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Identification of the indigenous pest control methods adopted in *jhum* fields of Mokukchung district, Nagaland

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The present study was conducted to document the various indigenous pest control methods in *jhum* fields in controlling pests. The data was collected from Mokokchung district taking 6 villages from a sample of 120 farmers practicing *jhum* cultivation. A total of 10 common adopted ITKs were documented, validated and triangulated. These includes seed preservation (1), crop protection from insect-pest and disease (7), crop protection from birds (1) and sowing time (1). A majority of the farmers (96.67%) perceived the indigenous pest control methods as effective in controlling the pests in the *jhum* fields. For the farmers in Mokukchung, *jhum* is a way of life and is to stay considering the socio-cultural institutions embedded with this practice along with the ITKs, their associated beliefs and perceived effectiveness.

Keywords: Documentation, Effectiveness, Indigenous pest control, *Jhum*, Nagaland

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Farmers have experimented and developed a variety of agricultural practises throughout history, from prehistoric agriculture to modern farming, to address the many challenges faced in farming operations. This understanding is founded on insights learned over many generations from direct contact with natural and physical micro-environments[1,2]. According to Talukdar[3], this type of knowledge is sometimes referred to as Indigenous Technical Knowledge (ITK) or Indigenous Knowledge System (IKS). Ethnic groups, in order to mitigate the immediate situational problems, have developed indigenous knowledge over time based on necessities, experimentation, curiosity and observation[3].

According to NRSC[4], *jhum* (shifting) cultivation, which includes both current jhum (53%) and abandoned jhum (47%) fields, occupies more than 84% (0.76 m ha) of the 0.94 m ha of land in India's Northeastern states. *Jhum* cultivation provides a stable source of income for about 0.44 million indigenous families[5]. The current *jhuming* area in Nagaland has increased from 1239.09 sq. km to 1514.95 sq. km[4]. These shifting cultivators are categorized as indigenous communities, government-organized colonists and spontaneous settlers or ranchers[6] who have been practicing indigenous methods pertaining to their belief on pest control.

Nagaland's traditional agriculture is a very complex system. In order to retain their way of life, farming families must simultaneously adopt and manage a variety of agricultural practises, primarily terraced rice cultivation (TRC), shifting agriculture, home gardens, and firewood reserve forests. The farmers are compelled by the placements of these various sites to adopt and modify practises that fit the site parameters. Shifting cultivation covers over 73% of the total arable area of the state[7]. The shifting cultivators' communities are embedded with unique and rich socio-cultural characteristics. Those involved in jhum cultivation still practice the ITKs as a measure for plant protection from pests and disease. Any idea, belief, or ritual has local knowledge exclusive to a particular culture or civilization[8]. This awareness has grown over time mostly as a result of the accumulation of experiences and in-depth knowledge of a particular culture's environment. Before the introduction of chemical pest control, indigenous pest management was practised. This knowledge-based management was inexpensive and site-specific. Farmers might effectively manage pests with those techniques without

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harming the environment. There are various types of pest infesting *jhum* fields but the farmers sometimes are not aware and do not know of them, but those pests which were known by the farmers as destructive were controlled by their indigenous methods. Common pests like birds, rodents and insect pests like grasshopper, gundhi bug were the major pests of destruction even in the field and in the storage structures. However, the indigenous methods are not well documented and are known only to the *jhuming* farmers themselves. Keeping this in mind, the present study aims to record the agricultural indigenous pest control methods, associated rituals, and beliefs related to agriculture practices and their perceived effectiveness by the *jhum* farmers of Nagaland.

