



Research Article

IDENTIFICATION AND DOCUMENTATION OF INDIGENOUS TECHNOLOGICAL KNOWLEDGE(S) REGARDING PEST CONTROL METHODS IN AGRICULTURE

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Abstract- The study was conducted to identify and document the various indigenous technological knowledge regarding indigenous methods for pest control in agriculture gathered and applied through experiences of the local people in north eastern part of India. This indigenous technological knowledge is based on the experiences of the people over a period at a given place. The information, thus, were collected from the selected informants of the given area and documented in a systematic manner based on some attributes. In recent times, climate change has taken place with its significant and most observable impacts on various aspects of agriculture. Subsequently, plant protection, now a day, has become a serious matter because due to changes in climate, the ecology and biology of different insect pests are also changing which makes pest control mechanisms more difficult and complex. Moreover, indiscriminate use of chemical pesticides in agricultural field not only develops resistance in the pests but also leads to environmental degradation. On the other hand, there are some indigenous people who are still following some indigenous practices in case of controlling the pests in their agricultural fields through using locally available plans and low-cost resources. The basis of these indigenous technological knowledge has its base deep rooted into the experiences of their ancestors being passed on from generation to generation. As these ITKs fulfil the criteria of cultural and environmental compatibility and are also economically feasible, therefore, an appropriate blend between the indigenous knowledge system and scientific knowledge system regarding pest control methods should be considered during formulation of an effective and efficient crop protection strategy for ensuring sustainable agricultural development.

Keywords- Indigenous technological knowledge, climate change, plant protection, chemical pesticides.

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Introduction

From time immemorial, agriculture is closely associated with nature particularly its weather and climate components. Agriculture has various aspects like crop production, protection post harvest management, marketing etc. and all these aspects are, more or less, dependent upon climatic factors either directly or indirectly. Therefore, any change in climate is sure to have its effects on agricultural practices whether negative or positive. But, in recent times, climate change has, in many cases, adverse impacts on agricultural production and productivity in various corner of the globe. For instance, climate change related disaster limits progress and productivity through reduction of fixed assets, loss of production capacity and productivity, reduction of market access, landslides induced damage to transport, communication etc. [1]. Overall, productivity levels are expected to be lower than without climate change – due to changes in temperatures, crop water requirements and water availability and quality [2]. Among several aspects, crop protection is a major one which has strong influence on the production and profitability of any crop enterprise. Therefore, there is a real need to manage this crop protection aspect effectively and efficiently to ensure the sustainability of any agro-based enterprise.

But, with the changing climate, a serious problem has occurred in case of controlling pest attack on crops. Climate change influences the ecology and biology of insect pests. Climate change or global warming will probably lead to increase agricultural, forest and public health insect pests. Climate change will directly affect insects as (i) the geographic range of insects, (ii) the timing of life

cycles of insects, (iii) the population dynamics of insects, (iv) the natural habitats of insects and (v) the structure and composition of ecosystems [3]. In this way, climate change would lead to a major change in crop pest synchrony; change in pest complexes on spatial and temporal bases and finally pests management strategy [4]. This problem of pest management may occur at any stage of crop growth and even at any phase of agricultural system starting from sowing to harvesting and marketing of the produce. This problem has ultimately increased the risk and uncertainties associated with production, marketing and profitability of farming profession. Therefore, controlling the pests in various crops has become an important area of concern both for the practitioner of agriculture and the researchers engaged in agricultural development.

India has witnessed green revolution in agriculture since long back in the 60s with intensified application of various inputs including plant protection chemicals. But, with time, huge application of pesticides in the agricultural field has resulted in negative impacts like developing resistance in the pests against those pesticides, resurgence of the unknown pest-species, loss of bio-diversity, existence of residual toxicity in the crops etc. Moreover, the prices of the pesticides have gone up very high due to high demand which has ultimately increased the cost of cultivation. Therefore, the farmers are often unable to afford those costly pesticides and as a result, face the problem of pest attack in their field leading to loss of yield and subsequent reduction in income. But, on the other hand, still there are some indigenous people in various localities who are applying their indigenous technological knowledge (ITK) in controlling pest attacks. For example,

