TRADITIONAL KNOWLEDGE IN THE DEVELOPMENT OF SCIENTIFIC KNOWLEDGE

1. INTRODUCTION

Traditional knowledge (TK) is knowledge, know-how, skills and practices that are developed, sustained and passed on from generation to generation within a community, often forming part of its cultural or spiritual identity. While there is not yet an accepted definition of TK at the international level, it can be said that:TK in a general sense embraces the content of knowledge itself as well as traditional cultural expressions, including distinctive signs and symbols associated with TK.

TK in the narrow sense refers to knowledge as such, in particular the knowledge resulting from intellectual activity in a traditional context, and includes know-how, practices, skills, and innovations. Traditional knowledge can be found in a wide variety of contexts, including: agricultural, scientific, technical, ecological and medicinal knowledge as well as biodiversity-related knowledge.

Traditional knowledge is the knowledge or practice that has been passed down from generation to generation and forms part of the traditions or heritage of the indigenous communities. They are the knowledge or practice for which indigenous communities act as the guardians or custodians in preserving. Indigenous cultural expression is the ways in which indigenous communities express their traditional culture. Indigenous communities regard themselves as the guardians and owners of traditional knowledge and indigenous cultural expression on behalf of their communities.

The concept of traditional knowledge gained recognition by UN Conference on Environment and Education in 1992. Indigenous Technical Knowledge (ITK) can be defined as ‘’an accumulated skill and technology of a locality or a community that has been passed on from one generation to another generation’. It is not confined to the rural people rather any community possessing indigenous knowledge *viz.*, rural or urban, settled or nomadic, original inhabitants and migrants. The methods of collecting traditional knowledge are interaction with elders and leaders, rural appraisals, case study, brainstorming, group discussions, field observations, notes, photos, audio recordings, video recordings etc. Traditional knowledge plays an important role in the developmental process by integrating with scientific knowledge.

1.1. Objectives

- To understand the concept of traditional knowledge and its' characteristics
- To understand the importance of blending traditional knowledge and scientific knowledge
- To understand the reviews related to traditional knowledge in agriculture

2. CONCEPT OF TRADITIONAL KNOWLEDGE

Traditional knowledge refers to the knowledge, innovations and practices of indigenous peoples. Developed from experience gained over the centuries and adapted to the local culture and environment, traditional knowledge is often transmitted orally from generation to generation. It tends to be collectively owned and can be expressed in stories, songs, folklore, proverbs, cultural values, beliefs, rituals etc. It is also the source for the traditional use and management of lands, territories and resources, with indigenous agricultural practices that care for the earth, without depleting the resources. Indigenous peoples follow oral traditions, with dances, paintings, carvings and other artistical expressions, that are practiced and passed down through millennia. Traditional knowledge is at the core of indigenous peoples' identities, cultural heritage and livelihoods. The transmission of traditional knowledge across generations is fundamental to protecting and promoting indigenous peoples' cultures and identities and as well as the sustainability of livelihoods, resilience to human-made and natural disasters, and sustaining culturally appropriate economic development. Traditional knowledge underlines indigenous peoples' holistic approach of life, which is a central element of the world's cultural and biological diversity.

2.1. Indigenous cultural expression

Indigenous cultural expression refers to ways in which Indigenous communities express their traditional culture, ways that are part of their heritage or identity, ways that are passed down from generation to generation. Indigenous cultural expression might, for example, take the form of song, stories, dances, art, designs, crafts, etc. Indigenous communities regard themselves as the guardians and owners of traditional knowledge and Indigenous cultural expression on behalf of their communities.

The intellectual property framework does not easily protect traditional knowledge and Indigenous cultural expression. Sometimes, the opposite is the case, where the intellectual property framework might operate to allow traditional knowledge and Indigenous cultural expression to be commercially exploited, for great profit, without any economic benefits accruing to the Indigenous communities that made it available in the first place.

For example: An Indigenous community might have knowledge that a particular plant has a medicinal effect. Scientists, with the benefit of that knowledge, undertake research on the plant. They identify the compounds that have the medicinal effect and develop a drug. The pharmaceutical company that produces and markets the drug realises significant profits, and its shareholders benefit financially. However, there are no economic benefits for the Indigenous community that made this possible.

The music of an Indigenous folk song might be adapted so that the adaptation is subject to copyright. The copyright holder earns royalties and income from the recording, as well as its performance. However, no royalties or income are shared with the Indigenous community that 'owned' the music before its adaptation. However, intellectual property laws offer protection for traditional knowledge and Indigenous cultural expression in only a modest way.

For example, maintaining the knowledge of the medicinal properties of a plant as confidential information might be effective. However, it is only by disclosing that information that economic benefits and other benefits can be realised, by research, and patents. Protecting works as copyright might be only a modest protection, if any at all, given that most works, having been passed down from generation to generation, might not so easily be protected by copyright. Efforts are being made to provide some protection for traditional knowledge and Indigenous cultural expression.

For example, under Queensland's Biodiscovery Act 2004 (the Act), a biodiscovery entity (an entity that uses the state's native biological material for commercial purposes) is required to enter into a Benefit Sharing Agreement with the State of Queensland. This ensures the State, for the benefit of all persons in the State, obtains a fair and equitable share in the benefits of biodiscovery. The Queensland Government is exploring options for changes to the Act.

The Benefit Sharing Agreement includes a requirement for the biodiscovery entity to comply with the Queensland Biotechnology Code of Ethics, which provides guidelines in relation to the use of indigenous knowledge for biodiscovery. However, the protection of traditional knowledge and Indigenous cultural expression remains an objective that is only modestly achieved by the existing intellectual property framework. Internationally, efforts are being made to formulate a treaty where traditional knowledge and indigenous cultural expression can have the benefit of its own intellectual property law, which blends with the existing intellectual property law framework.