Materials and Methods

The study was carried out purposively in Mokokchung district of Nagaland. It covers an area of 1,615 sq. Km. and is bounded by Assam to its North, Wokha district to its west, Tuensang district to its east and Zunheboto district to its south. Amongst the 11 districts, *jhum* farming is most dominant in this district wherein 60% of the farmers practice *jhuming* by preparing the land for cultivation through the slash and burn method (Fig. 1 & 2) covering an approximate 9630 ha of area[9] where paddy is the dominant crop in the *jhum* fields mixed with vegetables, cucurbits and root crop. The district is divided into six mountain ranges, out of which two ranges *Ongpangkong* and *Langpangkong* range were selected. Setsu, Longsa and Aliba villages from *Ongpangkong* range and Yongyimsen, Mongsenyimti, and Chuchuyimlang villages from *Langpangkong* were selected. Using simple random sampling, six villages with three villages from each range were selected for the study. Thus, upon prior consent from the farmers, a total of 120 respondents were selected taking 20 *jhum* farmers only from each village. A pre-tested open-ended interview schedulewas developed to collect the primary data.

Fig. 1 & 2 — *Jhum* fields being prepared for cultivation through slash and burn method in Mokukchung

While selecting the respondents for the interview, due consideration was given to those individuals who had rich traditional knowledge of that particular village. The ITK collected was documented and validated for effectiveness using focus group discussions with key informants of the villages. The effectiveness of the indigenous pest control methods was assessed based on the respondent's observation and perceived effectiveness of ITKs methods when applied in the management of insect pests using the methodology developed by Adesiji[10]. Secondary sources were used for the triangulation of the findings.

Results and Discussions

Common ITKs identified

A total of 10 common ITKs that are being practiced and followed by the *jhumias* were recorded. The details of each ITK are present in Table 1. Each sampled village practiced their own indigenous pest control methods. The use of *Pandanus purpurascens* Thouars (Wild leave) (Fig. 3) and *Dryopteris* spp. (Wild fern) (Fig. 4) was recorded from Setsu village

Fig. 3 —*Pandanus purpurascens* Thouars (Wild leave)

Fig. 4 — *Dryopteri* spp (Wild fern)

Table 1 — Indigenous Pest control methods used by the *jhum* farmers of Mokukchung

ITK used	Local Name	Scientific Name	Utility
Wild leave	*Metsulangetsu*	*Pandanus purpurascens* Thouars	A long slender leaf which when dried over fire resembles the shape of a snake. It is hung loosely around the field with the help of a thread and it mimics the movement of a snake when it is blown by the wind thus scaring away the birds from the *jhum* fields.
Crabs	*Tsungken*	*Nanhaipotamon macau*	For brown planthopper (*Nilaparvata lugens*): First crab is allowed to rot. It is then crushed and mixed with water and then filtered using a piece of cloth. The filtrate is then applied in the field to repel the insect. Reason being that the crab shells contain chitin which act as a natural bug repellent. For gundhi bug (*Lepto coryza* spp): Crabs are collected and hung in different parts of the field. When the crabs rot, *Lepto coryza* spp sit on the rotten crab instead of the rice plant. Similar findings were also made by Borkakati[12] wherein in it was reported that, smell of dead animals attracts gundhi bug towards it which can help to protect grains.
Wild fern	*Asang*	*Dryopteri* spp.	Wild ferns are crushed and mixed with water and the extracts are applied in the field. This was used to control any kind of insect pest. Presence of metabolites like terpenoids in wild ferns acts against insect. Sometimes wild ferns are laid over the rice grains in storage houses to control the rice grain moth.
Red chilli	*Mersu*	*Capsicum annuum*	Red chillies are used to control some insect pests like aphids in vegetables. First red chillies are crushed in a hollow bamboo with the help of small cylindrical wood and mixed with water. It is then filtered and the filtrate is applied in the infested areas. *Capsaicin* present in chilli has insect repellent property. Use of chilli extract as insecticide was also reported by Diamante[13].
Tobacco	*Moko*	*Nicotiana tabacum*	Tobacco is soaked in water overnight and the extract is sprayed in the field. Tobacco extracts are used in all the crops in the field like rice, maize, chilli, yam, etc to control any kind of insect pest. *Nicotine* present in the tobacco has insecticidal property.
ITK used			Utility
Wood ash			Ashes are used in vegetables to control insect pests. This is done by dusting the ash over the plants to control pests as well as to condition the soil. The microclimate is altered by the broadcasted ash, which also modifies the pH of the plant surface and renders the environment uninhabitable for the insect pest. Similar usage was reported by Ansari[14].
Sowing time according to lunar calendar			Sowing time is planned according to the lunar calendar for any kind of crops grown in the field. Sowing is always done three days after the full moon or before the full moon. If sowing is not done during the said time, it is reported that insect infestation was more, yield decreased and the fruit size formation was small. The seeds used for propagation are also taken from those crops which are grown after the full moon, as are reportedly found to be more productive. Zürcher[15] that the exact moon phase at the time of sowing has a significant impact on the entire vegetative cycle that follows, including germination, growth, flowering and fruiting. This function combines with the season of the year, which corresponds to the relationship between the earth and the sun.
Old batteries			Old batteries are used to control rodents by crushing the batteries into a fine powder and mixed with sticky rice and placed in different parts of the field. It served as poison bait for rodents.
Clearing of forest around the field			Clearing of forest around the field served as a control measure for rodents. This according to the farmers is the only effective control measure for rodents as such clean cultivation was very important. It also served as a buffer zone to control *jhum* fire.
Seed preservation			Seeds to be used for sowing in the next season are kept above the fireplace (*tsuktentak*) till the next season. The smoke from the fire prevents the seeds from insect attack as well as from rotting, however, germination rates were low in the seeds treated. Smoking of seeds for preservation was also reported by Mngoli[16].