farm folk of Sikkim follow number of traditional pest management practices for managing pests and diseases of various crops like use of wood ash, kerosene, table salt, lime, cow urine, cow dung, some unique indigenous plants and indigenous techniques like insertion of bamboo pegs [5]. Indigenous technological knowledge (ITK) is the actual knowledge of a given population that reflects the experiences based on tradition and includes more recent experiences with modern technologies [6]. Such knowledge is collectively owned, developed over several generations and subject to adaptation and imbedded in a community's way of life as means of survival [7]. Similarly, the people of the present study area have also developed their indigenous pest control methods from their experiences by using various low-cost and locally available resources for the purpose. These ITKs also fulfil the criteria of cultural and environmental compatibility and the sustainability concern that's why these are in practice for several years among those communities.

Therefore, in the present climate change scenario, there is an urgent need to appropriately blend these ITKs with the scientific knowledge related to pest management strategy in agriculture for controlling and minimizing pest attacks on the crops in a better way and thereby make agriculture more productive and profitable for the farmers. Under such a research niche, the present study was conducted to identify, to assess and to ultimately document some of the indigenous technological knowledge regarding indigenous methods for pest control in agriculture.

Materials and Methods

The indigenous technological knowledge in the study area were collected from the selected informants and documented in a systematic manner on the basis of the following attributes.

- Title
- General description of the Indigenous technological knowledge
- Area of specialization
- Application of Indigenous technological knowledge
- Cultural compatibility and environmental feasibility
- Sustainability
- Scientific rationale
- Revelation
- Photograph

This type of documentation helps in developing the contents of indigenous technological knowledge which will be disseminated to the community for its future implication in other areas through Information Communication Technology (ICT).

The indigenous technological knowledge was documented through interaction and discussion with the farmers of the study area without knowing its scientific validity. Scientific validity refers to the degree to which the information on indigenous technological knowledge is realistic with a scientific backstopping. The validation of documented indigenous technological knowledge was done with a group of scientists for their relevance in scientific scenario and indigenous technological knowledge. The documented indigenous technological knowledge which the farmers concerned mostly was sent for scrutiny.

These were circulated to twenty five scientists for their responses on three point validity continuum and the responses scored 5, 3 and 1 for valid, not considered and not valid respectively. Thus, one ITK could get a maximum score of 125 and a minimum of 25 [8]. The higher scores on indigenous technological knowledge scientific validity would establish the validity of the particular indigenous technological knowledge in a scientific manner.

Results and Discussion

Identified indigenous technological knowledge(s) regarding pest control methods applied in agricultural practices

1. Title: -Indigenous pest control method cum compost preparation.

- **General description of the indigenous technological knowledge:-** Firstly, a commonly found plant species *Cestrum aurantiacum* locally known as *ganday jhar* or *murdaphul* (a poisonous plant), is collected from the nearby areas and is mixed with cow dung and stored in the

compost pit for about 1 month and above. The compost is then mixed thoroughly and is used during cultivation of the crops. This process kills and prevents the underground pests from damaging the crops. [Fig-1]

- **Area of specialization:-** Agriculture is the specialized area but, still it can be used in case of other household pests.
- **Application of the indigenous technological knowledge:-** The compost is stored by the farmers near their fields and during the time of cultivation they apply it in the soil at the rate of 2 quintal per acre.
- **Cultural compatibility and environmental feasibility:-** It is culturally compatible and environmental friendly as it is produced by the bio-degradable raw materials which are locally available.
- **Sustainability:-** The application of this indigenous technological knowledge has shown better results hence it is being adopted by most of the farmers so it can be considered to be sustainable.
- **Scientific rationale:-** The presence of some poisonous substances in the plant used kills the insects and pests and the cow dung favours the growth and development of the crops.

Revelation: - It is a very effective pest control method and can be utilized as an organic method for pest control. It is mainly effective for the underground pests like nematodes, shoot borer, stem borer etc. Furthermore this indigenous practice should be promoted to other areas under this climate change scenario.



