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Unveiling Indigenous Traditional Knowledge (ITKs) Using Different Available Plants by the Local People of South Sikkim, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Method Article

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ABSTRACT

Northeast India is biologically diverse regions, among which the South Sikkim district possesses unique rural landscapes enhanced with endless waves of farming areas and terraced hills. Within this region, three main indigenous groups—Nepali, Lepcha and Bhutia—coexist, contributing to the cultural diversity. Over the years, these communities have cultivated a traditional knowledge based on which they are greatly dependant on diverse plant resources for both protective measures and medicinal practices. These traditional practices encourages a strong local knowledge base. These practices include local plants namely utis (*Alnus nepalensis*), chilauni (*Schima wallichii*), wild fern, titepati (*Artemisia vulgaris*) and many more. However, despite the rich diversity of these cultural practices connected with nature, there is a lack of detailed exploration and documentation for better

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understanding traditional practices and ethno-medicinal knowledge upheld by these communities. The absence of such documentation underscores a significant gap in our understanding of their cultural heritage, as these ITKs can be further integrated with science to make contribution for adaptive management to many environmental and health issues. Therefore, this study is conducted with the aim to unreveal the potential of these traditional practices and ethno-medicinal knowledge preserve among the diverse communities of South Sikkim, which can help to shed light on their cultural heritage and to recognize their invaluable contributions.

Keywords: Indigenous traditional knowledge; plant protection; ethno-medicine; cultural diversity; management.

1. INTRODUCTION

A network of knowledges, beliefs and traditions which aim at preserving, communicating and contextualizing indigenous relationships with culture and landscape over time can be used to the term 'indigenous traditional knowledge'. It is a treasure of knowledge that was accumulated by generations of close contact with nature. It is a collective local knowledge, practice and beliefs shared by people in the region [1]. Through social contacts, oral traditions, ritual practices, and other activities, indigenous knowledge is communicated formally and informally to the kin groups and communities. Over time, indigenous people around the world have maintained their own unique data includes geographical, biological and other information which indicates the relationship between humans and flora and fauna, land and water as well as supernatural forces among the different communities [2]. The knowledge of these relations is often passed on and preserving such traditions is a matter for skilled individuals and families; some of them are experts in the protection of esoteric knowledge [3].

Traditional medicine (TM), often known as complementary and alternative medicine in developed nations, is widely used and gaining popularity among healthcare systems worldwide. TM practices are used to address the healthcare needs of over 80% of the world's population, primarily in underdeveloped countries. In response to scepticism and denial from some stakeholders, the World Health Organization created a strategy in 2002 to address concerns of policy, safety, efficacy, quality, access, and sustainability use of traditional medicine [4]. It would be possible to integrate ancient knowledge and science, make a contribution to the adaptive management [5]. Although, there are some researchers, who are sceptical on the scientific validity of ancient knowledge and its usefulness in addition to local level, while there are others who are worried regarding the ethical issues associated with using it for educational or policy purposes [6].

One of India's most biologically diverse regions is Northeast India. A significant cultural heritage of culturally embedded native knowledge is built up as a result of the diversity of regions, cultures and farming practices, resource management through indigenous institutions, an extensive dependency on forest resources and use of local food and medicines [7,8,9]. Among the north-eastern states, Sikkim is one of the states which shares boundaries with China's Tibet Autonomous Region, Bhutan, Nepal and West Bengal in the south. Sikkim is the least populous and second smallest state in India. It is located in the Eastern Himalayas, is known for its biodiversity, which includes alpine and subtropical temperatures. Sikkim has a long history of using medicinal herbs to treat illnesses as well as for other purposes such as for plant protection. Indigenous people are well-versed in the native flora and its therapeutic virtues. Traditional healers, also known as Lamas or Jhankris, play an important role in applying this knowledge to health difficulties [10-12]. Sikkim has also been recognized as India's first completely organic state, encouraging sustainable agriculture. For many years these communities have depended on a variety of plant resources both for the protection of their plants and to treat different illnesses through traditional medicine in order to establish a more widespread local knowledge base. Apart from the medicinal practice and for plant protection, these plants are also used for different ethnobotanical practices from ancient times. Plants like titepati (*Artemisia vulgaris*), Sisnoo (*Urtica dioica*) has been utilized in different activities like marriage, newborn ceremony, and funerals. Also, people believe these plants keep the evil spirit away from the house. The present investigation was carried out for better understanding of these traditional practices which can help in their documentation

to ensure that these traditional knowledges will not get lost in time and also can help in aiding more profound scientific research on these traditionally utilized plant species.

