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A note on indigenous technical knowledge in Kinnaur and Lahaul-Spiti districts of Himachal Pradesh

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Over the years, Indian farmers have leveraged their ancestral know-how and experimented to cultivate different crops in difficult environmental conditions. Of late, however, traditional knowledge and practices have suffered massive erosion, mainly due to the impact of globalization and modernization. In this regard, the objective of the present paper was to document and validate the Indigenous Technical Knowledge (ITKs) in the tribal farming system in Himachal Pradesh. Kinnaur and Lahaul-Spiti districts of Himachal Pradesh were purposively selected for the study owing to their special status of Scheduled Tribal Area. Further, three villages from each district were selected randomly covering a sample of 120 farmers. In addition, 5 key informants experienced in particular ITKs were selected from each village for its validation through Quantification of Indigenous Knowledge (QuIK) methodology. The major documented ITKs were classified into appropriate categories such as soil and water management, cropping system, farm implements, post-harvest technology, storage, horticultural crops, food product development, agro-animal based yarns and leaves, medicinal, veterinary science, animal husbandry, and some myths. Further, *Kothar*, *Graat*, *Suttar*, tying of branches of trees, and *chicha* were revealed as the most useful ITKs in the tribal areas of Kinnaur. In Lahaul-Spiti, *Khudh*, *Sumbhu*, *Sem*, and shaving off of yak's hair in summer were the most popular ITKs.

Keywords: ITKs, Traditional knowledge, Tribal areas

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Since the advent of the green revolution in India, agricultural technologies have been developing at a very fast pace. These technological packages have increased the food grain production nearly more than five times since the 1950s, simultaneously, having treacherous effects on the environment. The imported 'technological package' had been formulated under very different ecological and socio-economic conditions. The increase in yield has been accompanied by a decline in genetic variability, natural soil fertility and biological pest regulation and enhanced soil erosion, salinization and other environmental problems because of the injudicious utilization with high cropping intensity and dumping of chemical and synthetic pesticides, fertilizers and growth promoters. Hence, the need for sustaining and blending the traditional farming still remains amongst all dimensions of the farming sector in the world as a whole and in India in particular.

India is facing a huge population pressure. With more pressure of numbers, and with more mouths to feed, intensive efforts are being applied to satisfy the need for food. High population density is related to smaller farm sizes with greater demand for inputs especially fertilizers¹. This has led to serious environmental degradation about which many researchers are aware of. The most profound effect of climate change can be seen in agriculture, as it is the most sensitive and dependent on climate. Changes in temperatures, rainfall patterns, pest and diseases, climate extremes (e.g., drought, flood, etc.), ground-level ozone concentration, nutritional quality of some food are some of the effects of the climate change. Resources in agriculture such as water, land, fertile soil, etc. operate on the principles of limiting factor. Today, the water table is decreasing at a very fast rate due to injudicious use for irrigation to increase productivity and hence total production. Earlier, the same resources used to be community-based, which was much more sustainable.

