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Indigenous technical knowledge in pest management

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Abstract
Since inception of human civilization man has been fully dependent upon nature for food, fibre and habitat. In the course of development, man learned to domesticate and cultivate plants. And thus, the plants became crops. On the other hand, terrestrial herbivorous insects also became dependent on plants for food and habitat. In this cross road of inter-specific competition, human has led to evolve several unique system of knowledge with regard to protection of their domesticated/cultivated plants. For centuries, humans planned agricultural production and conserved natural resources with the instruments of indigenous technical knowledge (ITK). The development of indigenous knowledge (IK) systems is cumulative, representing generations of experience, careful observations, trial and error experiments. The people have evolved ecologically sound technologies to deal with issues related to agro-ecosystem management. Most of these indigenous technologies and practices are at par with modern technologies and have provided the desired results. ITK is stored in people's memories and activities and are expressed in stories, songs, folklore, proverbs, dances, myths, cultural values, beliefs, rituals, community laws, local languages, agricultural practices, equipments, materials, plant species and animal breeds etc. An attempt has been made to review the ITKs prevalent at different parts of the country; and such technologies adopted and practiced by different communities, many of which may be on brink of extinction. Most of these indigenous technologies and practices are validated and documented: still a vital link between the indigenous practices and modern technical knowhow is missing; most often there exist serious issues related to intellectual property rights.

Keywords: Indigenous, knowledge, technological, practices, cow dung, cow urine

Introduction
From time immemorial, the peoples with their own cultural experiences, religious beliefs had adopted numerous plant protection practices to protect their crops from different kind of insect pest menaces. Knowingly or unknowingly, they utilized indigenous practices involving various plant species having insecticidal properties available locally, other naturally available waste produces and techniques adoptable with cultivation practices. This knowledge is dynamic and is continuously influenced by internal creativity and experimentation as well as by contact with external systems. These traditional treasures of knowledge have been passed on from generation to generation without being documented [1]. However, in this technologically developed modern era, some of these ITKs have already been documented, tested and even recommended for sustainability and profitability for future agriculture.

The age-old ITKs can have a pivotal role in lowering toxic chemical load on the agricultural produce, stabilization of agro-ecosystem as well as lessening the cost of cultivation leading to remunerative crop cultivation. In every ethnic group of people all over the world these in-built knowledge base is found in every sphere of life including agriculture. A good number of these have also been documented and analyzed as well as refined by [2]. The indigenous technical knowhow is a dynamic system, ever charming, adopting and adjusting to the local situations and has close links with the culture, civilization and religious practices of the communities [3]. These technologies are of low cost, easily available and above all eco-friendly. Successful inclusion of these ITKs in present day Integrated Pest Management (IPM) strategy may change the crop production scenario in the agro-ecological region under consideration including lowering down the cost of production and increasing net returns.

Indigenous technical knowledge (ITK) is specifically concerned with actual application of the thinking of local people in various operations of agriculture and allied areas; whereas Indigenous knowledge system (IKS) delineates a cognitive structure in which theories and perceptions of nature and culture are conceptualized.

Thus, it includes definitions, classification and concepts of the physical, natural, social, economic and ideational environments. The dynamics of IKS takes place on two different levels, the connective and empirical. On the empirical level IKS are visible in institutions, artifacts and technologies.

Different workers have precisely defined Indigenous Knowledge as indigenous innovation, farmer's innovation, grass root innovation, local knowledge, traditional technology or indigenous technology etc [4]; whereas [5] defined indigenous agriculture as local agriculture and agriculture system that has developed over a period of time with cropping pattern and status of pest based on agriculture knowledge system; though in 1991, Warren again defined it as a local knowledge that is unique to a given culture or society. Similarly, [6] opined it as indigenous knowledge which is not confined to tribal group or original inhabitants of an area; it is not confined to rural people, rather any community possessing indigenous knowledge- rural or urban, settled or nomadic, original inhabitants or emigrants. Though, IK contrasts with the international knowledge system generated by the universities, research institutions and private firms. It is the basis for local level decisions making in agriculture, health care, food preparations, education, natural-resource management and a host of other activities in rural communities.