2.2. Importance of Indigenous Technical Knowledge

The Indigenous Technical Knowledge (ITK) is the local knowledge that is unique to a given culture or society where its knowledge passes from generation to generation. It is the knowledge that people have gained through inheritance from their ancestors. Wang (1988) defined ITK as "the sum total knowledge and practices which are based on peoples accumulated experiences in dealing with situations and problems in various aspects of life and such knowledge and practices are special to a particular culture." ITK is stored in people's memories and activities, and is expressed in the form of stories, songs, folklore, proverbs, dances, myths, cultural values, beliefs, rituals, community laws, local language and taxonomy, agricultural practices, equipment, materials, plant species and animal breeds. ITK is shared and communicated orally, by specific examples and through culture. An African proverb says "When an old knowledgeable person dies, a whole library dies" indicating the importance of ITKs.

The basic characteristics of the ITKs provide for conservation and efficient utilization of resources by being eco-friendly, less capital intensive, cost effective, and efficient byproduct and waste recycling and use. Most of the ITKs are location – specific, using locally available materials and are products of informal research. ITKs are found to be socially desirable, economically affordable, sustainable, and involves minimum risk to users and widely believed to conserve resources. Thus, ITK provides basis for problem solving strategies for local communities. In addition, the use of ITK assures that the end user of specific development projects are involved in developing technologies appropriate to their needs (Warren, 1991).

Some of the ITK's practiced in crop husbandry are as follows:

*   Stubbles are burned in the field for controlling pests.

*   Neem leaves are buried in soil for termite control

*   Ash is applied in seedbeds and in the field of paddy nursery before sowing to control insect pest attack

*   Residues of Tobacco are incorporated into soil to control termites.

*   Deep ploughing is taken up in summer in drylands for avoiding hard pan in soil, improving water holding capacity and pest control

*   The filtered extract of well crushed cloves of garlic (1/2 kg) mixed in kerosene and left overnight, filtered solution of 50 grams crushed chillies in one litre of water and 100 grams of detergent powder dissolved in sufficient quantity of water is mixed. The mixture of these three solutions is used at the rate of 25 ml in 16 litres of water and sprayed on the pigeon pea crop for controlling pod borer. (It is found scientifically that garlic has volatile sulphur containing oil which is vaporized with increased temperature, Chillies contain capsaicin which irritates skin, the detergent helps in spread of solution and adherence to crop.)

*   Cotton seeds are dipped in cow dung slurry and shade dried before sowing to facilitate better germination.

*   Pulse seeds are treated with red earth slurry and shade dried for prevention of storage pests and better germination.

*   Sheep and Goat are penned in fields prior to ploughing, to enrich fertility status of the soil.

*   Intercropping Sesbania with Tomato during summer is found to enhance the yield of Tomato crop.

*   Intercropping castor, Bhendi and Cluster beans with Cotton reduced pest and disease incidence in Cotton.

* Using Neem and Eucaluptus leaves in storage bins controlled damage by storage pests in cereals.

* 6-8 kg of freshly collected green neem leaves (Azardirachta indica) are boiled in 10 liters of water until the liquid turns dark brown. After 10-12 hours, this is mixed with 80-100 liters of clean water and sprayed on the fields for controlling the girdle beetle (Oberia brevis), Bihar hairy caterpillar (Dicrisia oblique) and other pests in soya bean.

* 1.5 - 2 kg of dry tobacco leaves are placed in 5-6 litres of water and boiled until the liquid is reduced to 1-1.5 liters and has turned dark black. After 10-12 hours the solution is filtered and mixed with 80-90 liters of fresh water to spray one hectare, early in the morning to control the larvae of gram pod borer (Heliothis armigera).

The Indigenous Technical Knowledge (ITK) could be helpful towards the achievement of food security at the household level and could also make contributions to the development of sustainable adaptation policies to assist rural based communities. The framework of local knowledge systems combining traditional skills, culture and artifacts with modern skills, perspectives and tools is not something that has happened only in the recent past. From time immemorial, new crops were introduced from one part of the world to another and cultural and ecological knowledge systems evolved while adapting these crops, animals, trees, tools, etc., into their new contexts. This is an ongoing process. Therefore, the need of the hour is to create a foundation at the national level that helps in building national register of innovations, file applications for patents, and provide micro-venture capital support for enterprises based on indigenous knowledge and non-material incentives such as recognizing or honoring innovators and community holding indigenous knowledge.

2.3. Characteristics of ITK

Indigenous technologies are recognized as animate, imbued with the breath of life, they live in form and function having emerged from the realms of the invisible. Indigenous technologies emerge from the implicate order to reflect the art of skillful living. Indigenous technology is pragmatic. It is responsive and responsible to the ecology in which it lives. Indigenous technologies attract the learning spirit(s) they provide a learning ecology that supports the revitalization and transformation of awareness and knowledge. To maintain and renew balance and harmony within a multi-dimensional environment. Indigenous

Technology is created within a sensory environment that builds on our sense of relationship, meaning, balance, feeling, memory and place as well as sight, sound, smell, taste and touch. Through meaningful interactions Indigenous technology seeks to engage and evoke significant knowledge and experiences reflective of the Indigenous world. Indigenous technologies have the obligation to come into existence, to be used and to transform within an ethical space that is responsible to life in all its forms. The ability or capacity to make something does not constitute a valid reason for its existence. Indigenous technology is coherent with the natural order. Indigenous technologies have intrinsic value because we know their ancestry where they came from, what their place is in our world. We know they will transform and pass from this place to return to the realms of energies.