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Scientists and policymakers have realized the consequences of modern agriculture, climate change, and have come to a consensus that limited resources can be harsher in the future, if not dealt with it timely. This has to lead to an additional responsibility on agricultural research system to move from “green revolution” to the “evergreen revolution”. ‘Evergreen Revolution’ is described as an increase in productivity, but in ways which are environmentally safe, economically viable and sociologically sustainable. Indigenous people have the knowledge on how to live sustainably. The role of ITK can be synonymously used with ‘traditional ecological knowledge’, ‘traditional knowledge piece of information ‘indigenous knowledge’, ‘folk wisdom’, ‘rural wisdom’ or ‘traditional science’. ‘Traditional knowledge refers to knowledge, innovation, and practices of indigenous and local communities around the world’. Developed from experience gained over the centuries and adapted to the local culture and environment, traditional knowledge is transmitted orally from generation to generation. It tends to be collectively owned and takes the form of stories, songs, folklore, proverbs, cultural values, beliefs, rituals, community laws, local language, and agricultural practices, including the development of plant species and animal breeds. In tribal areas, ITKs are drawn on local resources; farmers are less dependent on outside supplies which can be scarce, costly and irregularly available. Secondly, these farmers are familiar with indigenous practices and technologies. They can understand, handle and maintain them better than newly introduced practices and technologies. In the tribal farming system, ITK is the basis for self-sufficiency and self-determination. For scientists, it is important in planning and implementing new programs. A judicious combination of indigenous and scientific knowledge will help to speed up the adoption of improved practices by the tribal farmers. In India, for generations, primitive tribes were persisting in villages and hills without having linkage with the population in open plains and the civilizations. The livelihood of the tribals is mainly based on agriculture and forests. They practice traditional ways of farming. Their isolation in a particular region helped them to preserve their rich tribal wisdom and indigenous technical knowledge in agriculture and allied activities. Tribal people are those “who have followed ways of life for many generations that are largely self-

sufficient, and are clearly different from the mainstreaming and dominant society”². A tribe is a social group with territorial affiliation, endogamous, with no specialization of functions, rules by tribal officers, hereditary or otherwise, united in language and dialect, recognizing social distance with other tribes and castes, without any social obloquy attaching to them, as it does in the caste structure, following tribal tradition, beliefs and customs, illiberal of naturalization of ideas from alien sources, above all conscious of homogeneity of ethnic and territorial integration³.

India has the largest concentration of tribal population in the world, having nearly more than half of the tribal population of the world. The total tribal population in India as per 2011 census, is about 10.45 crore, which is equivalent to the 11.58% of the population of India. Tribal peoples in India generally occupy compact areas such as thick forests, hills, undulating tracts. They have an inflexible social structure and little social mobility; due to which they are away from scientific and technological progress. Also, these lead to their dependence on indigenous technologies and practices which are practiced in their location and which they have learned from their ancestors. Indigenous knowledge systems are at risk of becoming extinct and still it is not yet fully utilized in the development process. So there is a need for identifying, documenting and validating the indigenous technical knowledge scientifically. Keeping this in view, the present study is formulated to document and validate the ITKs in the tribal farming system in Himachal Pradesh.

Methodology

The study was conducted in Himachal Pradesh state. The proposed research locale was selected purposively because Himachal Pradesh state is very rich in ITKs and represents a large number of ITKs found in the North-Western Himalayas⁴. Two districts i.e. Kinnaur and Lahaul Spiti of Himachal Pradesh have been selected purposively as it is specified as Schedule Tribal area⁵. These areas represent the extreme agro-ecosystem in India and the most vulnerable to climate change, as there have been rapid retreats of glacial system, reduction in snowfall, changes in precipitation pattern, changes in temperature, etc. ultimately affecting the farming system of these places⁶. So they are the first ones utilizing their indigenous knowledge in their day to

day activities so as to cope with these changes, and a good amount of ITK can be documented.

Simple random sampling technique was used for the selection of respondents. Among the two districts i.e. Kinnaur and Lahaul-Spiti, three villages were selected randomly from each. From each village, twenty farmers were selected randomly. In addition to this, five key informants from each village were also selected to validate the documented ITKs. Exploratory research study was adopted for the documentation of Indigenous technical knowledge, which seeks what, is rather than predicts relations to be found. Descriptive research was used for the validation of indigenous technical knowledge and is designed to obtain pertinent and precise information concerning the current status of phenomena and whenever possible to draw valid general conclusion.