Need for indigenous knowledge: In the emerging global knowledge economy, a country's ability to build and mobilize knowledge capital is equally essential for sustainable development as the availability of physical and financial capital [7]. The basic component of any country's knowledge system is its indigenousness. It encompasses the skills, experiences and insights of people, applied to maintain or improve their livelihood. Significant contributions to global knowledge have originated from indigenous people, for instance in human and veterinary medicine with their intimate understanding of their environments. Indigenous knowledge is developed and adapted continuously to gradually changing environments and passed down from generations to generations and closely interwoven with people's cultural values. It is also the social capital of the poor, their main asset to invest in the struggle for survival, to produce food, to provide for shelter or to achieve control of their own lives.

How traditional knowledge (TK) differs from modern knowledge

Primarily traditional knowledge differs from modern knowledge in the manner of creation i.e traditional knowledge is normally empirically validated, whereas, modern knowledge has been validated in laboratory and traditional knowledge in laboratory of life.

Table 1: Difference between traditional knowledge (TK) and scientific knowledge

Traditional knowledge	Scientific knowledge
• Knowledge is transmitted largely through oral media.	Knowledge is transmitted largely through the written word.
• Knowledge is holistic, intuitive, qualitative and practical	Knowledge is essentially reductionist, quantitative, analytic and theoretical.
• Knowledge is developed and acquired through observation and practical experience.	Knowledge is generally earned in a situation, which is remote from its applied context.
• Knowledge is generated by resource user in long term time scale.	Knowledge is generated largely by specialist researcher on short term time scale.
• The nature and status of particular knowledge is influenced by spiritual beliefs and communally held.	The nature and status of knowledge is influenced by peer review and held by individual specialist.

Characteristics of ITK

- ITK is not static but dynamic.
- Exogenous knowledge and endogenous creativity brings change to ITK.
- ITK is intuitive in its mode of thinking.
- ITK is mainly qualitative in nature.
- ITK study needs a holistic approach.
- ITK, if properly tapped, can provide valuable insights into resource, processes, possibilities and problems in particular area.
- ITK is recorded and transferred through oral tradition.
- ITK is learned through observation and hand-on experience.
- ITK reflects local tradition.

Special features of ITK: World Bank (1998) emphasized the special features of indigenous knowledge as

- **Local*:*** ITK is local that is, it is rooted in a particular community and situated with broader cultural traditions; it is set of experiences generated by people living in those communities, separating the technical from the non-technical, the rational from non-rational could be problematic. Therefore, when transferred to other places, there is a potential risk of dislocating indigenous knowledge.
- **Tacit*:*** tacit knowledge and therefore, not easily modifiable.
- **Transmitted:** ITK is orally transmitted or through imitation and demonstration. Codifying it may lead to the loss of some of its properties.
- **Experimental rather than theoretical knowledge:** experience and trial and error, tested in the rigorous laboratory for survival of local communities constantly reinforce indigenous knowledge.
- **Learned through repetition:** which is defining characteristic of tradition even when new knowledge is added. Repetition aids is the retention and reinforcement of indigenous knowledge.
- **Constantly changing:** ITK is constantly changing being produced as well as reproduced, discovered as well as lost; though it is often perceived by external observer as being somewhat static.

Indigenous Technical Knowledge in pest management

The use of non-chemicals methods for pest control and crop protection is already gaining importance in several countries including India. The integrated pest management strategies developed and promoted by the governments is now based on the use of plant extracts which can be an economically viable option for sustainable development of eco-friendly pesticides/ insecticides.

There is a need to study the indigenous practices for pest management due to the following reasons:

- Indigenous products offer a potential alternative or substitute to conventional pesticides.
- Indigenous products have assumed greater importance in recent years all over the world due to growing awareness of harmful effect of indiscriminate use of insecticides.
- Studies on indigenous technologies are urgently wanted because of great deal of knowledge is being rapidly lost.
- Some indigenous technologies that have been documented provide an opportunity to evaluate their efficacy on different pests.
- This is the era of IPM which involves the use of eco-friendly indigenous pest management practices to obtain the rich harvest and to keep the environment safe for ever.