Fig. 5 — Seed preservation above the fireplace (*tsuktentak*)

Fig. 6 — Decayed crabs (*Nanhaipotamon macau*)

And Mongsenyimti village to scare away birds in the *jhum* field. Tobacco and red chilli was recorded from Longsa village for controlling insect pests. For seed preservation, seeds to be used for sowing in the next season are kept above the fireplace (*tsuktentak*) (Fig. 5) till the next season to prevent the seeds from insect attack as well as from rotting. Decayed crabs (*Nanhaipotamon macau*) (Fig. 6) were used to control brown planthopper and gundhi bug in Yongyemsen and Mongsenyimti village. The farmers of these villages collected crabs and hung them in different parts of the field so that when the crabs rot, gundhi bug will sit on the rotten crab instead of the rice plant. Similar utility was reported by Bhattacharjee & Ray[11] in Barak Valley, Assam. Apart from these five particular methods, the rest of the indigenous pest control methods were found to be practiced in all the villages.

Table 2 — Perceived effectiveness of the indigenous pest control methods

Category	Frequency	Percentage
Effective	116	96.67
Not effective	4	3.33

Perceived effectiveness of the indigenous pest control methods

Table 2 showed that an overwhelming number (96.67%) of respondents indicated indigenous pest control methods in *jhum* fields as effective while just 3.33% indicated that the indigenous methods of controlling pests in *jhum* fields as not being effective. Many indigenous methods, deemed simple and superstitious over the years, have proven effective today[17]. Therefore, according to the *jhumias* of Mokokchung district the age-old indigenous pest control methods that they have been following and practicing to date are effective and they will continue to practice them because many of the ITKs are associated with their rituals and beliefs.

Conclusion

The ten various indigenous pest control techniques that have been reported from the research area show that indigenous pest management was practised prior to the introduction of chemical pest management. This knowledge-based management was inexpensive and site-specific. Farmers were able effectively manage pests to certain extent with those techniques without harming the environment. 96.67% of the respondents from the study perceived that the indigenous pest control methods documented were effective in managing the pests in *jhum* fields. But sadly, these uses of knowledge on indigenous pests control methods are being forgotten by the younger generation in the process of persuasion of modern education. The present study may trigger awareness and importance of this indigenous knowledge in our endeavor to achieve sustainable and environmentally friendly agricultural practice. The *jhum* system has cultural ties to traditional communities; as a result, researchers and developmental workers have no other choice than to improvement of *jhum* in order to motivate people to mitigate the ecological deterioration of the production system.

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Conflict of Interest

We, the authors declare that we have no known competing financial interests or personal relationships that could appear to influence the work reported in the paper.

Author's Contributions

The idea was conceived and conceptualized by BT along with KPB who validated the findings with HT. BT and KPB collected primary data, prepared the first draft and analysed the data. HT reviewed and edited the final paper.

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