3. TRADITIONAL KNOWLEDGE AND SCIENTIFIC KNOWLEDGE

3.1. Difference between traditional knowledge and scientific knowledge

Indigenous knowledge is often seen or referred to as ‘’people’s science’’ simply because it is rooted in local culture and tradition. IK is usually preserved and transmitted through observations and experience verbally, with forecast methods rarely documented, whilst modern scientific knowledge is usually written. These practices have been observed in most African countries, as communities had their explanations based on social and spiritual values. However, in rural communities, IK is a way of life; it looks at both the process of knowing and the knowledge itself. It is explicit in its social-context aspect and it is an integral part of peoples culture. On the other hand, modern science has no social context. It is based on rules of science, which are repeatable, evidence, quantification, and number based. While IK has rules of the knowing, process language-based and qualitative. Moreover, IK is holistic and covers variables qualitatively, while modern science covers a small number of variables quantitatively. IK is grounded within specific communities for local conditions and needs, whereas modern science is formulated at a larger scale and lacks relevance at a local level. Indigenous knowledge refers to rainfall duration and distribution and it is aligned to crop-weather indicators, whilst modern science refers to rainfall quantity at a regional level.

3.2. Potential of integrating Indigenous Knowledge Systems and Modern Science

Although the two knowledge systems are viewed differently when defining seasonal phenomena by local farmers and scientists, there is a significant overlap between them especially regarding climate and weather forecasts. Both knowledge systems have weather produced through validation, experimentation, and observation, suggesting a meeting point between them. Smallholder farmers are willing and open to the idea of integrating new information into their indigenous methods. The willingness and interest smallholder farmers have could work at an advantage for climate scientists, as this could give them the ability to design forecasts that would be acceptable and of priorities to smallholder farmers. For instance, in most cases, climate scientists' systems rest on spatial analysis courses that do not always address the risks in sub-regions that are drier relatively to moist regions. So, these provide an opportunity for incorporating indigenous knowledge of spatial variability in climate patterns for identifying areas at risk for drought. Due to some reasons, smallholder farmers do not embrace scientific forecasting information. This is because they lack a sense of ownership, so, that has added to the partial acceptance of the meteorological information disseminated. Modern science is more acceptable to indigenous communities if it is integrated with what they already know. Climate scientists are under pressure to encourage farmers to part-take and participate in using the meteorological information to realize its full potential.

Therefore, an arrangement between smallholder farmers, climate scientist, and policymakers is crucial to create partnerships that will allow maximum use of available climate information using indigenous climate indicators, and building culturally relevant analogies into the climate communication process. Hence, the South Africa Department of Science and Technology (DST) developed a national policy on indigenous knowledge systems that promotes interfacing indigenous knowledge with other knowledge systems and provides opportunities for new products and services further highlighted that integrating indigenous knowledge systems with scientific knowledge needs the cooperation of the government, which is often lacking in most cases.

Smallholder farmers can achieve the integrations of the two knowledge systems through the establishment of a proper information dissemination network that will be easy to understand. Dissemination channels such as community-based organisations, local schools, use of mobile app and local churches would greatly enhance the farmers' food security. Importantly, for easier understanding of the scientific weather forecasts by the majority of the smallholder farmers, the disseminated weather forecasts information should be translated into farmers‟ native language. Therefore, there is a need to integrate the smallholder farmers' indigenous knowledge and modern science by having both scientific and local indigenous custodians working together to produce accurate and comprehensive weather forecasts for better production and adaptation to climate change.

4. PROCESS AND METHODS OF ITK ANALYSIS

4.1. Identification and collection of ITK: methods and techniques

1. Documentation of oral histories
2. The Delphi method
3. Agro-ecosystem analysis a) Mapping (ecological, agronomic, seasonal, spatial) b)
a. Transect
4. Manual discriminative analysis (ask farmers to discriminate practices and find
a. rationality)
5. Decision tree analysis
6. Use of local resource persons
7. Linguistic and historic analysis of concepts, vocabulary and key words
8. Ethno botany
9. Critical incident analysis (farmers „seed exchanges and new variety introduction)
10. Analysis of peasants‟ journals and newspapers

4.2. Documentation

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

4.3. Testing and Validation: method and techniques

1. Prepare a list of all the collected ITK practices
2. Decide the continuum for rating the rationality of ITK with specific weight ages
3. Send the list of ITK practices to experts for their opinion and judgment on each
4. practice.
5. Calculate the weighed mean score of individual practices.

6. Select practices above mean score as rational.

4.4. Developing extension programme to validate farmer experiments

Farmers are not passive consumers, but active problem solvers who develop for themselves most of the technology they use. For many hundreds of years before today's national agricultural research systems were set up, farmers did their own research. And, by integrating technology from different sources and continuing to adapt it on their farms, they still do so today. Indigenous knowledge systems form the basis for informal experimentationof farmers. The factors which influence farmer experimentation are:

1. Ecological: innovations that result due to interaction among crops, soil, and climate
2. Historical: a major happening such as crop failure or year of glut or scarcity
3. Serendipity: a practice discovered by farmers accidentally
4. Economical: Farmers innovate new practices taking advantage of government
5. Subsidies for flood and drought relief activities.

Validating farmer experiments is an extension process in which SMSs encourage farmers to replicate their own experiments in their own environment in order to understand experiments in the socio-cultural and agro-ecological environments, determine the impact of the experiments on productivity, profitability, and sustainability of the agricultural system

The various steps involved in the process of developing the extension programs are:

1. Selecting "research minded" village extension workers
2. Identifying "research minded" farmers who are already involved in farmer experiments
3. Establishing programs for validating farmer experiments

The various steps involved during the process of validating farmer experiments are:

1. Understand the rationale behind farmer experimentation.
2. Recording the mode of conducting experiments.
3. Identifying farmers' evaluation criteria.

Understanding, identifying, recording, and evaluating farmer experiments form the various stages of validating farmer experiments. It is important that extension personnel must understand the farmers' criteria when they explore indigenous approaches to experimentation.

