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Agro-biodiversity management related ITKs in North-Eastern India

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Abstract

North eastern India is not only rich in biodiversity but also in agro- biodiversity of crops. Range of crops both cereals and non – cereals are cultivated in diverse habitats both in hills and plains. Rice being the staple food crops, hundreds of land races in itself makes the diversity of rice crops. Crops cultivated in the organic farming system are managed using unique indigenous technique/ traditional knowledge (ITKs) based methods by different farming communities in the region beginning from the sowing of seeds till the harvesting of crops. The diversity of ITKs that include ITKs for seed germination and sowing, ITKs for preparation of land and organic manures, ITKs for management of crops at different phenological stages of crops using unique agronomic practices, ITKs for post-harvest storages, ITKs for the control against pests and pathogens etc. Some of the ITKs being practiced by the traditional farmers may be considered as an important agricultural input for the sustainable management of crops in the organic farming system-a common practice in north east. Diversity of crops related ITKs for the management of crops in different parts of North-eastern region are enumerated together with the scientific rationales attached with the concerned ITK holder with emphasis on ITKs related to rice crops management are presented and discussed in this paper.

Keywords: Agro-biodiversity, ITKs (Indigenous technical knowledge), Organic farming system, Green revolution, scientific rationale

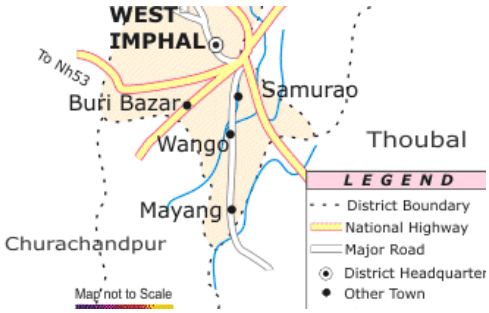
1. Introduction

Agro-biodiversity or agricultural biological diversity is a component of biodiversity that contributes to food and fodder in agricultural produce. Infact, it is a subset of natural biodiversity which includes the plant genetic resources including different cultivars, land races, ecotype, weedy races and wild relatives, etc. used for food production through agriculture (Negri *et al.* 2009). Agro-biodiversity has also been defined by FAO as the variety and variability of animals, plants and microbes that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries. The growing concern about the loss of agro- biodiversity in the last decade has fuelled global efforts to improve conservation action through a number of international documents including documentation of ITKs and agreements. The convention on biological diversity (1992) has made a significant contribution towards the current loss of plant and crop diversity through the recognition of traditional knowledge of indigenous people around the world for poverty reduction and sustainable development. Agro-biodiversity provides farmer and breeders with raw material for continuously selecting and adapting crops to location specific areas in changing environmental conditions to meet the need of ever growing human population (IPGRI, 1993). There is a strong connection between agro- biodiversity, indigenous people, culture and landscapes around the world. On the other hand, the introduction of high-yielding varieties of seeds after 1965 in India and the increased use of fertilizers and irrigation, which provided the increase in production, making the country self-sufficient in food grains, and thus improving agriculture in the region, are widely known. Negative impact of green revolution such as excessive and inappropriate use of fertilizers and pesticides has polluted waterways causing health hazards to agricultural workers, killed beneficial insects particularly the pollinators besides losing many indigenously practiced location diverse To cope of this adverse situation, indigenous people around the world have inherited a complex farming system in order to have a better adaptive farming system so as to get adapted to risk prone situation which enable them to manage the harsh situation, conserve the agro-ecosystem for sustainable agricultural production. This system is indeed sustainable and a matter of appreciation as it safeguards the traditional legacy of human interaction with nature in developing a sustainable agro-farming system. Although ethnic knowledge of the indigenous groups is at the verge of extinction due to modernity, yet it can be preserved and should be well studied by way of blending with scientific methods for sustainable agriculture, at least in the developing countries. The climatic conditions of North-East India are conducive for growing a wide range of crops, herbs, shrubs, vegetable crops, cereals, pulses, oil