Fig-1 *Cestrum aurantiacum* plant mixed with cow dung

2. Title: -Preparation of pesticide, using *titaypaati*.

- **General description of the indigenous technological knowledge:** - Locally available plants such as *Artemisa vulgaris* commonly known as *titaypaati* and *Urtica dioca* commonly known as *sisnu*, is brought from the nearby areas and is beaten to extract its juice, it is then mixed with water (500ml paste mixed with 5 litres of water) and sprayed on the crops. It kills both the underground pests as well as those pests living above the ground. [Fig-2 and Fig-3]
- **Area of specialization: -** This indigenous knowledge may be used in case of protecting the crop from different natural pests.
- **Application of the indigenous technological knowledge: -** The indigenous technological knowledge is used by the farmers in their own fields as an organic pesticide to protect their crops against the attack from pests.
- **Cultural compatibility and environmental feasibility: -** It is culturally compatible and has no harmful effects in the environment as because this pesticide is prepared with the help of assured supply of resources from the local areas.
- **Sustainability: -** The application of the indigenous technological knowledge has shown better results. Hence it can be considered as sustainable.
- **Scientific rationale: -** The presence of certain chemicals in the plants kills the insects and pests that come in contact with it.

Revelation: - This indigenous technological knowledge can be extrapolated in similar type of ecosystem for sustainable and safe ecology during this changing

agrarian scenario. It also needs to be promoted for increasing its efficacy and coverage



Fig-2 *Artemisa vulgaris* and *Urtica dioca* being crushed to extract its juice

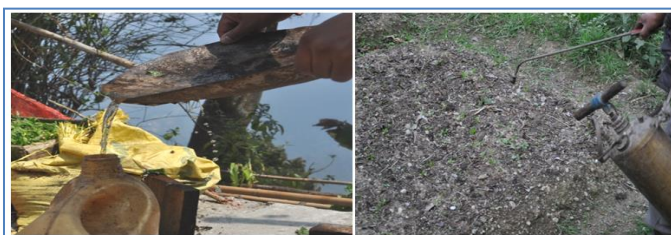


Fig-3 Extracted juice being collected and sprayed

3. Title: -Preparation of pesticide, using leaves and fruits of *timur*.

- **General description of the indigenous technological knowledge:**
 - Leaves and fruits of *Litsaea citrate* commonly known as *timur*, a locally found plant is collected and smashed and the juice is extracted. It is then mixed with little amount of water and then a clean piece of cloth is soaked in the mixture and about 2 to 3 drops is applied near each plant, it can also be sprayed if the crop is in large numbers. It has a certain smell which keeps the pests away from the plant; it also kills the insect pests nearby the area. [Fig-4 and Fig-5]
- **Area of specialization:** - The indigenous knowledge can be helpful in case of preventing the pests from coming in close contact with the plants and thereby protecting the crop from pest infestation.
- **Application of the indigenous technological knowledge:** - The farmers mostly prepare and store such pesticides previously and apply them when required.
- **Cultural compatibility and environmental feasibility:** - It is compatible with the local culture and the environment would be least affected through applying the indigenous knowledge for pest control.
- **Sustainability:** - The indigenous technological knowledge is being practised by the people as an organic way for pest control. Hence it is sustainable.
- **Scientific rationale:** - The pungent smell of the plant keeps the insects away from the areas covered by it.

Revelation: - The diversity in pest population is a great challenge to the agrarian society in this changed society. This indigenous technological knowledge is an outcome of necessity. With the help of available local organic resources the local people are controlling the pests through this indigenous practice. So, the promotion of this indigenous technological knowledge is the need of the hour in the second green revolution era.