5.TRADITIONAL KNOWLEDGE IN AGRICULTURE

Indigenous Traditional Knowledge (ITK) is developed over a period of time through accumulation of experiences and intimate understanding of environment. This knowledge is gradually vanishing due to population pressure and industrial development. Traditional crops and cropping practices are becoming extinct, of which modern farming practices are major contributors. Further climate change is a significant change in the statistical distribution of weather patterns. The Intergovernmental Panel on Climate Change Third Assessment Report 2001 concluded that current knowledge on adaptation to climate change is limited and emphasized the need for research on viable adaptation measures. India is vulnerable to climate change as the majority of its population depends on agriculture, which is climate sensitive. Agriculture in India is involved in domestic food supply, employment and cash income. Recognizing the challenges to mitigate climate variability promotes more sustainable and resilient agriculture. The traditional knowledge for ecosystem management and use of natural resources is gaining credence as a key weapon to fight against climate change. Understanding the ITK will help sustain farming practices preventing plant genetic erosion and environmental deterioration. It contributes to sustainable food security and conservation of variety and variability of animals, plants and soil properties.

5.1. Rain-water management

Rain water management for teak, mango and neem in arid and semi-arid regions Description of the ITK This practice is to retain rain water in the soil and to grow trees, particularly mango, neem and teak, which are best suited for arid and semi-arid regions. The practice is appropriate for a garden or estate where teak, mango or neem trees are grown. This technique may be adopted in areas where there is less water available. There is no practical risk and it is easy to handle, less labour intensive and best suited for such trees. This is in practice in Periakovilankullam village of Tirunelveli district in Tamil Nadu.

Rain-water measurement using rolu (indigenous raingauge) Description of the ITK Rolu (7.4” depth, 9” diameter hole on a 3’x3’x1.5’ granite stone block) is useful in knowing the quantity of rainfall for sowing. Seeds in the field are sown when the rolu is filled with rain-water. This technique helps the farmers in estimating the rainfall that is sufficient to go for seeding. This method is adopted for sowing dryland crops like sorghum, castor etc. in Alfisols.

Method of rain-water management in mountainous land scape under apple orchard Description of the ITK In several parts of the Himalayas villages, villagers often harvest rain water by building small waterstorage "ponds" (locally called chaal).The number of such ponds varies from 30 to 40 depending upon the valleys and villages. Each water pond is 9 m. long, 9 m. wide and 0.9 m deep. The water used as drinking water for cattle and for irrigation purposes.

5.2. Soil and water management

Cultivation of apple in Himalayan region Description of the ITK Traditional apple-orchard farming involves the use of contour ditches, water-control canal, soil traps, bench terraces and hedge rows of fast-growing leguminous plants, which have been adopted by the farmers of Himalayan region. Soil and water erosion is a serious problem in hilly regions. Since earlier times farmers used to practice this technology in an integrated way to improve soil and water conservation and manage nutrients in apple orchard. This technology helps in stabilizing the fragile eco-system dominated by apple-farming system. Use of such technologies lays focus on soil and water conservation as well as fertility management, resulting in a paradigm shift towards maximization of productivity, profitability and sustainability of hill eco-system. This is in practice for several years.

5.3. Pest and disease management

Management of yellow stem-borer in paddy by use of parasi (Cleistanthus collinus) leaf Description of the ITK Application of 75-150 kg parasi (Cleistanthus collinus) leaves by broadcasting once in the rice field at 3 days after transplanting controls yellow stemborer during kharif. All the rice growers in Aralkocha village of Purulia district in West Bengal follow this practice for the last 50 years.

Control of insect-pests in lowland rice using parasi (Cleistanthus collinus) Description of the ITK Approximately 0.4 to 0.5 kg fresh, tender branches of Cleistanthus collinus are planted erect or spread in the standing water after establishment of summer rice with the anticipation of pest outbreak. This practice is being followed by a good number of farmers belonging to Kapgari village under Jhargram subdivision in Midnapur district of West Bengal. This practice has been in vogue over generations without any modification and is being followed in patches vulnerable to insect-pest incidence. Rice gundhi bug generally appears in damaging level during rainy (kharif) season in the early maturing varieties that mature during 1st or 2nd week of October.

Planting of wild Saccharum spontaneum in paddy field for controlling leaf-folder Description of the ITK Wild sugarcane (Saccharum spontaneum) twigs of height 4 to 5 feet and 4 to 5 cm diameter are planted after 15 days of transplanting in rice field for control of leaf-roller. These erected branches harbour the predators at the time of occurrence of leaf-roller, thereby suppressing the incidence of pest. About 90% farmers in the Benakunda village of Ganjam district in Odisha adopt this practice. Wild sugarcane, Saccharum spontaneum grows near river banks on marshy lands. The plant is used by the farmers of Bhanjanagar area (Ganjam district) to control case worm in rice.

Control of gall fly (Pachydiplosis oryzae) in rice Description of the ITK Gall fly (Pachydiplosis oryzae) is very harmful to rice crop. It damages whole crop of rice. Farmers of Tamar block of Ranchi district in Jharkhand use parso or persu (Cleistanthus collinus) leaves for controlling gallfly. In this practice, fresh leaves of parso or persu are collected and spread in the infested field without processing. About 10 kg leaves are required for 100 m2 area. These leaves are spread at the initial stage of infestation. This practice controls 70-80% insects. All farmers of the village use this age-old practice.

Management of gundhi (harmful green algae) in paddy field by karada (Cleistanthus collinus) leaves Description of the ITK Gundhi (Chard) which occurs in kharif paddy fields in stagnant water, can be controlled by broadcasting 50-100 kg freshly plucked karada leaves in August. The algae consumes oxygen from water of the rice field and produces carbon dioxide, which results in yellowing and dwarfing of rice plants. The toxicants present in karada leaves damage chlorophyll of green algae. This practice has been in use since time immemorial in Panipila village of Nayagarh district in Odisha.