yielding crops, including some of the important genetically diverse form of citrus, banana and rice cultivars some of which are endemic to Manipur that have been reported to be originated from this region (Anonymous, 1996) and are still in practice by indigenous people of this region. Manipur in particular is inhabited by many ethnic communities each having its own traditional knowledge of conserving and utilizing natural and domesticated plant resources. Rice being the staple food crop of the state, diversity of rice varieties including aromatic varieties is found cultivated by farming communities. Interestingly, management of rice against pests and pathogens are mostly controlled through their pedigree descended traditional knowledge. Significance of the traditional knowledge their evaluation and the scientific rationale attached with them are listed below.

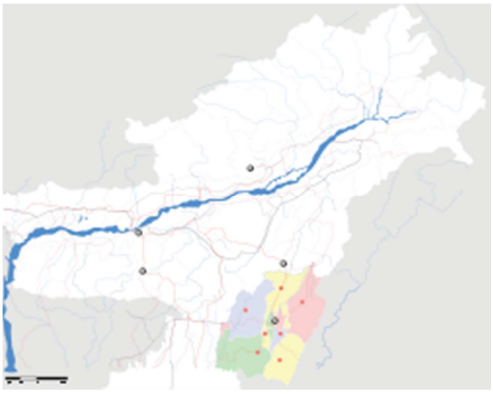
2 Methodology

Survey of agro-ecosystems to find out the diversity of crops and associated pest and pathogens with emphasis on rice crop was conducted specifically in three valley districts of Manipur viz., Imphal West, Thoubal and Bishnupur. The Thoubal district (fig.c) occupies the larger part of the eastern half of the Manipur Valley. The shape of the district is an irregular triangle with its base facing north. It lies between 23° 45' – 24° 45' North latitudes and 93° 45' – 94° 15' East longitudes. Its average elevation is about 790 m above the sea level. The district is dotted by a few hillocks and hills of low heights. The Imphal West district (Fig. a) lies between 24.300N to 25.00 N latitude and 93.450 E to 94.150 E longitudes. The climatic condition of the region is moderate with annual rainfall of 108.5 cm to 143.4 cm and the average temperature being 24.4C while Bishnupur district (Fig.b) covers an area of 530 Sq. Km., stretches between 93.43 °and 93.53 ° East Longitudes and between 24.18 ° and 24.44 ° North Latitudes. The three valley districts have been chosen due to their diversity in ethnicity and as they perform a unique cultivation practices which involves much of the ITKs and also the knowledge of these ethnic groups help in understanding the way local people view and specifies many issues regarding the cultivation practices of various crops. Moreover, the plain valley land at the periphery of the Loktak Lake is low lying and its major portion is inundated. Interviews with representative group of 30 progressive farmers both male and female of various ages from each villages of the districts were conducted based on pre-designed and semi- structured questionnaires format, focus group discussion (fig. d) and covered subjects pertaining to the diversity of crops, indigenous practices of cultivating these crops and their management using organic manures, locally available medicinal plants and other traditional cultural practices. The survey and data collection was done during the month of February to July, 2011. The data were analyzed and inferences were drawn using the descriptive statistics like percentage or frequency usage of the ITKs (Indigenous technical knowledge). Some of the ITKs being practiced by the traditional farmers have been explored for the management of certain crops with emphasis on wetland & dry land cultivated rice against pests and pathogens are presented and discussed:



(a) Location map of Imphal West District

(b) Location map of Bishnupur district



(c) Map of Manipur showing Thoubal district (represented by pink shaded region)

(d) Focus group discussion with the elderly

3. Results

3.1 ITK towards pest and pathogens management using various plants and their parts

Plant name: *Milletia pachycarpa*

Local name: *Ngamuyai*

The stem and roots of the plant (*Milletia pachycarpa* Benth.) is taken and cut into smaller segments and well ground to extract the liquid which is stored in earthen pot containing water for 2-3 days in order to get the plants sap dissolved in the water. It is effective against Case worm, Cut worm pest of rice when sprayed at the rate of 20% concentration

