Indigenous traditional knowledge for protection of crops from wild animals and birds

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Indigenous Traditional Knowledge (ITK) is the term used to describe certain local, indigenous, or regional societies' well-developed, long-standing customs and practices. ITK is not yet fully utilized in the developmental process. This always requires technology transfer from a location that perceives this knowledge. The horizontal spread of this knowledge requires the involvement of some agents who recognize it, value it, and appreciate it in their interaction with the local community and document it percolating from one generation to another generation. For this purpose, Krishi Vigyan Kendra Ajmer involved READY (Rural Entrepreneurship Awareness Development Yojana) students during their village attachment program. The READY students interacted with knowledgeable /progressive farmers to collect and document ITK being used by farmers to safeguard their crops against wild animals and birds. The study revealed 16 ITK technologies that are used by the local farmers.The study also revealed that farmers ranked barbed fence as the most effective ITK of the area, followed by Bijuka, planting of thorny bushes at the edges, planting rows of *Saccharum munja*, trenching, machan, and fixing of used coloured sarees /cloths and plastic strips /bright coloured cloths / bright pennies.

Keywords: Birds, Rural Entrepreneurship Awareness Development Yojana, Traditional knowledge, Wild animals

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The demand for a decent crop yield at a low cost is an urgent requirement in today's agriculture, and farmers who want to test these crop protection strategies need not invest a lot of money. Farmers in India and abroad face serious threats from pests, natural calamities, thefts, animal damages, and other crop losses, resulting in lower yields[1]. Due to a lack of food and water during the summer, wild animals cause more severe damage in places close to forests, Junglat, and Charagah.

Farmers all throughout the world have a unique difficulty when dealing with wild animals. Crops may sustain severe damage by animals including deer, wild boars, rabbits, moles, elephants, monkeys, blue bulls, and many others. They might harm the plants by eating plant pieces or just by racing through the field and trampling the crops. Wild animals might therefore quickly result in considerable yield losses and create new financial issues[2]. "Birds are also known to cause significant economic harm to a number of crops in the country's various agroecological zones during critical stages." The amount of bird damage to any crop relies on a number of variables, including the density of the local bird population, the total area covered by the crop, the area's cropping pattern, the season, and the physiological condition [2]of the birds[3].

Over a ten-year period, research by the All-India Network Project on Vertebrate Pest Management revealed that diverse rodent species caused 15% of the total damage, with birds coming in second at 9%. Recent research showed that wild boar damage to various crops ranges from 15 to 40%, Nilgai damage from 10 to 30%, elephant damage from 20 to 50%, *Rhesus macaque* damage from 10 to 30%, blackbuck damage from 5 to 15%, and gaur (*Indian bison*) damage from 5 to 10%. The intensity of damage depends on population density, cropping pattern, the extent of crop area, season, and stage of the crop[4].

In the study area, in order to effectively manage the damage brought on by nilgai, severe concerns must now be expressed. Due to their threat, farmers are

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severely suffering, and some are hesitant to produce particular crops like pulses. In addition to foraging, it was found that Nilgai may seriously injure most crops via trampling, relaxing in the field, and daily movement.

Farmers use a variety of preventive techniques to prevent financial loss. They consist of trenches, several kinds of fences, manual guards, and other devices[5-7]. These measures, however, frequently have considerable associated costs and hazards[8,10]. Traditional fences are constructed from wood poles and thorny branches that are cut from adjacent forests, seriously harming the forest. Highly sophisticated means for example electric fences are expensive and need continued maintenance[7,11]. While habitat manipulation, block plantations, reflective ribbon for scaring birds, reflective paper plates, and bird-resistant hybrids could be some of the environmentally friendly management techniques for predatory birds, they could also be used in conjunction with traditional management techniques such as erecting a machan amid crop fields, pitcher-effigies (scarecrows), and drum-beating.