2. METHODOLOGY

2.1 Study Area

The south Sikkim district, which covers about 75000 hectares in total, is at a height of 400 meters to 2000m above sea level with unique and rural landscapes with endless waves of farming areas and terraced hills intercepted by spring-patched forests. Area-wise it is the smallest district of Sikkim and the population-wise second one. In that region, the Teesta and Rangeet rivers are two of the main river streams. These two elements play a significant role in protecting the sustainability and rainfall of the region while making it a very biodiverse landscape. There are three main indigenous groups that live in the area: Nepali, Lepcha, and Bhutia. Report of the Commission for Review of Environmental and Social Sector, Policies, Plans and Programmes [13] records different communities and tribes of Sikkim such as Bhujel, Bhutia, Bahun, Chhetri, Dewan (Yakha), Damai, Gurung, Kami, Rai, Lepcha, Limboo, Magars, Newar, Jogi (Sanyasi/Giri), Sarki, Sherpa, Mukhia (Sunuwar), Tamang and Thami. For many years these communities have been depending on a variety of plant resources both for the protection of their crops and to treat different illnesses through traditional medicine in order to establish a more widespread local knowledge base.

The present investigation was carried out through a survey, using interview methods, and collection of data was done at the time of field visit, interactions with local people as well as visiting crop fields in different localities of South Sikkim district. Respondents were mostly tribal farmers who practiced ITKs in the selected regions. Individual and group interviews with participants were conducted as a part of the survey with the help of a checklist of questions administered. Since, the majority of the people in Sikkim speak Nepali, either one or two local assistants who could translate Nepali into Hindi or English more lucidly, accompanied during the field visits and interviews, as an additional help in case of complications felt in the accent and fluency of respondents. Respondents were asked to mention the indigenous practices they had been practicing for the past five years in the checklist to assess the extent to which those practices had been adopted. ITKs expressed by the respondent were recorded and were further analyzed and tabulated based on frequency and then ranked accordingly. The investigation was carried out in the villages of the South district of Sikkim and a total of one hundred twenty households (above 50 years age group) were interrogated during the period of 2021-2022. For the confirmation of responses from local folk and farmers for validity, extensive field surveys were undertaken during the present investigation.

Fig. 1. Derived from Google GPS map displaying the geographical distribution of Yang Yang, South Sikkim, Bhutan at the east, Nepal at the West, China at the North, and the Adjoining part of West Bengal, India at the south

The survey helped to derive an idea about the rate of use of ITKs in the crop field as well as for human health. Some participants expressed awareness regarding pest management using traditional practices and/or the use of organic insecticides, while others detailed about the use for different medicinal purposes. Some participants were unaware of any such practice with a detailed notion. This unaware group is primarily resource-poor, landless, illiterate, and a casual worker who does agricultural operations on other people's fields for a daily wage.

On the basis of the above survey, the ITKs which had been used more frequently from the past generations by all the communities are discussed briefly below.

3. RESULTS AND DISCUSSION

According to the findings of the survey, approximately 90% of participants were aware of the ITKs, which they learned from their elders. A total of 21 different indigenous practices, using different plant extracts, were discovered to be frequently used in that area to control various pests and diseases in agriculture as well as for medicinal purposes. Some of the ITKs were found to be used commonly among all locations. These ITKs were mostly used against the majority of crop pests in agricultural and horticultural crops and their dosage was found to be varying depending on the farmers. This variability of doses was due to the lack of published information on ITKs. However, the dosage applied by the farmers were based on their practical experience. During the survey it was found that most of the farmers and household completely rely on organic control since the state has been declared only organic state in the year 2016 by government of India. The use of ITKs play an important role in controlling plant pests and diseases by the farmers of Sikkim. The present study documented about 21 plant species, out of which 8 plant species (*Alnus nepalensis, Histiopteris incisa, Allium* sps*., Capsicum annuum* var. *cerasiformae, Schima wallichii, Lantana camara,* Indain Rhododendron and wild fern) were found to use for agricultural purposes such as for fertilizer, mulching material, disease control and pest repellent such as aphid infestation in brown mustard etc., 2 plant species (*Artemisia vulgaris* and *Eupatorium cannabium*) were found to use for both agricultural as well as for medicinal purposes such as nose bleeds, cuts, bruises, to control trunk borer in Sikkim mandarin etc., 2 plant species (*Cymbidium sps.* and *Zea mays*) were used for different handicraft makings such as foot mats, baskets etc. while they can also be utilised for mulching material for agricultural purposes and 9 plant species (*Girardinia diversifolia, Berginia ciliate, Dendrobium nobile, Aconogonum molle, Drymaria cordata, Zanthoxylum allatum, Lindera nissiana and Tetratarnium nepalense*) were found to be used for their medicinal values such as for applying on cuts and bruises to avoid infection, nosebleeds, dysentery, diarrhoea, stomach ache, sinus and many more. The plant species found were having multiple usage both for agricultural purpose as well for medicinal purpose. The fact that local communities in study areas have a history of carrying on this old wisdom, which has been developed over time, is apparent from these ethno-botanical knowledge; and herbal medicines are currently preferred rather than allopathic treatments for the majority of cases.