Review of important ITK in Pest Management

ITK involving miscellaneous practices

The predatory birds are encouraged in crop fields by providing support made up of bamboo or wooden sticks. Trapping with rotten crabs or repelling the insects with the odor emanating from the peels of grape fruit are practiced by the farmers in some areas of northern India. Similarly, sparrows are scared away by putting the dark coloured pseudostem of Colocassia - shaped like head of snake in rice field. Storing of rice seeds in containers is common practice adopted by farmers where several layers of paddy straw are used inside containers for maintaining seed viability [8]. The author further documented some more ITKs for heat and moisture regulation and uniform ripening, harvested paddy is tied into small bundles called *Pooli* or *Poola* which are dried under open conditions for 3-4 days. All such bundles are stacked at one place and allowed to remain there for a few days. Each stack is called a Kundli". This practice also enables easy handling in quick drying. Similarly, in Orissa [9] documented the farmers practice of one cross ploughing (*Mendha*) 3 days after sowing paddy with the help of a narrow wooden country plough, followed by laddering (*Garamai*) 3 days after *mendha* in the rain fed uplands of mid-Central zone of Orissa. Again after 3 days of *garamai*, work with a tooth harrow (*Bida*) is useful to weeds management, soil compaction, moisture conservation as well it helps in tillering (200 effective tillers/sq. meter); it also destroys the white ants and ultimately maximizes the yields. In another ITK in Orissa, crop seeds are stored in straw bin (*Olia*). The farmers usually store cereals, pulses and millet seeds in these especially designed straw bins [10].

Another, ITK for the management of paddy caseworm was documented by [11] wherein the tribal farmers of Koraput district managed paddy caseworm by using navel string of a newly born baby. The umbilical cord of new-born babies is sun-dried and preserved with vermillion. When required this umbilical cord is tied with a piece of clean cloth and is kept in the water passage with the help of a support. During irrigation the chemical substance present in the umbilical cord mixed with water spreads throughout an infested field and repel the case worms.

Rhinoceros beetle in coconut orchard is trapped into oily extract produced after boiling the ground castor seeds with water. Moreover, grubs of *Epilachna* beetle and nymphs of aphids are controlled by dusting dried household ash during sunshine [12]. In uplands of the mid and high hills, the farm cattle is shifted from one farm site to another after every 2-3 days to gathered cattle litter (dung + urine); the practice adds enough plant nutrients to soil to raise 2-3 bumper crops and also minimize the insect-pest incidence as it act as repellent [13]. The authors further documented the indigenous practice of sprinkling of *Chula* (a traditionally made fire place for cooking food) ash over fields and around the vegetable plants to be effective against insect's pests *viz*, beetles, defoliating insects, leaf miners, sucking insects like thrips and aphids etc. in hilly areas of Himachal Pradesh. Chewing and sucking insects find it difficult to chew plant parts due to deposition of ash. Though, [14] opined that storage pests can be effectively managed with Ash, Ash + dung and Ash + Chillies in all pulses and cereal crops.

In storage insect pest management, ash mixed with grain restrains the entry of insects and causes physical and physiological injuries. Ash besides having fine powder characteristics which is chemically inactive, is also having insecticidal properties. The ash dust reduces the relative humidity in the storage condition and could also dry the grain surface. Egg laying and larval development of the beetles could also be hampered because ash dust covers the grain seeds. It might also affect the insect movement in search for mating partners and friction of the dust particles with the insect's cuticle leads to desiccation and hampers the insect development. This practice could avoid the fig from fig moth infestation for the period of up to 6-8 months. If grains are to be stored for a longer period, then pots are sundried and again filled with fresh ash. Wheat grains are also stored by mixing cow dung ash which is desiccative and insecticidal in nature. The scientific reason behind using ash is that it contains silica which is harmful to insects; this method is still recommended as a cheap and safe control method. To be efficiently effective, atleast 5 % of ash is recommended for management of insect pests [15]. Similarly, [16] opined that ash is an inert dust that affects the respiratory system of the insect and may kill it by suffocation.

ITKs involving Insecticidal sprays in combination with cow dung and cow urine

A botanical pesticide comprising two kg of crushed tender green leaves of Mahananda (*Ipomoea carnea*), Datura (*Datura stramonium* Linn.), Gulvel (*Tinospora cordifolia*), Nirgundi (*Vitex negunda* Linn.), Sitaphal (*Annona squamosa* Linn.), Neem (*Azadiracta indica*), Castor (*Ricinus communis* Linn.), Kanher (*Nerium oleander* Linn.), Tantani (*Lantana camara*), and Papaya (*Carica papaya* Linn.). The crushed leaves were thoroughly mixed with 5 liters each of cow urine and cow dung; this preparation was finally put into 100 liters of water. The whole preparation was kept in covered tank for 21 days. After 21 days of fermentation, use it as a stock solution after sieving. The botanical preparation is sprayed @ 5 ml/ liter of water against insect pests infesting crops.This fermented mixture can be used up to 6 months from the date of its preparation [17].