Traditional Knowledge (TK) is a community's established, maintained, and passed down from generation to generation for knowledge, know-how, skills, and traditions that frequently make up that community's cultural or spiritual identity[12]. India has extensive expertise in agricultural production. By way of oral transmission, this practical knowledge spreads from one generation to the next and serves as a foundation for the development of new management techniques, particularly in rural areas and among socially disadvantaged groups. The irony is that such technical knowledge, which is common in several traditional societies and can be used to prevent damage from wild animals and birds, is not properly documented. The majority of them are in danger of going extinct[12]. Keeping in view the importance and economic utility of common ITKs in the Ajmer District of Rajasthan, one of the main objectives of the study's design was its documentation.

Methodology

The current research was carried out in the villages of Ajmer District of Rajasthan. The study was undertaken by READY students under the guidance of Scientists of Krishi Vigyan Kendra, Ajmer in the year 2020. The final year students of B.Sc. (Ag) under the READY (Rural Entrepreneurship Awareness Development Yojana) programme aim to educate undergraduate students about practical agriculture and allied sciences, to give them hands-on experience in a rural agriculture setting, and to raise awareness of rural entrepreneurship. This programme helps to develop skills, confidence, and Indigenous Traditional Knowledge (ITK) of the area. This READY program plays a key role in the overall personality development of our coming Agricultural Graduates. 150 agricultural students from five agricultural colleges in Rajasthan were deputed at Krishi Vigyan Kendra, Ajmer under the READY programme 2020. Scientists of Krishi Vigyan Kendra also organized a discussion session with these READY students to document the indigenous technologies prevalent among farmers for the safe guarding of crops from wild animals and birds in allotted villages.

During the 56-day village attachment programme of READY students, the ITKs information for the safety of crops from wild animals and birds was gathered from a total of 150 progressive farmers of 10 villages. Oral exchanges between students, scientists, and farmers served as the primary means of data collection. The information gathered verbally was recorded and presented in this paper.

The effectiveness of Indigenous Traditional Knowledge in preventing losses and damage from birds and wild animals was determined by gathering respondents' opinions on a three-point continuum, with the scores of most effective, effective, and not effective being 3, 2, and 1 respectively. The total scores were obtained by summating the scores for a given particular ITK practice. The mean score of an individual ITK practice was obtained by dividing this total score by the total number of respondents. Based on the Mean score, the ranking of each I. TK practice was given to conclude the results.

Materials and Methods

An orientation cum training programme on the role of ITK in agriculture was organised at KVK Ajmer for all the READY students before the start of the study. In this orientation, the KVK scientists explained the concept, importance, and use of ITKs in agriculture. All 150 students have been divided into 10 groups of 15 students each. Each group was allotted one village. In this way, 10 villages namely Madhopura, Dang, Nadi-I, Rampura Dabla, Daurai, Narvar, Saradhana, Dantra, Nooriawas and Kesarpura were allotted for the study's purpose. Each student was attached to one progressive farmer to collect the required information. Thus 15 farmers from each

village *i.e.,* a total of 150 farmers were selected for the study. Prior Informed Consent (PIC) was obtained from all the farmers who were interviewed.

The READY students interacted with the selected farmer about prevailing indigenous methods to keep birds and wild animals away from their crops. Oral interactions between students and farmers as well as their discussions served as the technique of information gathering.

In the last phase of this program, KVK scientists conducted a village seminar in each village to discuss and verify the information collected by the READY students. In this village seminar, KVK scientists interacted with various stakeholders like Sarpanch, agriculture supervisor, Veterinary Officer, Panchayat Samiti Director, Progressive farmers, and Village Development Officer. Scientists obtained feedback and suggestions from these various stakeholders and farmers, in the light of which the documentation was modified and prepared.