The remark on each traditional agricultural pest control practice based on their experience is presented in

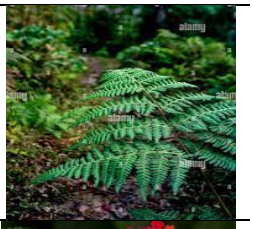
Table 1. It is interesting to know that the components of most of the traditional practices are of biological origin such as different plant extracts

Plant species	Plant part used/ Purpose of use (Description)	Purpose	ITKs	Photographs
1.Utis *Alnusnepalensis* (Betlaceae)	Leaves and twigs (dried)	Use as fertilizer/ insect repellent	Harvested fresh green leaves, which have been carefully sealed in an airtight container, will be used after fermentation to create liquid fertilizer for the vegetable gardens.	

Plant species	Plant part used/ Purpose of use (Description)	Purpose	ITKs	Photographs
2.Tettipati *Artemesia vulgaris* (Asteraceae)	Tender leaves	To control trunk borers and sucking insects	The leaf extract is employed to manage bleeding, particularly in the case of nosebleeds and bruises. This involves cutting and grinding the leaves. The gathered plants are crushed in water and left to ferment for 20-25 days. The resulting liquid extract is then filtered and applied to Sikkim mandarin trees as a drenching treatment to protect them from trunk borers.	
3. Unew *Histiopteris incise* (dennstaedtiaceae)	Long, thin mature fronds.	To control thwart mites and deter insects	Mature leaves are gathered and utilized by farmers to facilitate poultry egg hatching, as they are believed to deter insects and thwart mite infestations.	
4. Banmara *Eupatorium cannabium* Linn (Asteraceae)	Young, matured leaves, tender shoots, racemous flowers.	Use as mulching material	The extract from matured leaves and stems, obtained by simply rubbing them between our palms, is applied to cuts and bruises to manage bleeding and prevent infection. It is also widely used as the mulching material mixed with crop residues.	
5.Sisnu *Girardinia diversifolia* (Urticaceae)	Inflorescence (whorled clusters), leaves (young petioles).	Use as medicine	During the monsoon season, both flowers and young leaves are gathered, boiled and consumed as a drink. It is thought to have potential benefits in managing high blood pressure.	
6.Pakhanbed *Berginia ciliate* (Saxifragaceae)	Root and rhizome	Use to prepare tea	The dried and ground rhizomes are prepared as a tea to alleviate body and bone pains, while the leaves can be boiled and consumed as a stew.	

Plant species	Plant part used/ Purpose of use (Description)	Purpose	ITKs	Photographs
7.*Cymbidium* sps. (Orchidaceae)	Leaves, bulbs	Use as handicraft	Flowers serve as cut flowers, while aged dried leaves are gathered for crafting items like foot bats, baskets, etc.	
8.Corn *Zea mays* (Poaceae)	Husk	Use as mulching and handicraft	Soon after harvesting, corn husks find use as a mulching material, and they are also employed in crafting items such as tool mats and baskets.	
9.Dendrobium *Dendrobium nobile* (Orchidaceae)	Stems	Use as medicine	Fresh and dried stems, after grinding, people have been drinking this as a tonic for body pain, lethargy and religious practices.	
10.Thotney *Aconogonum molle* (Polygonaceae)	Young shoots	Use as medicine	Tender shoots, gathered during the rainy season, are enjoyed fresh in salads and pickles. Additionally, these shoots are consumed raw for their astringent properties.	
11.Abhijaal *Drymaria cordata* (Caryophyllaceae)	Whole plant	Use as medicine	Above ground parts steamed during sinus trouble. Plant paste are also used for fever, cold and cough.	
13.Bhoteylasuun *Allium* sps. (Amaryllidaceae)	Cloves	To control fungal infestation	Fresh cloves are collected, shelled, ground into a paste soaked in water overnight, filtered the next day, and then used to spray over vegetable seed beds to combat fungal infestations.	