5.4. Horticultural crops

Pest management in tomato (Lycopersicon esculentum) by using leaf extract of Cynodon dactylon

Root rot and damping off in tomato is controlled by applying Cynodon leaf extract. This is applicable only for tomato PKM, 1 (local variety) in Karikuttanoor village district Dharmapuri. Fresh leaves of Cynodon dactylon (doob in Hindi, arugampul in Tamil) are dried in shade. The dried sample is powdered and then mixed with water and placed in an air-tight mud pot and left undisturbed for 24 hr. This mixture is filtered twice, first using gunny cloth and then with a white cloth. The clear mixture is ready for use. Then 1 litre of this mixture is added to 1 litre water, which is sprayed either by using hand-sprayer or by power sprayer.

When tomato seedling is 15 days old, this mixture can be sprayed at frequent intervals until harvest. For 1 acre land, 10 litres of this solution is recommended. Control of root rot and damping will result in good yield. It is best suited only for tomato PKM 1 in Thaipattam (January).

Control of insect-pests in cucurbits, cowpea and lady's finger by spraying cow urine mixed with tobacco-soaked water.
Insect on leaves and fruits of cucurbits, cowpea and lady's finger are very common. These are controlled by spraying urine of domestic animals mixed with tobacco-soaked water. This age-old practice has been adopted by 56% farmers in Bahadurpur village of Dhanbad district of Jharkhand.

Control of insect-pests by spraying starch, animal urine and dusting of cowdung ash in vegetables Description of the ITK The sticky nature of starch and uric acid of animal urine helps in killing the insects. Dusting of cowdung ash helps in controlling the biting and chewing types insects, especially aphids. Rice starch and animal urine are sprayed on vegetable plants. These traditional practices are adopted by 85% farmers in Kurchi village of Dhanbad district in Jharkhand.

Control of shoot and fruit borer through use of tobacco (Nicotiana tobaccum) soaked water in brinjal (Solanum melongena) The shoot and fruit borers are very common in Kauwakol, Jorawardih and Mananiyatari villages in Kauwakol block in Nawada district of Bihar. Tobacco is soaked in water in the ratio of 1 : 10 overnight and the extracted liquid is filtered through fine cotton cloth. The filtered material is sprayed either with spray machine or fine broom. Before spraying, 1-2 teaspoonful detergent powder is mixed in the filtered liquid. This is an age old practice by majority of the farmers in these villages.

Protection of cabbage from pests Description of the ITK Cabbage is one of the important cash crops of Shimla district. In cabbage plants a special type of pest spoils the inner portion of cabbage, the cabbage remains loose, and ultimately plant falls down. Ash and cow urine are used to protect cabbage plants from insect pests. This ITK is useful to check insect pests and also to enhance cabbage productivity. Cow urine may have same chemical that may have insecticidal properties.

5.5. Farm implements

Pingali dhanti for intercultural operation in tomato

Bullock-drawn pingali dhanti can be effectively used for weed control in tomato both during kharif and rabi instead of hand-weeding. It can cover an area of 0.4 ha/day with a cost of operation of Rs. 150/ha. By adopting this, clean weeding is achieved. It costs about Rs. 100.

Guddeli to uproot ginger Description of the ITK Good harvest with total recovery of ginger with less power is obtained by use of guddeli at harvest. It is easy to operate and cost of operation per hour is Rs. 300. The cost of guddeli is Rs. 60 per piece.

5.6. Fishery and animal science

Use of banana pseudostem in fish pond to enhance productivity of fish

Pseudostems of banana, after harvesting the bunch, are added to the pond by cutting longitudinally, which increases the pH and oxygenation of pond water. This practice increases the fish yield. As it involves low cost, it is being followed by 80% of the farmers in Bastar village of Balasore district in Odisha.

Treatment of foot-and-mouth disease in cattle by using harida (Terminalia chebula) and baheda (Terminalia bellirica) Description of the ITK Foot-and-mouth disease (FMD) in cattle is controlled by applying to the affected parts with 500 g each of harida and behada powder mixed with 2.5 liter water, twice a day, after boiling. It is being used extensively by the cattle growing farmers in Makarbili village of Nawapada district in Odisha.

Curing lesions of FMD or wounds by applying extract of peach (Prunus persica) leaves mixed with fresh milk Description of the ITK To treat the lesions of mouth and hooves of the animals suffering from FMD, an extract of peach leaves mixed with fresh milk is applied three times daily on the lesions of FMD-affected parts of the animals. This is followed in many villages of Budaun, Shahjahanpur and Bareilly districts of Uttar Pradesh.

Use of Babool (Acacia nilotica) and Jamun (Syzygium cumini) bark extract to cure footand-mouth disease in animals Description of the ITK A paste of Babool bark and Jamun bark is applied on the hooves of the FMD-affected animal thrice daily, costing Rs. 2-5 per animal. In this method the disease is cured up to 70%.

6. ITK in Karnataka

1. Sowing of sorghum, red gram and Beans on bund of Terraces Advantage: Efficient utilization of space and smothering the weeds on bunds

2. Mixed cropping of Rice + Sorghum in drought prone areas.
Advantage: As insurance crop to get the produce from either of one crop depending on rainfall

3. Inter-cultivation and 'Hodta' (Planking) operations in dry and wet conditions in paddy fields

Advantage: Helps in removing the weeds, induces better tillering, avoids percolation loss of water and nutrients

4. Cutting the sides of terrace bunds during rainy season with big sickle and putting the soil on terrace bunds.

Advantage: Removes weeds and avoid the flow of water from Paddy fields

5. Manuring the weeds removed by heaping in the fields and turning it frequently

Advantage: Improves organic matter and soil properties in the paddy fields.

7. ITK and IPR

The relationship between indigenous/traditional knowledge and intellectual property law is a complicated contemporary legal problem. Questions around indigenous knowledge protection present issues unlike any other that intellectual property law has had to consider. Indigenous peoples' concerns include legal questions involving copyright, patents, trademarks, designs and/or confidential information. They also raise issues that are not always legal or commercial in nature and can include ethical, cultural, historical, political, religious/spiritual and moral dimensions.