Rationale: The extract is very poisonous and ethnic people have been using this as fish bait, and as a control measure for various insect pest of rice

Plant name: *Albizzia amara*

Local name: *Kangol*

Leaves of *Albizzia amara* Roxb. is ground with addition of water until sufficient lather is obtained. It is sprinkled over the crops (rice) @ 20% concentration

Traditionally, it is said to be very effective in controlling pest (Case worm) and pathogens of rice.

Rationale:The extract is foul smelling and is said to be repellent towards pests.

Plant name:*Xanthium strumarium* L

Local name: *Hameng sampakpi*

The plant leaves of *Xanthium strumarium* L. is ground with addition of little quantity water. The liquid extract is bitter in taste. When sprayed (@1:10) over the crops, it is said to control Case worm effectively and blast and brown spot disease to some extent.

Rationale: The extract is very bitter in taste. The leaf extract has antimicrobial property.

Plant name: *Euphorbia antiquorum* L

Local name: *Tengnou*

The milky liquid of the whole plant of *Euphorbia antiquorum* L. is extracted by grinding and is diluted with water @ 1:10 and sprayed over the rice crops. They effectively kill the pests such as Case worm, Cut worm and many other pests like rodents etc. It is very effective in killing water borne pests. Each cut segments of the plant stem are also placed randomly in the well irrigated field so that the sap leaks out and thereby making the area unfavorable for the

survival of pests

Rationale: The extract is highly poisonous and was widely employed as fish poison/bait.

Plant name: *Vitex negundo* L., *Xylosmia longifolia* Clos.

Local name: *Urik sibi, Nongleishung*

Traditionally, the leaves of *Vitex negundo* L., *Xylosmia longifolia* Clos. were used for controlling various pests of rice. The plant leaves are boiled together and the solution is kept incubated at room temperature for 2-3 days. When the fermented liquid extract is sprayed over the crops, it controls Case worm, cut worm, leaf folders etc. Report says it controls blast and brown spot to some extent, when sprayed at 20% concentration.

Rationale: It liberates foul smell that repels the pests

Plant name: *Cedrela toona* Roxb

Local name: *Tairel*

The liquid extract of the leaves *Cedrela toona* Roxb. fermented with cow urine for ½ a month is used to sprinkle/spray the rice crops to control the pest like case worm, cut worm and blast of rice crops to some extent.

Rationale: Its foul smell has repelling properties.

Plant name: *Colocosia esculenta*

Local name: *Lamban*

The sliced petiole and leaves are spread in the paddy field and the leaked out sap repels the insect pest. Rationale: The rationale is that the sap of the plant cause irritation towards the pest and pathogens and helps to repel them.

Plant name: *Clerodendrum serratum* L.

Local name: *Moirangkhanambi*

The use of plant *Clerodendrum serratum* L.was widely in practiced in the interior of Manipur valley. The plants which mature in the month of June- July are very bitter in taste. The matured plants are placed randomly in the rice field. The birds perch on it, feeding on insects.

Rationale: When the plant withers and falls off, it not only adds to the fertility but also controls the pest of agricultural importance like stem borer, cut worm. It liberates foul, repelling smell when decomposed.

Plant name: *Jatropha curcas* L

Local name: *Awa kege*

The liquid extract of seeds of *Jatropha curcas* L. when used @20% concentration is very effective in controlling Case worm and other pest effectively.

Rationale: It acts as insect repellent

Plant name: *Neem (Azadrirachta indica)*

Extract of neem leaves when allowed to ferment with cow urine and pieces of copper for 15-20 days provides another control measures for blast and other pests of rice crops.

Rationale: The liquid has antimicrobial and repelling properties towards insect pests and copper being used in various antimicrobial preparations.