Plant species	Plant part used/ Purpose of use (Description)	Purpose	ITKs	Photographs
14. Timbur *Zanthoxylum allatum* (Rutaceae)	Fruits and leaves	Use as medicine	The fruits serve as common Himalayan source and are employed to address issues like diarrhea and food poisoning.	
15. Siltimbur *Lindera nissiana* (Lauraceae)	Matured fruit	Use as medicine	This seed spice is akin to Szechuan pepper and is primarily utilized in cases of food poisoning and stomach ache.	
16. Chimphim *Tetratarniumnepalense* (Apiaceae)	Fruits	Use as medicine	Once mature, the seeds are gathered and employed to alleviate stomach ailments.	
17. Dalle *Capsicum annuum* var. *cersiformae* (Solanaceae)	Matured fruit	Use as insect repellent	Frequently employed as an insect repellent especially against aphids, whiteflies. Fruits are ground, and then sprayed onto the affected areas.	
18.Chilawne *Schima wallichii* (Theacea)	Leaves	Use as mulching to control diseases	Gathering fallen leaves is a method utilized for mulching in order to control issues like soft rot, bacterial wilt, and ginger soft rot.	
19. Indian rhododendron *Melastoma malabathricum* Linn. (Melastomataceae)	Stem	Use as repellent	Use of chopped pieces of stem of Phutuka or Indian rhododendron after transplanting the rice seedling to main field. Strong scent emitted by Phutuka stem possesses repelling characters against insect pests from field [14].	

Plant species	Plant part used/ Purpose of use (Description)	Purpose	ITKs	Photographs
20. Wild fern	Leaves	Use as insect repellent	The leaf extract of wild fern is being mixed with cow urine and spray to the insect infested plants to control all type of insects.	
21. Indian Wild Lantana *Lantana camara* (Verbenaceae)	Leaves	To control all kinds of insects	Aqueous extracts are being diluted with either water or cow urine and utilised as foliar spray against storage grain insects,	

@image sources: internet

Following traditional practices were highly adopted by most of the participants of study area:

Method 1: Fermentation of UTIS leaves (*Alnus nepalensis*)

1. Carefully select fresh green leaves from plants that are healthy and free from disease or pests.
2. Thoroughly wash the harvested leaves, twigs to remove any dirt, dust or contaminants. This step helps ensure a clean and effective fermentation process.
3. Chopping or shredding increases the surface area, promoting better microbial activity during fermentation.
4. Transfer the chopped or shredded leaves into an airtight container. This could be a large plastic or metal container with tight-fitting lid.
5. Close the lid tightly to create an airtight environment. This step is crucial for the anaerobic fermentation process.
6. Allow the leaves to ferment in the sealed container for a specific period, typically ranging from a few weeks to a month long. During this period beneficial microorganisms break down the organic matter in the leaves, turning it into nutrient-rich liquid fertilizer.
7. After the fermentation period, strain the liquid to remove solid residue, obtaining a clear liquid fertilizer.
8. Use the liquid fertilizer to nourish your crop after dilution to your understanding. This can be applied directly pouring it into the soil or by spraying in onto the plants as a foliar spray.

Method 2: Grinding of Titepati (*Artemesia vulgaris*)

1. Choose a clean and young leaves ensuring they are free from any pesticides or contaminants.
2. Wash the harvested leaves thoroughly to remove dirt, dust or any other impurities to reduce the risk of introducing foreign substances that could potentially worsen the bleeding situation.
3. Now grind the leaves into a paste. This can be done using a mortar and pestle (optional), in between your palm (common practice). This increase the surface area for better extraction of the juice by adding a small amount of water to facilitate the grinding.
4. Now place the ground leaves directly over the cut or strain the juice directly over the cut/bruise.
5. The extract's potential properties aid in stopping the bleeding and promote healing.
6. This plant extract is also use as insecticide same as fermented method and spray

directly to the infected plants. It works against different type of insect pests viz. aphids, white flies, cabbage white etc. It is also use against trunk borers of Sikkim mandarin.