Documentation is the conversion of traditional knowledge information provided by communities into written documents. It was done by using both primary and secondary sources of information. For documentation, in-depth interview using open-ended questions and focus group discussion of respondents was conducted. Validation of ITKs was done with farmers through modified QuIK (Quantification of Indigenous knowledge) method by the same key persons who were experienced in the particular ITK(s). The basic premise of this method was that farmers knew and understood the environment in which they live. Major steps followed were:

1. Selection criteria: Simple random sampling technique was used for the selection of respondents.
2. Identification of Key Informants (KI): The advice from Panchayat and local people were taken to select the required experts (based on years of the experienced and interest) to document ITKs. The local people were asked about the users of ITKs. The name occurring more than twice was selected as expert or KI. Experienced (based on years of experience in farming) respondents were asked various criteria on the basis of which they can weigh the ITK(s) in their own area.
3. Conducting an interview with KI: In QuIK, matrix ranging was combined with an interview schedule to elicit numerical data from experienced farmers. The matrix was designed through preliminary discussion with farmers and was then obtained as part of a systematic process to obtain quantitative data. The participants were

asked to give their score from 1 to 5 scales (5 for best and 1 for worst) based on the above-mentioned criteria for each ITK. Triangulation was done by taking data from other experts also.

4. Analysis of data: The mean values were worked out for all the ITKs. Total of 30 key informants was interviewed.
5. Finally, the interpretation of data was made based on their community validation.

Results

The ITKs were identified and categorized into eleven groups namely soil and water management, cropping system, farm implements, post-harvest technology, storage, horticultural crops, food product development, agro-animal based yarns and leaves, medicinal, veterinary science & animal husbandry, and some myths. The major ITKs documented under the above-mentioned groups as revealed by present study were as follows:

Soil and water management

Preventing soil erosion by use of Suttar (Pine tree or Kail tree)- Pinus wallichiana

Pinus wallichiana (Pine tree or Kyle tree) is a coniferous evergreen tree indigenous to the Himalayan region. This tree has high utility for the local people of these tribal areas. Local people collect leaves from the forest. Its shape is like that of the needle. They are flexible with a length of 12 to 18 cm. These were tied in small bundles and spread on the field. Land in mountainous regions is generally sloped. So, while irrigating the field, runoff of water can take place leading to soil erosion. But, when *suttar* (leaves of Pine tree) were spread on the field, they slow down the velocity of water and allow more percolation into the soil. They also prevent water erosion and thus contribute to even spreading of irrigation water in the field.

Mulching by Suttar (leaves of Pine tree)

Suttar, leaves of a Pine tree are easily available in Kinnaur district for the farmers, hence, largely utilized in their farming system. *Suttar* was utilized as mulch and thus conserving soil moisture and as it decomposes, acts as a source of nutrients too.

Community-based manuring by sheep and goat

When the time for sowing comes, sheep and goat migrate to different areas of Himachal come back to their owners. Farmer together made a group, sheep and goat were kept in a particular farmer's field for

two to three days. Droppings of sheep and goat in this duration were uniformly spread on the field, which was then mixed with the soil by plowing. This acts as a source of nutrients for the soil. When the turn of one farmer was completed, they were moved to another farmer's field of the group. This way, the whole village was covered and sufficient manure and nutrition were provided for the crops. It is easy and requires less labour. Hence, it is an efficient way of adding organic manure by community participation.

Cropping system

Crop rotation with leguminous crop

Tribal farmers prevent the monoculture as it can harm the productivity of the soil. Hence, to avoid it, they utilize a leguminous crop (Peas) to restore soil fertility. It is the only prominent crop available in Lahaul and Kinnaur to restore the fertility. Leguminous crops are known to fix nitrogen in the soil which helps in restoration of fertility in the soil lost due to exploitation by crops grown earlier and also helps the following crop to reap the benefits of increased fertility in the soil.

Sowing of peas by women in the traditional method

Sowing of peas was performed by women in tribal areas of Himachal Pradesh. It involved a small plough, which was made up of locally available wood. This activity required three to four women.

They had a unique method of sowing by using a plough. It involved a small size of the plough, pulled by two women with the help of ropes. Third woman controlled a small plough and created a line in which seeds were placed by fourth woman and sowing was performed.