Intellectual property law is largely European in derivation and promotes particular cultural interpretations of knowledge, ownership, authorship, private property and monopoly privilege. Indigenous peoples do not necessarily interpret or conceptualize their knowledge systems and knowledge practices in the same way or only through these concepts.

Indigenous peoples' interests in intellectual property law can affect over 370 million indigenous people and any researcher, cultural institution, corporation, industry affiliate or government department working in and/or with indigenous peoples and/or indigenous communities.

While the value of indigenous knowledge has changed dramatically in the last ten years, there is not yet an international consensus about how indigenous rights to the protection of their knowledge systems can be secured, either within an intellectual property regime or through some other over-arching legislative or policy framework.

Indigenous people must be centrally involved in developing appropriate frameworks for access and use of their knowledge and knowledge practices. Future directions are foundationally dependent upon the development of frameworks that enhance and embolden indigenous perspectives about existing and emerging knowledge management approaches. Indigenous knowledge can no longer be considered a raw-resource from which others benefit. Indigenous people are asking for their cultural systems and ways of governing knowledge access and use to be recognized as legitimate, and to be respected as custodians/owners/nurturers of knowledge that is valuable within and beyond indigenous contexts.

Critical evaluation of categories and frameworks that have been taken for granted are crucial for developing new strategies in this area. Rethinking how we do research, how we conceptualize knowledge, how we share knowledge, how we recognize legitimate overlaps in knowledge use and circulation, and the extent of the role of law in influencing our social orders of knowledge exchange, are necessary starting points.

Two types of intellectual property protection are being sought

Defensive protection aims to stop people outside the community from acquiring intellectual property rights over traditional knowledge. India, for example, has compiled a searchable database of traditional medicine that can be used as evidence of prior art by patent examiners when assessing patent applications. This followed a well-known case in which the US Patent and Trademark Office granted a patent (later revoked) for the use of turmeric to treat wounds, a property well known to traditional communities in India and documented in ancient Sanskrit texts. Defensive strategies might also be used to protect sacred cultural manifestations, such as sacred symbols or words from being registered as trademarks.

Positive protection is the granting of rights that empower communities to promote their traditional knowledge, control its uses and benefit from its commercial exploitation. Some uses of traditional knowledge can be protected through the existing intellectual property system, and a number of countries have also developed specific legislation. However, any specific protection afforded under national law may not hold for other countries, one reason why many indigenous and local communities as well as governments are pressing for an international legal instrument.

8. CASE STUDIES

8.1.Method of rain-water management in mountainous land scape under apple orchard

Description of the ITK

In several parts of the Himalayas villages, villagers often harvest rain water by building small waterstorage "ponds" (locally called chaal).The number of such ponds varies from 30 to 40 depending upon the valleys and villages. Each water pond is 9 m. long, 9 m. wide and 0.9 m deep. The water used as drinking water for cattle and for irrigation purposes. Name and address of the discloser Shri Prem Singh Verma, Gawahi village, Sandhu P.O., Theog tehsil, Shimla (Himachal Pradesh) 171 222.

Location of use of the ITK

Different villages in the foot-hills or valleys of the Himalayas were considered. The experimental site is an apple orchard, located at village Gawahi, which is 45 km from Shimla city on national highway 22 (commonly called Hindustan-Tibet Road) and 8 km from Theog town, which is a gateway to apple belt of Shimla district. The orchard is of about 3 ha area, at 2,400 m above MSL, which was established 10 years ago.

Experimenters Dr. Pradeep K. Sharma, Chief Scientist (WM), Dr. O.C. Kapur, Senior Scientist (Soils), and Dr. S. S. Masand, Senior Scientist (Soils), Department of Soil Science, Ch. Sarwan Kumar Krishi Viswa Vidyalaya, Palampur (Himachal Pradesh) 176 062. Results and discussion This experiment was conducted during 2002- 2004. Two sets of treatments were imposed in this study.

1. For in-situ rain-water harvesting and profile moisture conservation, the following three sets of treatments, in addition to control, were tested: mulching, terracing + mulching, and terracing + trenching + mulching.
2. For testing chaal, five types of dug-out tanks were constructed at appropriate locations in the experimental area, viz. (i) polyethelene-lined tank, (ii) bitumen (tarcoal)-lined tank, (iii) cement+ concrete lined tank (RCC), (iv) mudplastered tank, and (v) unlined tank (control). Indigenous rain-gauge (rolu) Measurement of rain water collected in rolu 5 Traditional Knowledge in Agriculture The whole experimental site was divided into three blocks for imposing the following treatments:

i) Terracing: Land shaping between two apple trees along the contours in such a way that rain water flows towards the tree basins,
(ii) Trenching: Small trenches of appropriate sizes were dug above the tree basins to harvest rain water in situ. (iii)Mulching: The tree basins were mulched with FYM, pine-needles, pebbles and cocopit, in addition to unmulched control. Stability of terraces and trenches Land shaping (trenching and terracing) was done in October-November 2002. Due to fragile nature of landscape and heavy snowfall during winters, the terracing was severely damaged, and had to be reconstructed after one and half years.

Therefore trenches need to be frequently repaired in fragile and erosion-prone soils. In spite of the damage done to the terraces and trenches due to rainfall and snow, the moisture conservation due to these land-shaping treatments encouraged the growth of natural vegetation. After the rainy season, the terraces provided with trenches showed profuse growth of grasses and leguminous vines due to profile water conservation. It would help in soil conservation and add organic matter to the soil upon its decay. conservation through harvesting the runoff water and the water directly from the rains and snow.

Terracing alone was also effective in conserving moisture by directing the flow of runoff towards plant basins. Terracing and trenching thus should be practised in rainfed orchards for harvesting and conserving rain water in situ. Mulching retained more soil moisture than no-mulch. Pine-needle mulch had an edge over other mulch materials. Pine needles are easily available locally. Pebbles also appear as a potential mulch material, as they are also locally available in plenty. The land shaping as well as mulching used for soil-moisture conservation significantly improved the growth parameters of apple trees, viz. plant height, canopy circumference and stem diameter.