Method 3: Egg hatchery by wild fern (*Histiopteris incisa*)

1. Gather matured leaves from the jungle, ensuring they are matured and pest free.
2. Place the harvested leaves in a suitable container for transport to the poultry area.
3. Spread the gathered mature leaves in the poultry area, creating a layer that is conducive to egg hatching.
4. Utilize the leaves to naturally deter insects that could potentially harm the eggs or chicks. There is a common belief among all the villagers that this leaves can help thwart mite infestations, providing a more favourable environment for the egg incubation.
5. It is also widely use as organic spray against various insect pests in the crop. Clean and matured leaves are collected and grinded then mixed the plant sap with cow urine at a required dose and directly spray in the infected plants. It works against all type of insect-pests. The doses are vary depending upon the farmers.

Method 4: Garlic fungicide

1. Gather locally available fresh cloves and leaves.
2. Carefully remove the outer shells from the cloves to expose the inner part.
3. Grind the shelled cloves into a paste using mortar and pestle, grinder, or similar tool.
4. Combine the paste with water to create a paste and let it soak overnight. It allows the infusion of beneficial compounds even more.
5. The following day, filter the soaked clove mixture to separate the liquid from any solid residue.
6. The filtered liquid serves as an anti-fungal solution derived from cloves.
7. Transfer the filtered substance into a spray bottle or another container suitable for spraying.
8. Spray the anti-fungal solution evenly over the vegetable seed beds, or as a foliar spray over any crop.
9. Regularly monitor the seed beds and reapply the clove-based anti-fungal spray as needed, especially after rain or as new seedling emerge.

Method 5: Chilauni soaked overnight:

Chilauni is also used by fermentation process, a locally available plant with insecticidal activity widely used by the local farmers to control different insect pests like aphids, white flies, plant hopper, leaf hopper etc. Farmers soak the fresh plant samples in water over night for fermentation and the water next day spray in the infected plants. It repels the insect-pests or works as antifeedant in the crop.

It was found that among the various traditional knowledge followed by people of south Sikkim, fermented leaf extract of *Alnus nepalensis* using as a solvent is most widely used since it can be applied as organic fertilizer as well as against

various plant diseases and pest such as aphids, which is a major sucking-pest for leafy vegetables and causes huge crop loss. Also, various studies have been done where it has found that the leaf extracts of *Alnus nepalensis* possess antimicrobial properties against fungus and bacteria. The results are in close agreement to the findings of Lamichhane et al. [15]. Therefore, the leaf extracts of it helps in both plant growth as well as protection against various biotic factors.

The next widely used ITK was found to be grinded leaf extracts of *Artemisia vulgaris* which can be used against pests such as trunk borers of Sikkim mandarin as most of the farmers having orchard grows Sikkim mandarin and trunk borer is a major pest for this fruit crop. Also, the grinded leaf extracts help in aiding human health purposes such as bruises and nose bleed. It is also similar to the findings of Gopi R et al. [16] and Han C et al. [17].

Leaf extracts of wild fern comes third in line of most widely utilized ITKs. They are usually used in combination with cow urine and are sprayed on crop to repel all sorts of insects. The ratios for mixing the extracts with cow urine varies from farmer to farmer and crop to crop. For hygiene purposes, usually in leafy and fruit type vegetables lower amount of cow urine is mixed with higher amount of leaf extract while in case of root type and underground vegetables, higher amount of cow urine can be applied in the mixture. The leaf extracts of fern have shown to possess high anti-fungal as well as anti-bacterial properties against various strains. The findings are in harmony with the observations by Chettri et al. [18] and Borkataki et al. [19].

Fungus is one of the major causes of crop loss, especially during seedling stage and being an organic state, farmers are not allowed to apply any fungicide onto their crop fields. Therefore, extracts prepared using garlic cloves can be used as an alternative to commercial fungicide as garlic possess great anti-fungal properties. The reason behind the anti-fungal properties of garlic extracts lies in the volatile compound present in garlic, which is di-allyl di-sulphide. The most commonly used fungicide is wettable sulphur. Hence, the sulphide present in garlic helps against fungus and decreases crop loss.