Plant name: *Adhatoda vasica* Nees., *Vitex negundo*, *Cedrela toona*, Neem (*Azadrirachta indica* A.Juss.) and *Xylosma longifolia* Clos

Use of mix solution of copper, *Adhatoda vasica* Nees., *Vitex negundo*, *Cedrela toona*, Neem (*Azadrirachta indica* A.Juss.) and *Xylosma longifolia* Clos. are still in practice in some of the remote areas of the Manipur valley. 250ml of this mixture is taken and are added in 15 litres of water and are kept overnight. This solution when sprayed

controls blast and some of the pest such as Case worm, cut worm, stem borer larvae.

Rationale: The liquid extract has antimicrobial properties and liberates foul smell, repelling the insect pests. Just 5.5% of the farmers in valley of Manipur practice this.

3.2 ITKS based on agronomic practices

Genetic resources management for future seed /pure bred.

Traditionally, seeds for future use are harvested and collected from healthy crops separately either before or after the general harvest, sun dried for few days , contaminants if any, are well separated and stored in a traditional granaries made up of domestic bamboo sealed with cow dung mixed mustard oil cakes or pond bottom mud. This traditional practice enables the stored seeds to remain free from stored or field microbes & pests at least for one year. This traditional method is specially followed for rice but the same may be equally hold good for other seed crops like *Vicia faba*,grams

Rationale: Scientific principle/rationale attached with the practice is that air tight sealing of granaries do not allow to harbor any biological entities over the least moisture content seeds. Further, cow dung mixed with oilcakes probably inhibits /repels the growth of pests and pathogens which deteriorates the seed quality. Although it is old and outdated, yet it is eco-friendly and sustainable practice followed by the Meitei community of Manipur valley. About 50% of marginal farmers who could not afford the modern chemical based pesticides & fungicides are in practice in the interior villages of Manipur valley

Summer plough for controlling soil -borne pest - pathogens of rice.

Traditionally, the ploughing of the agricultural field many a times and exposing the turned over soil to the scorching heat of sunlight was practiced. Summer ploughing of the field was done at least 3-4 times giving a gap of 10 to 15 days interval, especially for the cultivation of rice crops. Here, after the field is ploughed and properly tilt the rice grains are broadcasted, and then harrowed properly to cover the grain. No irrigation water was required, and the seeds germinate during the onset of rain.

Rational: This aged old practice of ploughing many a times and exposing it to the scorching heat of sunlight prior to sowing or transplanting kills the most of the pests like stem borers' larvae, rice weevil larvae, etc. This type of practice is quite sustainable and can be well adapted for the cultivation of various crops as it helps eliminate the major pests of cultivated crops. Indeed, this practice still continues for the small scale farmers of the valley.

ITKs for the management of weed-pest in rice field.

Weeding or the weed management in the agriculture land was traditionally being practiced. Various methods of weeding have been followed by the traditional farmers which were quite sustainable. The following management practices are being followed by the indigenous farmers in order to manage the weeds effectively in the field. This includes preparing and leveling the cropping area and surroundings. Preparation is done through ploughing, making of bunds and removing the roots of unwanted plants supposed to be weeds, Storing water for at least 7 to 10 days from planting and closer planting of the crop (rice) etc,. Also, in case of wetland cultivation, harrowing is in practice. Plain harrowing using the plain harrow presses the grown rice crop along with the weeds towards the ground. Another type of harrowing using Metla Guntaka with blades or the tooted harrow removes the weeds along with unhealthy and diseased leaves. Weeds are easier to be uprooted. Hand picking is also commonly practiced.

Rationale: Leveling off the field, removal of unwanted roots/seeds, storing water for fewer days etc. follow a specific scientific rationale like long term storage of water prevents the germination of weeds, thereby eliminating them, planting geometry of the crops like closer planting do not provide enough space for the growth of weeds. Indeed, these practices can be widely followed for other various crops of agriculture importance.