A spray formulation advocated by [18] comprising 20 ml cow urine and 30 ml desi ghee in 12 liters of water gave effective control of larval stages of *Helicoverpa* spp. in cotton during bud formation. The authors further reported that two to three sprays of cow urine (50 ml) + cow dung (20g) + wood ash (40 g) mixed in 15 liters of water during bud formation checks the aphids and jassids infestation in cotton. Moreover, use of cow dung and kerosene oil too controls termites in sugarcane.

The preparation of cow urine (15-20 liters) + cow dung (1.5 - 2 kg) + NSKE (10 kg) in 200 liters water is sprayed against

sucking insect pest infesting different crops, though initial instars are more susceptible [19]. The authors further reported use of wood and cow dung ash for the management of stored grain pests (pulse beetle).

Another preparation followed by some of the farmers was using of fresh cow dung (20 kg) + cow urine (10 liters) + jaggery (1 kg) + chick pea flour (1kg) and 2 kg of soil from the root zone area of well grown tree. The mixture is fermented for 8 days and is used as 200 liters' solution to spray 1 acre of soil on any crops [19]. The spray solution of Lime + ash and green chilli extract are found effective against the leaf folder of rice; the presence of silicon in the preparation might have deterred the larvae from feeding. Similarly, for another pest of paddy yellow stem borer; the extract of Cow dung, cycas cone and brick kiln ash has been found effective against borer pest. The strong odor of the cycas flower emanating due to putrefaction of proteins and amino acids in presence of moisture might have deterred the adult moth from laying eggs on the plants, and also cow dung extract by its coat on the rice leaf might have deterred the moths from oviposition [20].

In North Eastern Indian states, [21] documented the traditional farming practice of spraying mixture of Cow dung, Cow urine, Chili and Garlic in the proportion of 2.0: 1.0: 0.5: 0.25 for managing defoliators in Kitchen gardens. Another indigenous practice for disease and pest management in different vegetable crops was documented by [22] by mixing green chilies (1kg); garlic (250 gm); cow urine (3 liter) and water 200 liters. The whole preparation was fermented for thirty days; after fermentation, only 2.5 liter is taken and added 3 liter of cow urine and then final spray prepared with 200 liter of water. In storage, coconut dust and wood ash is used against insect pest/ diseases infesting tomato seeds. Rice starch and animal urine are sprayed on vegetables for the control of biting and chewing type of insects [23].

An indigenous pesticide spray against *Helicoverpa* larvae was reported by [19]; by mixing cow urine (20 liters) + neem leaves with twigs (2 kg) + tobacco (500 gm) + crushed spicy green chilies (500 gm) + crushed garlic cloves (250 gm). The mixture thus made is boiled for about 15 minutes and allowed to cool for 48 hours. Stirring of the mixture is done twice a day; finally it is filtered with cloth and stored in shade for 3 months. At the time of spray application, 6- 10 ml of the mixture from stock solution is mixed with 20 liters of water.

In hilly mountain terrains of Himachal Pradesh, the indigenous spray mixture of cow urine + *Vitex ugundo* (Nirgandi) + *Ferula asafoetida* (hing) is practiced in most of the villages for insect pest management. The combination of Ash + cow urine is used to protect the cabbage plant from insect pest; and is also reported to improve compactness of the ball and marketable yields. The mixture preparation of *Gwar patha* (*Aloe vera*) leaf decoction (1 kg) ; tobacco powder extract (200 gm) are prepared in 5 litre of boiling water for 3-4 hours until it makes a 2 litre solution. Neem leaf extract (200 ml) is added to it after evaporation and finally decoction of 50 gm aritha (*Sapindus mukorossi*) powder is added to the above solution and mixed thoroughly. This preparation has been widely used against many insect pest infesting different crops [13]. Use of bio-rational products such as cow-urine and vermiwash is one of the alternatives to chemical pesticides in suppressing the insect pests. Use of cow-urine [24, 25] and vermiwash [26, 27] have been evaluated against insect pests and found giving encouraging results.

ITKs involving plant products

Chinese used wood ash for pest control in enclosed spaces with botanicals *viz*., pyrethrum for seed treatments [28]. Ash is predominantly used by farmers in the area for protecting plants. In hilly areas, wood obtained from forest has been major fuel. Ash dust is a product after the burning of fuel wood. The kitchen ash, thus obtained is mixed with the farmyard manure or in pure form applied in the field and onto plants. It is very effective for insect having chewing and biting mouth parts. When insects come to feed on ash broadcasted plants, ash sticks to their mouth parts and damages them because of which later insect are dead [29].