Results & Discussion

Indigenous traditional knowledge (ITK) practices used by the farmers to avoid losses and damage by birds and wild animals
Bijuka /Adava/ Krishirakshakputla/ Pitcher-effigies/Scare-crow

This is a traditional popular method of scaring away wild animals and birds by scarecrow which has been practiced since ancient times. In this method, a mannequin is erected in the field to scare away birds and small animals. These scare-crows are prepared by the farmers with locally available material. Farmers use native materials to create these scarecrows. To represent a man's head with black hair, an old pitcher (terracotta jar) with a black exterior is kept upside down on a vertically built wooden pole of a man's height. The head can occasionally be constructed of black fabric as well. The vertical pole is then connected to a horizontal stick to simulate arms raised to shoulder height. A wooden structure is covered with an old bright coloured shirt (kurta), creating the appearance of a man working in the fields. This bijuka illusion (Fig. 1) is a watchman standing in the crop for animals and birds. For more effectiveness, the location of the scarecrow keeps changing over a few day intervals so that birds and wild animals do not get used to it.

Bright-coloured cloths/Bright pennies

In this technique, farmers apply white strips or bright pannier clippings of cloth in the crop fields with the help of wood sticks (Fig. 2). These stripes keep moving in the air, which causes vibration and reflection so that birds and wild animals like nilgai or blue bull and wild boars run away. Nowadays, reflective ribbons are available in the market. The reflective ribbon is a polyster strip with a 1.5 cm width that has a red coating on one side and a silver metallic coating on the other. These strips are set up parallel to the crop using bamboo poles and strings at intervals of 5 metres and 0.5 metres above the crop. Birds avoid crop fields during sunny hours because of the sunlight's reflection and the wind's humming sound.

Machan

A platform-like place built in a field with the help of wood sticks and grasses to keep away animals that can cause harm to the crops is termed a machan. It is an age-old method and is still in use. Farmers apply different colored plastic stripes on this scaffolding, due to which the air produced different sounds so the animals and birds ran away. Farmers climb on top of it many times and also inspect their fields for safety.

Fig. 1 — Bijuka

The farmer mounts these scaffolds and guards the crop of his field well because he can see them all around (Fig. 3a). Many farmers make this scaffolding firmly so that they can rest during the day and also

Fig. 2 — Polyster strips

Fig. 3a — Machan

Fig. 3b — Machan on tree

sleep at night. A machan is built amidst crop fields. To create a small hut for shelter known as Dagla, a semicircular mat made of split bamboo is placed on the machan. Some farmers make machan structure on the tree and protect the crops (Fig. 3b).

Barbed fence

Farmers placed barbed fences around their fields to protect crops from stray animals and wild animals. Farmers used branches of desi babool, ber, Vilayati babool, Israeli babool, and other thorny plants for this purpose (Fig. 4).

Planting of prickly/thorny bushes at the edges

Different xerophytic species were planted in close proximity on high bunds formed from the soil gathered after trenching around the crop, including local thorny plants like Karonda (*Carrissa carandus*), *Prosopis juliflora*, and *Ziziphus* sp. after digging deep trenches around the fields Fig. 5). While attempting entry, nilgais suffer injuries and produce distress sounds, which causes the other animals to evacuate the area as well. Some of these plants as border crops give the farmer great advantages by providing additional income. This border plant line also saves the crop from cold and heat waves and is eco-friendly.

Cow dung/ blue bull dung on standing crop

To keep stray animals and wild animals away from crops, cow/bull dung solution is made and sprayed around the periphery of the crops for approximately

Fig. 4 — Barbed fence

Fig. 5 — Planting of prickly bushes

Fig. 6a — Gofan

Fig. 6b — farmer rotarting Gofan before releasing stone

5-10 feet on each of the field's four sides. The pungent odour generated by the dung repelled the blue bull from entering the field.

Gofan

Gofan is a very powerful and accurate technique that was used by the farmers in Rajasthan. Now, this practice is confined only to tribal-dominated regions. Gofan is a traditional catapultart in the tribally dominant area, and people typically carry it with them tied to their waist or turban (Fig. 6 a). Gofan is used to keep birds and other animals away from an agricultural crop.