3.3 ITKS based on ecological and cultural practices

Practices of mulch cutting of rice crops for controlling of pests- pathogens and towards increasing soil fertility

Since generation, mulch cutting is practiced in the valleys of Manipur. The traditional farmers burn away the plant remains and then ploughed the field. The rationale is that burning not only kills the pests like stem borer and case worms' larvae and pathogens associated with the rice crops but also adds to the soil fertility by favoring the growth of beneficial organisms against the antagonists.

Role of irrigation water in controlling Case worm, other pests and pathogens.

The role of the traditional farmers of the valleys in controlling case worm of rice is indeed a matter of appreciation

and quite sustainable. The principle behind this is that, during the time of heavy infestation of case worm in rice field in wetland cultivation, the farmers would drained off the water from the field and kept it dried for few days.

Rationale: The rationale is that, wetland cultivation or water stagnant field is highly favorable for the case worm survival. 100% of the progressive farmers follow this unique, sustainable and eco- friendly practice as it is very effective. As case worm would reside in water during the day and harbors the crops at night, draining of the water would be appropriate, so as to eliminate the pests.

Ash of rice husks in controlling Aphids and also for healthy crop growth

The ash is applied to the aphids infested crops during the morning hours (morning dew). It controls aphids effectively. Also, the broadcasting of ash before sowing also helps in easy uprooting of the rice nurseries and resulting in healthy plant growth. *A*fter the rice fields are ploughed and are leveled using plain harrow, the ash is broadcasted over it and water is let in to a depth of nearly 1 inch. Then sowing of the rice grain is done. Unlike normal practices of sowing the grains, prior application of ash before sowing helps plantlets to be uprooted easily without any damages to the crops and results in healthy plant growth after transplantation. Infact, application of ash loosen the soil besides providing the fertility and healthy nursery growth. 100% of the marginal farmers follow this technique in the interior of the village in Manipur valley.

Rationale: The rationale is that ash possesses an alkaline property which kills the pests feeding on the crops. This is an aged old practice but quite sustainable

3.4 ITK based weather forecast in reducing pest and pathogens attack

3.4.1. It was a belief of the traditional farming communities that when the sun sets, and if there was appearance of a rainbow like structure in the sky (what is locally known as Dharma Ketu), rain is likely to fall in 3-4 days after. With this idea, the farmers arranged the working schedule like harvesting, drying, storage etc. to prevent possible contamination.

3.4.2. The buffaloes giving birth to a calf or the local plant Sougri- , *Hibiscus cannabinus* Linn. flowering at its terminals are indication of end of monsoon. With this knowledge some farmers begins the cultivation of crops like cauliflower, cabbage, etc., knowing that it is the right time for cultivation of various crops. Also, the rainfall in a season is predicted by the flowering pattern of the *Hibiscus cannabinus* plant. More flowering of the plants indicate that rainfall of the season will be good.

3.5 Organic manure based ITKs for the reduction of pests and pathogens

3.5.1. Application of partially decomposed cow dung

The use of decomposed cow dung, plant waste materials, other animals litter etc., in the agricultural land is an aged old practice. The partially decomposed cow dung is spread in the field and is ploughed many a times along with the soil. This practice not only increases the soil fertility, but also eliminates the harmful pathogens by favoring the growth and establishment of soil pathogens antagonistic microbes in the soil as the soil porosity increases. The system is organic and sustainable. Almost 63.8% of the marginal farmers depend on this. Although, most of the farmers preferred this type of practice, yet they could get the resource and had to depend on costly fertilizers.

3.5.2. Use of locally available plant- *Colocasia esculenta* (L.) Schott (Taro) in increasing the soil fertility many fold

The plants petioles are sliced into many segments and are spread over the field during the peak growing season of the crop or are incorporated at the time of land preparation as a green manure input. As the plant materials decayed and decomposed, it helps to increase the fertility of soil many fold. It also controls pests such as Case worm, Cut worm and other water borne pests and pathogens. It has repelling and irritating properties towards insect pest. This system of practice in incorporating the green plant material as organic manure is quite appreciable and sustainable. 31.6% of the progressive farmers practiced this method in the entire valley of Manipur.