ITKs involving Plant extracts, botanicals

Plant based insecticides have been used in agriculture since time immemorial (1200 BC). In Vrikhsayurveda, a branch of ayurveda which deals with plant health drugs possessing specific quality, treatments are recommended against insect attacks. Aragvedha (*Cassia fistula* L.), Karanja (*Pongamia pinnata* L.), Saptapurana (*Alstonia scholaris* L.) and Nimb (Neem: *Azadirachta indica* A. Jass.) are included in Aragwadhadigana of Surrata for use against worms (maggots). The oil of Bhaltaka (*Scenecarpus anacrdius* L.) is also mentioned in Krimighna Gana of Charaka [30]. A number of texts in Vedic period mention the pesticidal properties of neem [31].

The ether extracts of *Annona* sp. possessed both toxic and repellent action against the larvae of *Plutella maculipennis* Curt [32, 33]. Reported insecticidal property of 45 plants occurring in Karnataka, but none among them were found to be effective stomach poisons. However, the authors found that dust and alcohol extracts of *Derris elliptica* Benth, *Tephrosia candida* (Robx), *T. villos*, *Madhuca* sp.and *A. squamosa* L. Caused more than 80 per cent mortality of *S. litura*, *Crocidolmia binotalis* Zeen and *Bruchus chinensis* L.

In another indigenous practice, [34] reported insecticidal activity of suspensions and extracts of parts of 20 plants on larvae of *Spodoptera. litura* and adults of *Uroleucon carthemi.* Aphids were more susceptible to plant extracts than *S. litura*. The active ingredients in the extracts of *Vitex negundo* (L.) responsible for insect mortality were 1-9- pinene carrphane terpenyl acetate and diteropone alcohol [35]. Similarly, [36] found neem seed suspension to be effective on eggs and larvae of *S. litura* in the laboratory. They observed, when first instar or fifth day larvae were treated at 0.2 to 0.5 per cent, suspension, 100 per cent mortality was recorded by the end of larval stage i.e there were no further development of pupal and adult stages of the insect pest and hence controlled [37]. listed 2,121 plant species possessing insecticidal properties, these included neem, sweet flag, cashew, custard apple, sugar apple, derris, lantana, Indian privet, agave, crow plant, etc. In the succeeding year, [38] listed 1,005 plant species having biological properties against insects; which included 384 plant species as antifeedants, 297 as repellents, 97 as attractants and 31 as growth inhibitors. The use of neem is well known in India and documented in the earliest Sanskrit medical writings [39, 40].

ITK in management of storage pest

Different ITKs have been used by different communities in different parts of the country to protect their food grains and cereals for their own consumption and also to preserve these grains as live and viable seed for next sowing season in as safe and efficient manner [41]. Used table salt for storage of

rice grain. After sun drying of the grains, salt was mixed with rice grains during storage which provided ample protection against storage insect pests. In another indigenous practice, [41, 42, 43, 44] demonstrated that thin paste mixed with cow dung, clay and cow urine was applied on storage yarns to make them air tight. Cow dung and urine have antimicrobial and insecticidal properties and provided better results for the storage of both *Kharif* and *Rabi* crops. Cow urine was especially used for the storage of *Lens esculenta* (lentil). The use of mustard oil was documented by [45], the oil was applied on storage grain especially pulses. This was also used as paste with turmeric powder. It has antimicrobial substance, allyl isothideyanate and provided better protection. The age old practice of sun drying and exposing infested grains to scorching heat during the months of May and June kills stored grain pests (and periodic sun drying of pulses suppresses the internal infestation. It was used for storage of *Kharif* and *Rabi* crops. Farmer's sun dried the seeds of maize, wheat, pulses and rice after harvesting [46]. The traditional practice of using ash for safe storage of grains was documented by [47]. The ash has crystalline property and may cause wounds in insects body, which leads to dehydration, desiccation and ultimately insects death. The ash is mixed with grains in the ratio of 1:1 the treatment has been found to be as effective as controlling the storage losses up to 80 per cent.

In another documentation of ITKs, [48] reported turmeric powder and chilli (*Capsicum annuum*) mixed with storage grains provided protection against insect pests. To repel the storage pests, farmers used chilli fruits with pulse grain. The astringent smell of chilli fruits control the storage insect pests like pulse beetle, lesser grain borer, floor beetles etc. The practice of frying the storage grains especially green and black grams in iron pan for three to four minutes makes the seed coat of grain hard and thus reduces the chance of infestation of seed borers [47, 48]. The technique using ginger and clove pieces especially for storage of rice grain. Ginger was cut into pieces and put into storage yarns along with rice grain. Clove either fried or un-fried were put into storage yarns to check the insect pests. The grains were stored in such a way by adding chilli powder, salt, edible oils, condiments etc. to keep them fresh and viable [49].