The gofan works by having the cord pulled after putting the pebble or small stone in the bag (Fig. 6 b). When released, the pebble or small stone travels far and quickly in the direction of the target. The speed of the pebble or small stone is four to five times greater than that of a stone thrown with bare hands. Birds and animals run away fearing the sudden sound of the stone thrown from the fan and the shaking of the crop.

Castor rows surround the crop

Castor is commonly used as a border crop in this approach, and it is planted in 2-5 rows with close spacing around the crop. As castor effectively masks the natural fragrance of the crop, wild boars and Nilgai, who can only distinguish crops by smell, are unable to do so. Due to the unpalatable quality of the plants with a high concentration of anthologies and glucosides, damage to castor by animals is also not feasible. A farmer also gained additional revenue from the castor in this way. Castor can be used as a border crop in both the Kharif and Rabi seasons. Up to 90% of the damage caused by Nilgai and wild boar is effectively controlled by this strategy[13].

As in previous instances, the strong odour of phorate or thimet will also aid in producing the natural scent of the crop, baffling wild boars and reducing damage by up to 50-60%[13].

Planting rows of Saccharum munja

Rows of *Saccharum munja* around the crop are widely used for crop protection. These perennial wild grasses live on the fence on bunds and assist the farmer by bringing additional income.This perennial wild grass is used as a raw material for producing baskets and thatching roofs. Upper leaf sheets of flowering culms can be used to obtain valuable fibre. The stem is aphrodisiac, cooling, sweet, and acrid. It treats erysipelas, blood disorders, urinary complaints, eye conditions, and tridosha[13]. One of the native species that successfully colonizes abandoned mines on an ecological level is the perennial wild grass Saccharum munja. In rocky areas with skeletal soils, it produces pure patches. It creates a vast root system that holds the soil and pebbles together and grows into tall, thick clumps with dense biomass. Low-income residents use it to make ropes, hand fans, baskets, brooms, mats, shelters, and crop-protection shields. Saccharum munja is a preferred species in order to check and stabilize erosion-prone rocky slopes and turn them into biologically active places.

Arrangements made from coconut ropes soaked in a mixture of cow dung + pig oil

By using wooden poles, coconut rope/Niwar can be arranged around the crop in three rows with a one-foot gap between each row (Fig. 7). The coconut ropes should be covered with the prepared cow dung

Fig. 7 — coconut ropes soaked in a mixture of cow dung + pig oil

Fig. 8 — Trench with soil bund

solution that has been blended with domestic or local pig oil in the sufficient quantity. This combination produces the characteristic odour, discouraging wild animals from entering the harvested area.

Human hair as a respiratory deterrent

Wild animals like blue bulls and wild boars entirely rely on their smell sense for movement and finding food. In this process, it only moves from one location to another by smelling the ground, allowing it to be steered along the correct paths. Farmers employ a proven, inexpensive approach by spreading human hair that has been collected from neighbourhood barbershops and barber houses. Scientifically speaking, this traditional practice does imply that the wild boar's movement patterns cause human hair to be sucked into their nostrils, producing significant respiratory irritation. This causes the wild boar to lose its bearings and distract its path, which causes it to make distress sounds that deter other wild boars from entering the cultivated area. Several farmers employ this technique frequently to cultivate a variety of crops, reducing wild boar damage to between 70 and 80%[14].

Arrangement of used colored sarees /cloths

In this method, farmers place worn sarees and other fabrics in a variety of colours around the crop to give the impression that people are present and discourage wild animals from entering the area. Some farmers erect different colored flags made of cloth and plastic on standing crops. In locations where people migrate frequently, this method provides a slight advantage.

Creation of light and sound

Farmers /watchmen of crop fields during the night create light and sound through burning firecrackers to scare away blue bulls and other wild animals. Farmers create noise by using bonfires, empty tins, local drums, Dhamakada, and shouting. The farmers generated sounds through drumming, an empty tin, whistling, and shouting to scare away wild animals and birds. To drive away flocks of grain-eating birds, drums are hammered from machans or lofty locations. It is said that this approach works better against locust raids.