3.5.3. Use of leaves of *Clerodendrum serratum* as an organic input

The plant *Clerodendrum serratum* (stem along with their leaves) is placed as bird perches in the field. When the plants withers and falls off, they add to the fertility of soil. As it is bitter in taste, covers some protection from pest and pathogens. Some farmers used it widely as a green manure input and also the plant is also ethno medicinally important.

3.6 Post harvest related ITKs

3.6.1. In earlier days, earthen pots were used to store the food grains. The pots are sealed with cow dung. This practice increases the shelf life of the food grains, free from pest or pathogens attack. It was mainly practiced for storing seeds of *Vicia faba* L. (Hawai amubi in local dialect). The rationale is that pots made of mud are resistant to pathogens attack.

3.6.2. The harvested corns are well dried, and are kept above the roof of the kitchen (traditional) and are exposed to the smokes, a process known as smoking. The smoke possesses many volatile chemicals which help in preserving the

corn. Not only this, even the chilies and other crops are also preserved this way. This practice is also quite sustainable as the chemicals in smoke not only adds to the flavor but also prevents the seeds from pests and pathogens attack.

3.6.3. Use of *Lantana indica* Roxb. leaves in storage of grains, potatoes etc,.

The potatoes are preserved by keeping them over the layers of shade dried leaves of *Lantana indica*. The leaves possess a typical smell that repels the pests and pathogens. It increases the shelf life of potatoes. It also has some medicinal values.

3.6.4. Use of leaves of *Zanthoxylum acanthopodium* DC.) in seasoning of chilies and also avoiding pest and pathogens

The harvested chilies are spread or kept layer wise above the shade dried leaves of *Zanthoxylum acanthopodium*. The leaves possess a strong pungent smell which acts as pest repellent. It also possesses antimicrobial activities. 34.4% of the marginal farmers in the valley of Manipur practiced this type of post harvest management of chillies.

3.7 Seed collection technique practiced by the valley farmers

Traditionally, it was practiced that prior to the harvesting of crops, site selection was the main criteria. Least contaminated area is selected through visual observation. After harvesting, the crops are well dried and the seeds are collected and stored in granaries. While in the case of rice crops, the harvested crops are collected in bundles and are well spread and dried for 3-5 days in the field itself. They are then thrashed with sticks and the fallen grains are collected. The grains to be collected for the recurring seasons are thrashed separately

3.8 Seed hardening technique for better rice grain germination and healthy crop growth

Seeds to be used for sowing are well dried and are well soaked in salt solution overnight. They are further shade dried half a day and are sown. In another way, seeds are well dried and kept in water for 2-3 days, and they are further shade dried for ½ a day to bring back to its original moisture content. Hardened seeds are then sown in the seed beds. The rationale is that the salt treated seeds are mostly freed of contamination as the microorganisms are osmotically intolerant to salt solution. This technique is widely being practiced by almost every marginal farmer in Manipur valley and quite sustainable technique.

3.9 Superstitious beliefs

In addition to the above ITKS and rationales prevailing in these valley districts, there are also some superstitious beliefs of the valley farmers of the region. Some of them are discussed below,

The indigenous group of the valley, both the Meitei and the Muslim community still follow the type of rice crop cultivation practices which are superstitious. Some of the special examples of controlling Case worm based on their superstitious beliefs are,

3.9.1. A practice of money lending in order to get some interest is against the Muslim community. Few names of the money lenders (belonging to Muslim community) are written on a piece of paper or placard and are placed at the corners of the field. It is said to control Case worm effectively.

3.9.2. Names of both the husband and wife (locally known as yek salai- of the same clan) are written on a piece of paper or placard and are placed at the four corners of the rice field. This method controls Case worm according to farmers' opinion. Although, the practice is of superstitious nature, they are widely practice by these ethnic communities.