Boskhyars- for leveling of land

Plants that were utilized for the covering of seeds of peas after sowing with soil were called *Boskhyar*. It was tied with a rope in a criss-cross manner. It was made in a cuboidal shape. Its weight was increased by attaching stones with the *Boskhyar*, which is then tied from both the ends by the rope. Then it was pulled by labourers with their shoulder. It helps in leveling the land after sowing.

Farm implements

Farua

It was used for leveling the land.

Chau

It had ten teeth for collecting the fieldstones that enter the agricultural field due to glacial water and

snow in winters. These stones were collected at the starting of the season. They had to be collected and removed from the field so that agriculture operations can take place smoothly. It is generally practiced in the month of April before the sowing takes place.

Post-harvest technology

Hydro flour mill (Graat)

Locally, the hydro flour mill was called as *graat*. It was constructed near water channels at a steep slope so that water can enter the *graat* with a required velocity. In some places, special channels were also prepared with the help of metal sheets or woods. Water was diverted into these metal sheets or woods from a water channel by carving indentation on them. Its structure consisted of a wooden turbine, stones for grinding grains into flour, feed port and a wooden lever for controlling rate of flow of grains into grinding stones. The outer structure of the mill was constructed out of pine wood. It had medium weight and was relatively flexible with long durability. It is perfect wood with easy availability in the Himalayan region. The high velocity of water due to gradient was essential for the working of hydro flour mill. This practice has been followed by tribals for many years.

Storage

Kothar- food grain storage

As these places were very remote, there can be a shortage of food grains if roads get closed. Hence, they have developed their own storage structures. *Kothar* is a seed storage structure traditionally constructed out of pinewood, which consisted of a number of compartments where different kinds of grains can be stored.

It was constructed in such a way that it was kept above the ground level with the help of small pillars on all four sides. It was done to prevent the rotting of wood from water. Its size varied from household to household depending upon the capacity of individual food grains production. As there was less chance of pests and diseases due to cold temperature, it can be stored for years.

Potato storage in pits during winter

Firstly, a location in the agriculture field is chosen which generally remains dry. The terrain can be sloped or hilly. This should prevent the accumulation of water in one place. It is because if water percolates inside the ground, it can rot the potatoes. A pit is then dugout with a dimension of 3×2×6 feet. The pit was

filled with potato, which was then covered with dry grass locally known as *Booj*. The thickness of *Booj* was one foot over which stones with a dimension of 2×1 feet were placed. Stones were then covered with a thick layer of soil of around three feet. Using the pits can protect the tuber for consumption as well as seed purpose for around six winter months.

According to Ezekiel *et al.* (1999)⁷, potatoes for consumption if stored in cold storage at 2 to 4°C can lead to the accumulation of sugar and become sweet in taste. Therefore, it will become less suitable for consumption. They have to be stored in cold storage at 8 to 12°C and that also after treating with suppressant. So, it is profitable to store in non-refrigerated storage methods like pits in Lahaul and Kinnaur.

Sem: Storage of food grains

It was constructed with easily available natural materials like slate, a metamorphic rock. These slate stones are large in size. Storage structure is prepared by four slabs of slates which makes the four sides of the container. It was attached to wood blocks with the help of joints made between them. When the grains were put inside the container, the container was covered from the top with a slate slab. The whole container was then covered by mud so that grains do not come out and pests do not get in. As mud acts as a natural insulator, the temperature does not increase inside the container. Hence, prevents the degradation of grains. With the help of *sem*, grains could be stored for years and it is a very cost-effective storage structure.

Storage of barley grains inside the skin of sheep

Barley grains after harvesting and threshing need to be stored. The skin of sheep was indigenously used by the tribal people as one of the storage structure. Inside this, barley grains could be saved for months without any infestation.