Fig-4 Leaves and fruits of *Litsaea citrate* being smashed



Fig-5 Spraying of the solution for pest control

4. Title: -Preparation of indigenous pesticide, using cow urine and jaggery/ gurr.

- **General description of the indigenous technological knowledge:**
 - Firstly, the fresh urine is collected in a container, then, ½ kg gurr, 1 litre urine and 2 litres of water is mixed together. The mixture is then stored inside an air tight plastic container and is kept for about six months. When the product gets ready, it is diluted by adding water, (1 litre concentrated pesticide is mixed with 7 litres of water) it is then filtered using a clean cloth and then the mixture can be sprayed on the field crops. It kills both the pests below and above the ground. Gurr or jaggery is used because of its sticky nature, it does not get removed easily from the sprayed area therefore it works for a longer period. Nitrogen present in the urine also favours the development of the crops. [Fig-6 and Fig-7]
- **Area of specialization:** - The indigenous pesticide not only protects the crops from insect and pest attacks but also it accelerates the growth of the crops.
- **Application of the indigenous technological knowledge:** - The farmers use this pest control practice to protect their crop. They mostly store it and apply them through spraying machines when it is required.
- **Cultural compatibility and environmental feasibility:** - It is compatible with the culture and the environment is not affected at all with application of this indigenous pesticide.
- **Sustainability:** - The indigenous technological knowledge is being practised by most of the farmers in the study area. Hence it is sustainable.
- **Scientific rationale:** - The toxicity of the mixture kills the insects and pests that come in contact with it.

Revelation: - The locally available material and the simple preparation method make this indigenous technological knowledge more acceptable to the local people and this may be promoted to other areas to utilize the knowledge in fullest extent.



Fig-6 Urine being collected and jaggery is added to it



Fig-7 The final product is stored and when ready, it is used as a pesticide

5. Title: -Preparation of pesticide, using *angeri* and cow urine.

- **General description of the indigenous technological knowledge:** - Locally found plants like *Pieris ovalifolia* commonly known as *angeri*, and *Artemisa vulgaris* commonly known as *titaypaati*, is collected and grinded to form a fine paste. It is then mixed with cow urine and after filtering it, it is sprayed in the field to control and kill pests. [Fig-8 and Fig-9]
- **Area of specialization:** - Agriculture is the area of specialization for this indigenous knowledge with major emphasis on the crop protection through applying this indigenous pesticide.
- **Application of the indigenous technological knowledge:** - The indigenous technological knowledge is mostly used by the farmers to control the pest attacks in their fields. The mixture is firstly filtered and then it is applied with the help of vacuum sprayers.
- **Cultural compatibility and environmental feasibility:** - It is culturally compatible and creates no environmental hazards after applying this indigenous pesticide.
- **Sustainability:** - The better results shown by the application of this indigenous technological knowledge make it sustainable.
- **Scientific rationale:** - The presence of certain chemicals in the plants kills the pests and the urine favours the growth and development of the crops.

Revelation: - Organic pest control is the need of the second green revolution era. This indigenous technological knowledge paves the way to control pest in organic method. In other areas this can be extrapolated.



Fig-8 Leaves of the plant being smashed and mixed with cow urine



Fig-9The mixture being filtered and sprayer

6. Title: -Alcohol based pest control method in flowers.

- **General description of the indigenous technological knowledge:** - Organically produced alcohol by the farmers with the help of millets locally known as *chung* is poured in small plates and is kept under the flowering plants. The smell of the alcohol attracts the insects and kills them when they come in contact with it. [Fig-10]
- **Area of specialization:** - The indigenous knowledge has its potential to effectively protect the horticultural plants from the pest attack particularly during the flowering of the plants.
- **Application of the indigenous technological knowledge:** - The alcohol based pesticide is used during the bud initiation stage, so as to protect the plant from getting damaged by the use of other toxic chemicals.
- **Cultural compatibility and environmental feasibility:** - It is culturally compatible and environment-friendly because the indigenous pesticide has the ingredients which can be collected from

the local area.

- **Sustainability:** - The indigenous technological knowledge is used by only a few people but the results shown are considerable. Hence it is sustainable.
- **Scientific rationale:** - The toxicity of alcohol kills the pest when it comes in contact with it.

Revelation: - Floriculture is an innovative enterprise in the hill ecosystem. To protect the enterprise from pests this indigenous technological knowledge can be utilized and it can also be promoted in other areas where floriculture is one of the viable enterprises as it is eco-friendly and cost effective.

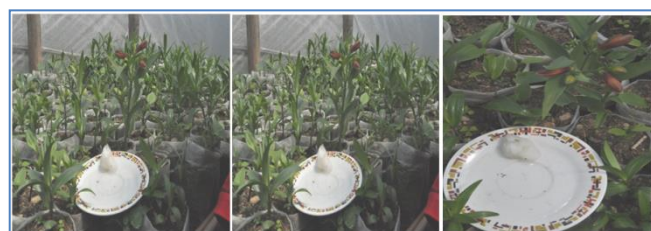


Fig-10 Plates containing alcohol and cotton (soaked in alcohol) kept under the plants.