4. Discussion

The diverse altitude and climatic condition of the Manipur makes it suitable for the cultivation of various groups of plant species. Documentation and conservation of various domesticated plant biodiversity is very important for their sustainable establishment and development as well. Survey and collection of various diverse forms of crops are essential pre-requisites for their conservation. All together 30 ITKs are in the list, all of which are based on management practices of various crops with main emphasis on rice crops against various pests and pathogens. Increasing soil fertility with addition of organic manure thereby creating an atmosphere for the establishment of aerobic group of organisms antagonist towards pathogens, water regime in controlling Caseworm, use of mixture of neem leaves extract and copper in controlling blast and brown spot diseases of rice, use of extract from *Xanthium strumarium* leaves in controlling water borne pests (case worm and cut worm) and pathogens, management of weeds through harrowing, hand picking etc., use of *Colocasia esculenta, Clerodendrum serratum* as a green manure input (Table 1) with 22.2% frequency of usage*, use of leaves of Lantana indica, Zanthoxylum acanthopodium* in repelling rice weevil during the post- harvest management of grains are the various indigenous practices of the progressive farmers in the valleys. In order to protect the various agricultural crops and their management against pests and pathogens of economic importances, the Valley farmers of Manipur have been exploiting the usage of various indigenous knowledge since time immemorial. As for example, the use of *Vitex negundo* leaves to control the rice

hispa, use of neem leaves as pest repellant (rice weevil) are well documented. Survey includes some of the major portion of which are mostly dealt with plant material and just a few miscellaneous. The frequency of use of *Milletia pachycarpa* is 10.5% among the studied communities (table 1), mostly by the Meiteis. Although, the knowledge is shared in all the communities regarding its powerful bio-pesticidal property, yet availability of resources limits its usage. The use of *Colocasia esculenta* as repellant (irritant) is common among the studied communities in the entire surveyed regions with 31.3% usage frequency (Table 1). Likewise, the use of *Euphorbia antiquorum* as pest repellant is common in the entire valley district (21%). The frequency of usage of mix extract solution of copper, *Azadrirachta indica*, *Vitex negundo*, *Cedrella toona,* and *xylosmia longifolia* is also practiced by the Meitei community of Bishnupur district (5.5%), though no other communities use this technique (Table 1). Also, the use of solution made from leaves of *Vitex negundo* and *Xylosmia longifolia* as pest repellant have been found to be practiced by the Meitei community of both Thoubal and Bishnupur, with frequency of 10% usage (Table 1). Flooding and draining of the rice field to control case worm and use of ash of rice husk to control aphids in vegetable crops are commonly practiced by all the communities of the region (100%). An analysis of the various findings stated above and also from the point of view of usage frequency (%) of various ITKs reveal that some of the ITks may be of immense importance with regards to management of various economically important pest of cultivated rice crops, post-harvest related pest, and also the importance of soil borne pest and pathogens being considered.

These views and practices of the farmers are quite unique, organic and sustainable. It clearly indicates that the management practices of the traditional progressive farmers are quite sustainable and indeed is a matter of appreciation and some of which like used of sliced petiole of *Colocasia esculenta, Clerodendrum serratum* as green manure input should be encouraged and importance to be given to their powerful pesticidal properties besides the role in increasing soil fertility. Similar findings and views are expressed by different authors working in the areas of traditional knowledge towards the management of pest and pathogens in traditional farming system (Thurston, 1992).

