle in order to control trunk borer. In many pesticide formulations, sodium chloride is a common inert component that has synergistic effects, promotes buffering and solubility, and functions as a diluent.

Use of fish water in citrus to control trunk borer as fish water attracts predatory red ants which will feed on borers (35%).

These were some ITKs followed by the *Karbi* community of Assam.

Tai Khamyang community of Assam uses leaves of non edible ferns (*Polygonum* sp.) to prevent insect attack on crops[20].

Conclusion

The study enlightened the important ITKs followed by the farmers of different selected communities of Assam. The identified ITKs also revealed that components of majority of indigenous practices were of biological origin. The documented ITKs serve as a ready reference for the agricultural scientists for further study for proper identification, documentation and scientific analysis of farmers' age old practices. The result will be helpful in technology blending programme for generation of low-cost, eco-friendly and location-specific technology by modifying already existing technologies for benefits of the farmers. The documented data might help in national-level data bank management on ITKs.

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Conflict of Interest

We hereby declare that we have no conflict of interest.

Authors' Contributions

NB: Carried out data collection, photography in UBVZ and HZ also prepared manuscript, draft paper of the study.

BSB: Carried out data collection in HZ.

ND: Perceived concepts, review, edits and prepare final manuscript.

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