The making of tree basins significantly improved all the three growth parameters. However, composition of terracing and trenching further improved the plant growth whereas all the three parameters were highest under the treatment of basin+terrace+trenching. Likewise, growth of apple trees was better with mulch than without mulch and highest plant growth was observed with pine-needle mulch. Effect of mulching on water status of apple Trees The relative leaf water content (RLWC) increased significantly with the application of mulch. Highest RLWC was observed with pine-needle mulch, and the lowest in control. Water harvesting The RCC and polylined tanks were effective in storing rain water in-situ water from springs brought to the site through rubber pipes.

No seepage was observed in RCC and polylined tanks even after 2 years of their construction. The bitumen-lined tank did not perform well at this site, because the soil at the experimental site was loose and gravelly. The chaal has to be lined with some effective sealant, like RCC or polyethylene (UV resistant material). Cost of construction was highest in RCC tank, followed by polylining and bitumen lining. Although the cost involved in the construction of mud-plastered and un-lined tanks was minimum, their utility would depend on the seepage losses and hence the effective water storage. Chaals without lining are not effective at all locations because of excessive seepage losses. To increase their efficiency in storing the harvested rain water, either the chaals have to be lined with suitable lining materials, or locations have to be identified for constructing chaals, that are low lying and naturally have very low permeability to water. Polythelene and RCC were two very effective lining materials for Chaals used traditionally in the village Trenching along the hill-side wall Terraced block Soil-moisture conservation Land shaping had significant effect on soilmoisture conservation.

Soil moisture in all soil layers and at all dates was significantly higher in plant basins terracing and trenching. Trenching enhanced water 6 Traditional Knowledge in Agriculture checking seepage losses in chaals. Since RCC is very expensive, polythelene is recommended to check seepage losses from each tank. Conclusion These studies have shown that chaal is an effective structure for harvesting water from lining material. Bitumen, being hydrophobic in nature, is also effective in reducing seepage losses from farm ponds, but its mode of application needs to be standardized in loose and gravelly soils. Land shaping (terracing and trenching) was very effective in conserving soil moisture in tree basins by directing the run-off water towards tree basins and harvesting the rain water. The moisture conservation effect was further enhanced when land shaping was coupled with mulching and observed significant growth of apple trees. Pineneedle mulch was comparatively more effective in moisture conservation. The pebble mulch was also effective, and may be easy to apply at on farm level because of its easy availability locally. However, due to fragile nature of the land scape, the terracing and trenches were damaged due to snowfall and rains, and had to be repaired even after 1 year of construction.

8.1.1. Control of caseworm (Nymphula depunctatis) in rice by leaves of parasi and Sali

Description of the ITK Caseworms are very common in the area of Khaspokharia village West Singhbhum district, Jharkhand. Fresh leaves of parasi (Cleistanthus collinus) and sali (Boswellia serrata) are spread on the insect-infested field @ 5 kg leaves per 100 m2 . A majority of insects (70-80%) are controlled with this practice.

Name and address of the discloser Shri Sanat Kumar Sawaiyan, Dumbisai, Chaibasa, West Singhbhum (Jharkhand) Location of use of the ITK Village Khaspokharia, block Tantnagar, West Singhbhum (Jharkhand) 834 006. Experimenters Birsa Agricultural University, Ranchi (Jharkhand) 834 006, Dr. N. Kudada, Assistant Professor-cumJunior Scientist (Senior Scale), Department of Plant Pathology; Dr. Rabindra Prasad, Junior Scientistcum- Assistant Professor (Senior Scale), Department of Entomology; Shri K.K. Sinha, Assistant Professorcum- Junior Scientist (Selection Grade), Entomology and Dr. R.P. Singh 'Ratan', Head Department of Extension Education. Bidhan Chandra Krishi Vishva-vidyalaya, Mohanpur, Nadia (West Bengal) 741 252, Dr. S. K. Mandal, Professor, Department of Agricultural Entomology. Results and discussion

Results obtained from the experiment conducted on 15 farmers' fields during 2003-04 and 2004- 05 cropping seasons. At 30 DAT minimum mean caseworm infestation (30.9%) was recorded in application of chlorpyriphos @ 1.0 litre/ha compared with 81.3% in control during two cropping seasons (2003-04 and 2004-05), followed by application of parasi leaves @ 100 kg/ha, which recorded 58.1% caseworm infestation. At 60 DAT recorded minimum mean caseworm infestation (9.4%). All the treatments were significantly superior to control. Use of parasi leaves was effective in reducing caseworm population. Conclusion The study revealed that spreading of parasi leaves once 5-10 days after transplanting @ 100 kg/ha helped in reducing both the rice caseworm infestation and larvae population. Application of parasi leaves showed significantly lower infestation of caseworm than control.

8.1.2. Control of gall fly (Pachydiplosis oryzae) in rice

Description of the ITK

Gall fly (Pachydiplosis oryzae) is very harmful to rice crop. It damages whole crop of rice. Farmers of Tamar block of Ranchi district in Jharkhand use parso or persu (Cleistanthus collinus) leaves for controlling gallfly. In this practice, fresh leaves of parso or persu are collected and spread in the infested field without processing. About 10 kg leaves are required for 100 m2 area. These leaves are spread at the initial stage of infestation. This practice controls 70-80% insects. All farmers of the village use this age-old practice.