Methods of ITK collection

There are no fixed methods for collection of ITK. It depends on type of ITK, situation, people, social system, cultural values etc. Some of the below listed important and mandatory aspects needs to be followed to make the respondents comfortable and at ease during interaction and collection of information:

Table 2: Methods of ITK collection

Interaction with community leaders or elders	Participant observation
Rapid rural appraisal.	Brain storming.
Case study	Group discussions.
History	Surveys.
Interview method	SWOT analysis

Documentation of ITK: The following steps are precisely followed while documenting the ITKs

- Documenting large variety of practices without scientific validations.
- Documenting prevalent practices and comparing them with traditional ones.
- Documenting the practices/ details of the experimentation on a specific aspect and understanding the various linkages.
- Documenting the practices evolved to mitigate specific problems of farming or for sheer survival under conditions of ecological and economic stress.
- Documenting practices that had evolved in response to specific external interventions.

Testing and validation of ITK

1. Prepare a list of all the collected ITK practices.
2. Decide the continuum for rating rationality of ITK with specific weightage.

Table 3: Rating of ITK practices into specific weightages.

Continuum	Weightage
Very rational	5
Rational	4
Undecided	3
Irrational	2
Very irrational	1

3. Send list of ITK practices to expert for their opinion and judgment on each practice.
4. Calculate the weighted mean score of individual practices.
5. Select practices above mean score as rational.

Traditional belief- a myth or reality

Indigenous people have rich store house of traditional beliefs, folklore, rituals and rites which may not hold any truth and have any practical a value but expected to hold some message and therefore need in depth observation. These beliefs include that seeds collected and thrashed on new moon (amawasia) for sowing in next season are usually not infested by any insect pest or disease, it's because the halo made by the sun around the seed. These beliefs have been shaped and nurtured by hundreds of ethnic groups scattered throughout the regions.

Limitation of ITK in pest management

- In particular, the transfer and the use of information is likely to be constrained since it has to be passed on orally or by direct experience and held in the heads or to memorize by the practioners.
- The scope for improvement via 'pure' ITK is limited to what can be done with local pool of techniques, materials and genetic resources, plus whatever is introduced casually by the indigenes.
- The informal system has neither the necessary forward perspective nor resources to anticipate the opportunities and constraints arising from changing environments.
- The capacity of individuals to generate, implement and transfer ITK varies.
- ITK and technology-centered relations do not emerge, and cannot be manipulated, independently of the social, political and economic structures within which they occur.

Threats to ITKs

- Rapid urbanization has affected the lives of indigenous community.
- Indigenous communities use oral communication and hands-on experience to preserve and transmit their

knowledge [50]. However, younger generation is losing skills, because they spend more time on educational institutions than with the elders in the community. Modernization has resulted in loss of their peculiar culture and heritage.

- Till date, ITK knowledge survival is through words only, preservation of indigenous knowledge is critical, because it ensures the continuation of community and its knowledge. If indigenous knowledge is not documented and preserved, the knowledge will be lost through death of elders and traditional leaders; and will remain inaccessible to other communities, scholars and other developmental workers and researchers.

Strategies in preserving ITK

- Strengthening the capacities of regional research and extension organizations.
- Building upon local people's knowledge that acquired through various processes such as farmer-to-farmer communication, and farmer experimentations.
- Identifying the need for extension scientist/ social scientist in an interdisciplinary regional research team.
- Generating technologies option rather than fixing technical packages.
- Bringing research -extension-farmer together to disseminate and validate indigenous knowledge.

Conclusions

The documented ITKs would serve as a ready reference for the agricultural scientists for further study of indigenous technologies used for prevention of insect pest and it would also be used for determining their scientific rationality and effectiveness. ITKs are organic in nature, the documented ITKs may be useful for extension personnel in planning and executing various IPM modules. ITKs are environmentally safe and easily adopted by farmers. It provides valuable inputs to make efficient use of natural resources. Hence, it can be concluded that the ITKs, which are prevalent among the farmers from the time immemorial, if organized and used scientifically may help in insect pest management and reduce the indiscriminate use of chemical insecticides.

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