Use noise aversive conditioning

Farmers in various regions of the country also practice constant monitoring during the crop season by using noise aversive conditioning such as making noise, shouting, whistling etc. The farmers claim that it is also one of the best methods for protecting crops from wild animals.

Use of dogs to frighten away

Dogs are among the first animals kept as pets, and their main purpose is to defend homes and livestock from intruders. The dog was seen as a faithful companion, hunter, guardian, spirit guide, and a treasured part of the family. The dog was highly valued in ancient India. The farmer rears the dogs and uses them for crop protection. Dogs have strong protection from wild animals due to their good smell and hearing power. These wild animals can be scared away using trained dogs because their barking discourages and alerts the farmer to the nilgai's crop-robbing activities.

Trenching cum Bunding

Making high bunds out of the soil gathered after trenching and digging a 90 cm wide and 60 cm deep trench around the cultivated area at a distance of one foot from the field keeps stray animals out of the field (Fig. 8). The wild animals are unable to enter the field due to the deep trench and high soil bund. This method works well for managing stray animals and is also helpful for in-situ moisture conservation.

Practices used by the farmers to avoid losses and damage by birds and wild animals

The data presented in Table 1 indicated that 98.66% of respondents reported that the barbed fence was the most effective and effective to avoid losses

Table 1 — Degree of the effectiveness of Traditional Knowledge (ITK) practices used by the farmers n=150

Sr. No.	ITK Practices	Response Categories			Mean Score	Rank
		Most Effective (3)	Effective (2)	Not Effective (1)		
1.	*Bijuka /Adava/ Krishirakshakputla/ Pitcher-effigies/Scare-crow*	98(65.33)	47(31.33)	05(03.33)	2.62	ii
2.	*Bright colored cloths / Bright pennies*	70(46.66)	30(20.00)	50(33.33)	2.13	vi
3.	*Machan*	90(60.00)	40(26.66)	20(13.33)	2.46	v
4.	*Barbed fence*	105(70.00)	43(28.66)	02(01.33)	2.68	i
5.	*Planting of thorny bushes at edges*	94(62.66)	51(34.00)	05(03.33)	2.59	iii
6.	*Cow dung/ blue bull dung on standing crop*	45(30.00)	45(30.00)	60(40.00)	1.9	x
7.	*Gofan*	05(03.33)	31(20.66)	114(76.00)	1.73	xi
8.	*Rows of castor around the crop*	50(33.33)	45(30.00)	55(36.66)	1.96	ix
9.	*Planting rows of Saccharum munja*	93(62.00)	50(33.33)	05(03.33)	2.56	iv
10.	*Arrangements made from coconut ropes soaked in a mixture of cow dung and pig oil*	45(30.00)	45(30.00)	60(40.00)	1.9	x
11.	*Human hair as a respiratory deterrent*	05(03.33)	31(20.66)	114(76.00)	1.73	xi
12.	*Arrangement of used colored sarees /cloths*	70(46.66)	30(20.00)	50(33.33)	2.13	vi
13.	*Creation of light and sound*	05(03.33)	31(20.66)	114(76.00)	1.73	xi
14.	*Use noise aversive conditioning*	60(40.00)	35(21.33)	55(36.66)	2.03	viii
15.	*Use of dogs to frighten away*	65(43.33)	35(23.33)	50(33.33)	2.1	vii
16.	*Trenching cum bunding*	93(62.00)	50(33.33)	05(03.33)	2.56	iv

and damage by birds and wild animals. Only 1.33% of respondents reported that this method is not effective. Based on the highest mean score (2.68) barbed fence was ranked as the most preferred ITK used by the respondents. The reason behind this practice was relatively cheaper and raw materials such as thorny bushes was easily available. At the time of the interview, respondents expressed reason for this that thorny bushes and branches for barbed fences were available from the trees planted in their fields and nearby area. Though, the barbed fence required regular maintenance.