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Table 1. Frequency distribution of the usage of ITKs towards pests and pathogens management by the indigenous farmers of the valley of Manipur

ITKs (Indigenous technical knowledge)	Frequency of use (%)						
	Imphal West		Thoubal district		Bishnupur district		Total (n=180)
	Meitei community (n=30)	Muslim community (n=30)	Meitei community (n=30)	Muslim community (n=30)	Meitei community (n=30)	Muslim community (n=30)	
Milletia pachycarpa as pest repellant			13.3		50		10.5
Albizzia amara as pest repellant	10	6.6					2.7
Xanthium strumarium as pest and pathogen repellant					66.6	23.3	14.9
Euphorbia antiquorum as biopesticide		33.3	33.3	16.6	33.3	10	21
Mixture of *Vitex negungo* and *Xylosmia longifolia* as pest repellant			43.3		16.6		10
Cedrella toona as pest repellant	10		50			21	13.5
Colocasia esculenta as pest repellant	63.3	33.3	33.3	16.6	36.6	6.6	31.6
Clerodendrum serratum as pest repellant			50		60	23.3	22.2
Jatropa curcas as insect repellant			60		23.3	10	15.5
Azadrirachta indica as antimicrobial and pest repellant			23.3	1	30		10.5
Mix solution of copper, *Azadrirachta*, *Vitex, Cedrella toona* and *Xylosmia longifolia* as pest repellant					33.3		5.5
Intermittent irrigation in controlling case worm	100	100	100	100	100	100	100
Ash of rice husks as aphids repellant	100	100	100	100	100	100	100
Decomposed cow dung as biofertilizer	33.3	50	66.6	83.3	83.3	66.6	63.8
Colocasia esculenta as green manure	33.3	43.3			83.3		26.6
Clerodendrum serratum as organic input					66.6	33.3	16.6
Earthen pot as storage vessel					40		6.6
Lantana indica as storage pest repellant	40	33.3	33.3	26.6	33.3	50	36

Zanthoxylum acanthopodium as storage pest repellant	50	33.3	33.3	26.6	40	33.3	34.4

Figure 1. The Trend of Economic Development

Description for the above figure.

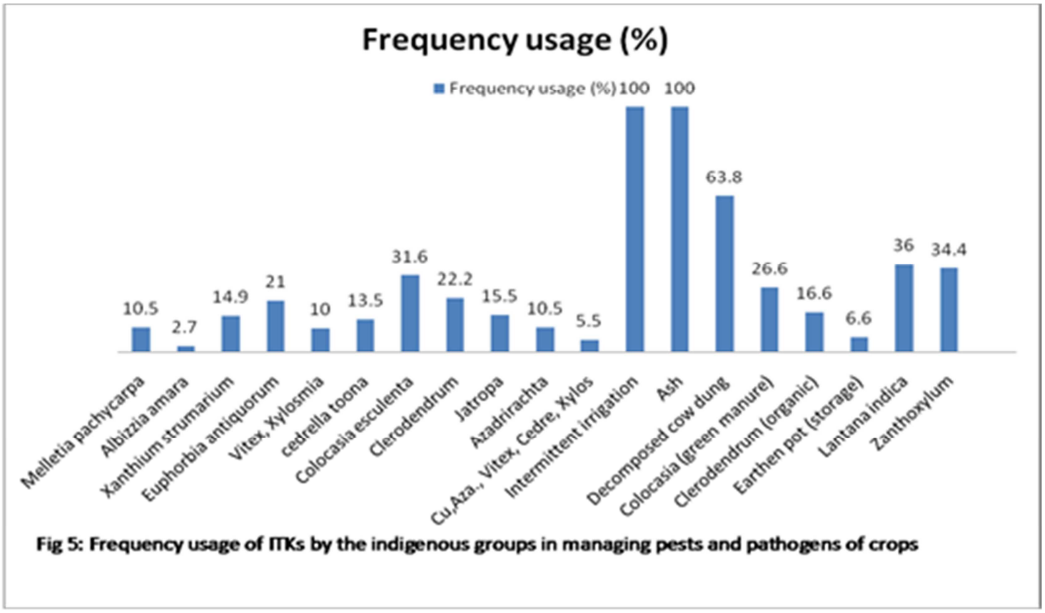

Fig 5: Frequency usage of ITKs by the indigenous groups in managing pests and pathogens of crops