7. Title: -*Munteso*: An indigenous animal trap.

- **General description of the indigenous technological knowledge:** - A bamboo is fixed on the area just below the field, it is then bent and a circular wire is tied on the top end of the bamboo. The bent bamboo is locked with a knot called *fitkauli*. When the animal gets trapped in the circular wire, the *fitkauli* or the knot gets detached and the bamboo takes its original form with the animal on the top. [Fig-11]
- **Area of specialization:** - The indigenous animal trap, *Munteso* is helpful for protecting the crops particularly from the animals.
- **Application of the indigenous technological knowledge:** - Due to the location of the farms near the forest areas, the crops are mostly damaged by the wild animals like porcupines, wild boars, and other herbivorous animals. The indigenous trap is made for stopping these damages. The animals if caught are put inside a sack and are then set free in the forest.
- **Cultural compatibility and environmental feasibility:** - It is culturally compatible and has no harmful effect in the environment because the indigenous animal trap is made of such materials which have no health hazard and are also available in the locality.
- **Sustainability:** - In the past years it was mostly in use but, now a days, it is very less used.
- **Scientific rationale:** - This indigenous trap is safer and more cost effective than the other modern animal traps.

Revelation: - To protect the crop from harmful animals this indigenous technological knowledge can be helpful. It is cost effective and eco-friendly trap which is prepared from the locally available resources. So, this may be an example to other local people in case of protecting their crop from harmful animals in future





Fig-11 The bent bamboo locked with a knot and a circular wire for trapping the animal

Table-1 Validity scores of collected ITKs assigned by the scientists (N=25)

s. no.	Indigenous Technological Knowledge	Scientifically valid (5)	Not Considered (3)	Not valid (1)	Validity score
1.	Indigenous pest control method cum compost preparation.	8	11	6	79
2.	Preparation of pesticides, using <i>titaypaati</i> .	19	4	2	109
3.	Preparation of pesticide using leaves and fruits of <i>timur</i> .	18	5	2	107
4.	Preparation of pesticide using cow urine and jaggery.	16	6	3	101
5.	Preparation of pesticide using <i>angeri</i> and cow urine.	18	5	2	107
6.	Alcohol based pest control method in flowers.	4	7	14	55
7.	<i>Muntoso</i> : An indigenous animal trap.	19	4	2	109

[Table-1] presents the validity scores of collected indigenous technological knowledge assigned by the scientists. The figure shows that even the scientists have a varied level of perception on different indigenous technological knowledge (ITK) practices. Total 7 ITKs have been asked for the validity scores out of which 71.43% of the ITKs (5 out of 7) were scored above 80 which indicate their wider use and compatibility in different agro-climatic zone. Moreover, the higher scores have been obtained in these ITKs as a result of higher points scored under 'scientifically valid' column. We may therefore, conclude that those ITKs are established and practised with their scientifically valid construct, whereas the ITKs with poor scores cannot be neglected because still in the hills they are very popular practices. Hence, these ITKs can further be tested in order to prove their importance.

Conclusion

The indigenous technological knowledge being applied in case of controlling pest attacks on important crops have inherent characteristics of cultural and environmental compatibility as well as sustainability with cost-effectiveness which necessitates an appropriate blending between these ITKs and the scientific knowledge in case of pest management strategy. The ITKs which have a high level of validity scores should be given due importance by the planners and policy makers as it will reduce the cost of pest control by using low-cost, locally available resources for the purpose as well as pay respect and acknowledge the traditional knowledge to the indigenous technological knowledge users. Effective action should be taken to preserve various plants and other natural resources which are of practical importance for their ability to kill the insect pests. In many cases, lack of knowledge regarding processing of herbs and other ingredients for preparation of indigenous pesticides, time constraint to document and validate ITKs, lack of awareness about suitable doses and wider use of ITKs for controlling and killing the insect pests are the major constraints of wider ITK applicability. This type of documentation will help in developing the contents of indigenous technological knowledge which will be disseminated to the entire community for its future implication in other areas through Information Communication technology.

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Conflict of Interest: None declared

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