Name and address of the discloser Shri R.S. Prasad, Department of Extension Education, Birsa Agricultural University, Kanke, Ranchi (Jharkhand) 834 006. Location of use of the ITK Village Deori, block Tamar, Ranchi (Jharkhand). Experimenters 1. Birsa Agricultural University, Ranchi (Jharkhand) 834 006: Shri K. K. Sinha, Assistant

Professorcum-Junior Scientist, Department of Entomology and Dr. R. P. Singh 'Ratan', Head, Department of Extension Education. 2. Bidhan Chandra Krishi Vishvavidyalaya, Mohanpur, Nadia (West Bengal) 741 252: Dr. S. K. Mandal, Professor, Department of Agricultural Entomology.

Results and discussion

Results obtained during 2003-2004 showed that when the crop was not given any treatment, i.e. in the control plot, the infestation of gall-midge increased from 6% at 30 days after transplanting (DAT) to 9.8% at 60 DAT. In parso leaf application, the intensity of infestation was reduced from 3.2% at 30 DAT to 2.1 % at 45 DAT and finally to 2.0% at 60 DAT. The Farmers spreading leaves of Cleistanthus collinus in rice field 13 Traditional Knowledge in Agriculture reduction in gallfly-affected shoots was maximum where parso leaf @ 100 kg/ha was applied. Conclusion Experiments conducted both at Ranchi and Nadia revealed that application of parso leaves is effective in reducing the damage caused by gallfly in rice. Application of parso leaves @ 100 kg/ha was more effective at Ranchi. Although parso leaf reduced the number of silver shoots in rice in Nadia, it was not reflected in the grain yield, because the incidence of gallfly was below the economic threshold limit.

Angadi *et al*., (2021) reported that 80 per cent of the farmers opined that the traditional knowledge of earthern bunding and field bunding were the most prevalent with regards to soil conservation followed by vegetative barriers (33 per cent).

Khatri *et al*., (2021) reported that the 'use of farmyard manure' was the traditional knowledge that showed the highest amount of relative advantage compared to the conventional chemical fertilizers, which was followed by 'erecting scarecrow in standing crops to protect from birds'.

9. CONCLUSION

The Indigenous Technical Knowledge (ITKs) are socially desirable, economically affordable, sustainable, involves minimum risk and focuses on efficient utilization of eco-friendly resources. It is possible that through flexibility, modification and mutual respect and trust, traditional knowledge experts can work with the experts from modern scientific institutions to generate more effective solutions for contemporary problems. In today's context, there is an urgent need to evaluate and popularize indigenous innovation. Government schemes and Research and Development activities should reach indigenous innovators. An appropriate coalition between the traditional and modern knowledge and technology systems has immense potential to provide solutions to various global problems.

Despite their importance and good spirit, prevailing policy initiatives aimed at protecting ILK face serious limitations. First, policy framings on the importance of ILK are primarily grounded on its instrumental value, as a tool to address global environmental challenges. Within this framing, ILK risks being reduced to something we can capture and use, such as lands, minerals and other resources, rather than recognized as a way of living and value on its own. Furthermore, to the extent ILK remains primarily valued as means to an end, its recognition will be contingent on the absence of more effective means to achieve those ends (e.g. through technological developments).

Second, policy initiatives to protect and revitalize ILK are unlikely to reverse the loss of cultural diversity as long as the political and economic structures of the industrial society remain essentially unchanged. In most likelihood, success in the regeneration of cultural diversity, including ILK, can only come about through major transformations in the present economic, political, and technological order and its ideological underpinnings. In turn, these shifts will require transformation in the ontological underpinning of modernity, evolving from the dominant dualist, anthropocentric and utilitarian worldview, towards relational ontologies, enacted and re-enacted by the people embracing ILK as centerpieces of their lifeworlds and communities.

As more and more people believe that climate and environmental breakdown cannot be tackled within the frame and logic of the existing political and economic order, the idea that we may be entering the final stage of the industrial civilization as we know it is gaining traction in some circles. This stage is marked by a lack of belief in the existing order as much as by the lack of visible alternatives. In Gramscian terms, we are living an 'interregnum', where the old is dying and the new cannot yet born. However, an expanding myriad of social and intellectual movements, including but not limited to indigenous rights, rights of nature, post-development, degrowth, and post-capitalism, are discussing the contours of how a post-industrial civilization could look.

The contours of the post-industrial society where diverse human cultures can flourish while regenerating the planet's ecological life-support systems cannot be drawn from the molds of the existing industrial growth-based capitalist order, but neither from a return to an idealized past that never existed. In all likelihood, the new order will emerge from a synthesis of tradition and modernity. Some elements of this post-industrial society are yet to be imagined and tested. Others can be salvaged from modern culture and philosophy, including its core emancipatory elements and labor-saving technologies. Yet, others can be rescued from the vast laboratory of arrangements developed by human societies over millennia and swept away by modernity and capitalist globalization. As holders of an ancestral social memory that represents thousands of millennia-long experiments in organizing human life, traditional societies will have a critically important role to play in this societal, economic and political reconfiguration.

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11. DISCUSSION

1) **Is there any difference between tribal knowledge and Indigenous Technical Knowledge?**

   Ans: Yes, there is a difference since tribal knowledge is confined to just the tribal community whereas ITK is the applicable knowledge possessed by a community be it rural, urban, nomadic or tribal.

2) **What are the advantages the indigenous community derive ot of sharing their knowledge?**

   Ans: Benefit sharing is a major advantage. In the legal field, benefit sharing is a technical term used in the context of access to and use of human and non-human genetic resources. Non-human genetic resources include plants, animals and microorganisms. The term describes an exchange between those who grant access to a particular resource and those who provide compensation or rewards for its use.

3) **How agrotechnological parks help to conserve ITKs?**

   Ans: By provision of models, demonstrations, live demonstrations and exhibiting the technology

4) **How can you quantify the traditional knowledge?**

   Ans: Traditional knowledge can be quantified based on rationality, validity, applicability etc.

5) **How can traditional knowledge be incorporated into the package of practices?**

   Ans: It could be done after proper scientific validation by experts in the field followed by multilocation trials to test its applicability and adaptability.