The data presented in Table 1 also indicated that 96.66% of respondents reported that the bijuka was the most effective and effective to avoid losses and damage by birds and wild animals. Based on the mean score, this Bijuka/ scarecrow practice ranked second by informants. At the time of the interview, the reason explained by respondents was that Bijuka was found effective tool to discourage birds from disturbing and feeding on recently cast seed and germinating crops. The reason explained that this ITK was easy to use, cost-effective, and a useful technique for scaring away birds and protecting crops during the sowing and seed formation stage. However, in the case of wild animals, this practice was only effective against blue bull because bijuka creates an illusion of a watchman standing in the crop for animals and birds. During the interview with the farmers, the farmers

also reported that bijuka was more effective if used with other ITKs like barbed fences, trenching, etc.

An examination of the data in Table 1 explained that the third most preferred ITK was planting thorny bushes at the edges with a 2.49 mean score. The reason behind this is that the thorny bushes gave protection against cattle and wild animals and also act as a windbreak, save the crop from cold and heat waves, enrich the soil by shading leaves, and were eco-friendly. These were less expensive than fences made of barbed wire and gives the farmer significant advantages by generating extra revenue.

The data depicted in Table 1 also revealed that 95.33% of respondents reported that the planting of *Saccharum munja* and trenching practices were the most effective to avoid losses and damage by birds and wild animals. Based on the same mean score (2.56) both practices ranked fourth by informants. *Saccharum munja* was known to be a successful colonizer of waste and marginal land; thus, the findings appeared to be fairly natural. It was a potential tall grass that, if planted along the border, would safeguard wild animals due to its high biomass yield and strong root structure, according to its ecological significance. Similarly, trenching around the cropped area was another traditional practice used by the farmer. This practice is not only to increase in situ moisture conservation in their fields but also to protect the crop from wild and stray animals. Apart

from being effective for stray animal management, the farmer said that this process also provides a great way to conserve water. Farmers ranked these ITK practices as useful in terms of cost-effectiveness, maintenance, and easiness. However, the initial cost of the establishment was a little high.

It was also narrated from Table 1 that the least effective ITK practices used by the respondents to avoid losses and damage by birds and wild animals were the creation of light and sound, gofan, and Human hair as a respiratory deterrent with the same mean scores (1.73). This might be due to the creation of light and sound, and gofan was effective only momentary. Birds and animals ran away only at the time of sudden sound and the sound created by the stone thrown from the gofan. Human hair as a respiratory deterrent ITK was the least effective practice might be because the respondents feel disgusted by the touch of cut hair and consider this practice not technically suitable.

These results demonstrated that all ITKs were beneficial for crop protection against wild animals and birds in the current scenario. So, it is an immediate need for scientific documentation of these ITK practices for their large-scale adoption or popularization among the farming community.

Conclusion

ITK is a valuable asset to local communities. They integrate the traditional tools, knowledge, culture, and abilities of the native populations. The recorded ITKs demonstrated their significance and potency in protecting crops from wild animals and birds. The majority of the farming population employs practices based on ITK without being aware of its scientific justification. By fusing indigenous and scientific knowledge, effective measures should be adopted to document and disseminate ITK. On the basis of the response by the farmers, it can be concluded that farmers ranked barbed fence as the most effective ITK of the area followed by Bijuka, planting of thorny bushes at the edges, planting rows of *Saccharum munja*, trenching, machan, fixing of used colored sarees /cloths/bright colored cloths / bright pennies and use of dogs for scaring away wild animals. For the future application of ITK, it is essential to integrate ITK with a scientific cognizance plan, document it properly, and use it to protect crops from wild animals and birds.

Conflict of Interest

The authors declared that they have no competing or conflict of interest.

Authors' Contributions

RS designed the study, the main conceptual ideas, and the proof outline for documentation and wrote the manuscript. DA participated in drafting the article or revising it critically for important intellectual content. SK directed the study and reviewed step by step and finalized the manuscript. SKS drafted the manuscript and designed the figures.

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