The fifth major ITKs utilized by the farmers of south Sikkim was extracts prepared from the leaves of *Schima wallichii,* which was prepared by soaking their leaves in water for overnight and soaking the crop with its extracts to prevent the occurrence of diseases. Also, the fallen leaves of *Schima wallichii* can be collected and utilized as green mulch. This method helps not only in retaining soil moisture, temperature and weed control but since the leaves are rich in phenols, it possesses anti-microbial properties and helps decrease in the occurrence of soil borne diseases. The results are close conformity with the findings of Choi et al. [20].

Other ITKs such as extracts prepared from *Histiopteris incisa, Eupatorium cannabium, Lantana camara, Capsicum annuum* var. *Cersiformae* and Indian Rhododendron were used for various plant protection purposes against different pest and diseases such as extracts prepared from *Histiopteris incisa* helps to control thwart mites and deter insects in the poultry, especially during the time of egg hatchling; extracts prepared from *Eupatorium cannabium* can be utilised from both medicinal purposes, extracts of *Lantana camara* are usually applied for protection against various kinds of insects as many studies has shown that its extracts possess high amount of secondary metabolites such as phenols and alkaloid which acts are pest repellent [21] while extracts prepared from cherry pepper (*Capsicum annuum* var. *cerasiformae)* which as commonly known as Dalle khursani helps in repelling insect and decreases occurrences of diseases in crop plants and extracts prepared from the barks of Indian rhododendron, which is locally known as *Phutuka,* is strongly scented and are usually plied in the rice field to repel various pests. Although, the traditional knowledge regarding these five plants is quite important but they are not being widely used as compared to other ITKs [22].

Other than agricultural purposes, there are various traditional knowledge which is used for human health, some of which we came across during our survey viz., Chimphim, Siltimbur, Timbur, Abhijaal, Thotney, Dendrobium, Pakhanbed and Sisnu. All these medicinal plants were utilised by the local healers as well as farmers for various purposes such as inflorescence and leaves of Sisnu were collected and boiled to drink as it is said to manage blood pressure; roots, rhizome and leaves of Pakhanbed are utilised to make tea (dried and grounded rhizome & roots) and stew (green leaves) as it helps to alleviate body and bone pain; stem (fresh and dried) of Dendrobium are being used to make health drink; Young shoots of Thotney are consumed as salad or made into

pickle for a healthy body; Whole plant of Abhijaalis utilised as medicinal purpose against Sinus (grounded parts are used for steaming) as well as for cough, cold and fever using fresh paste made out of it; and Fruits and leaves of Chimphim, Siltimbur and Timburare utilized to alleviate stomach ailments such as food poisoning, diarrhoea and stomach pain. Since the hospitals are usually very far away in many parts of the villages, it is a necessity to have traditional knowledge regarding medicinal plant for better survival of these people, especially the tribal people. Some traditional knowledge was regarding handicrafts as they are economically viable in nature. These includes handicraft made from husk of *Zea mays* which are used to make crafting items such as tool mats, baskets etc. also, leaves and bulbs of *Cymbidium* are collected and dried to make foot bats, baskets and many more.

The traditional knowledge regarding these plant species differs from place to place and tribe to tribe [23]. These traditional knowledges have been built up over a long period of time and with constant standardization by the indigenous people. Since most of the plant species found to have multiple purposes, it can be suggested that they have immense potential for both pharmaceutical as well as agricultural usage. This study suggests that the indigenous traditional knowledge should be explored more and proper documentation should be done which can help identify important plant species and can be conserved if needed.

4. CONCLUSION

The value and eco-supportive role of indigenous technical knowledge has recently been recognized to some extent. For researchers, this study should serve as an important source of information for the upcoming research and management of biological resources that will ultimately help in protecting these plants. Also,it looks like this old knowledge is going away with the younger generation. This situation is worsened by the absence of a coherent documentation in writing or digital form.It is necessary to raise awareness about ITKs in rural communities in order to conserve them and avoid extinction. To do this, ITKs needs to be used on a regular basis as an intrinsic component of organic farming. Prior to their use in organic farming, prerequisite information like as optimal doses and application times must be worked out and standardized by scientific investigation of the most potent ITKs. Furthermore, because ITK is economically viable in nature, it can be prudently used for sustainable agriculture, addressing hidden hunger and nutritional insufficiency in every undernourished resident of India.

5. RECOMMENDATION

This study has illuminated the profound significance of Indigenous Traditional Knowledge (ITK) in contemporary contexts, showcasing its invaluable contributions across various fields. Building upon the findings and insights gained from this research, several recommendations can be done such as proper documentation and preservation of these ITKs, sustainable development including both science and traditional knowledge etc.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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