Horticultural Crops

Tying of branches of younger apple trees

Climate change has led to a shift in the apple belt to higher altitudes in Kinnaur and Lahaul Spiti⁶. There was an increase in the planting of apple trees in these tribal areas. Branches of apple trees in a younger stage were tender. Hence, the branches of younger apple trees were tied with the help of cloth pieces or ropes with the main stem of the tree. Its purpose was to prevent the branches from breakage in winters due to heavy snowfall. Snow gets accumulated on the branches which become very heavy and there are

chances that it could lead to breakage of tender branches. To prevent that, they tie the branches of younger apple tree together with the main stem.

Food product development

Preparation of alcohol beverage using traditional knowledge

Alcohol is a major part of the culture in these tribal areas. Alcohol can be prepared out of barley, apple, or rice. This agricultural produce was cooked and boiled. After cooking, *phab* was added. *Phab* was used for its fermentation. Angmo *et al.* (2014)⁹ have reported that *phab* consisted of bacteria *Saccharomyces cerevisiae* and *Bacillus* sp. and was prepared out of the shrub *Artemesia*. *Phab* is used as a starter for alcohol preparation by traditional method. Agricultural produce mixed with *phab* were kept in a drum for a month in summer and for two months in winter for fermentation. This fermented form of liquor was called as *lugri*. *Lugri* had low alcohol content. To concentrate it, *Lugri* was boiled in a utensil made of brass (known as *thoka*). Due to boiling, the liquid gets slowly vaporized and passes through a hole of circular stone which is kept above the brass utensil. The hole of the circular stone is around three cm in diameter. Above the stone, a wooden utensil was kept, locally known as *bati* which also had a similar hole so that the vapors can pass through it. On the top of wooden utensil, there was another brass utensil filled with cold water. When vapours coming from the lower utensil got in touch with the base of top brass utensil, they got condensed and were transformed into water droplets. These water droplets were dropped into *bati* having a slanted floor which was then directed to the long nose. Longnose has a pore from which liquor is transferred and collected in a pot.

The first few liters of liquor that is collected were very acidic in nature hence they were rejected. The alcohol prepared from the method was called as *ghanti* in Kinnaur and *aara* in Lahaul valley.

While boiling alcohol, all these utensils had to be sealed properly so that vapors pass through the proper channel. For this dough was used. Dough seals the gaps between different utensils with each other. Hence, vapours do not leak out and alcohol can be prepared with the least amount of losses.

Dongmo

Butter tea is a drink of people in the Himalayan region. Traditionally, it is made with tea leaves, butter, milk, water, and salt. An instrument made from a wood known as *dongmo* was used for churning

the butter tea for preparation of butter tea. When not in use, it was filled with water, so that it does not get dried up. Drying can cause damage to the instrument.

Goat's skin use for butter making

In the tribal areas of Himachal Pradesh, milk products were one the major source of nourishment. Milk was obtained from cow, yak, sheep and goat. There are various methods of processing of milk which are indigenous to these tribal areas. One of this method was butter making using the skin of a goat. Goat's skin was utilized as a utensil for butter making.

Goat's skin was properly removed from the meat of goat. It was well cleaned and dried. It consisted of different openings, one from the neck side, one from the anal side and other four from the legs. Leg openings and anal openings are tied properly and the neck opening was kept open for inserting the curd. Once inserted, the neck opening was tied properly. Goatskin was then shaken back and forth until the butter was prepared.

One goatskin can be used for up to five years. It was cleaned and dried properly every time the procedure was followed. Major pests of goatskin in these areas were rodents. Hence, they store it by tying it to the roof.

Storage of meat

The meat of goat and sheep was cut into long pieces. The meat was properly separated from the bone. These pieces were generally six inches long. They did it so that it can be hanged properly on ropes for the purpose of drying. Salt was applied to the meat to prevent it from pests and fungus. Salt prevents decay of meat due to the osmotic pressure it creates via absorption. When the salt is applied, the microorganism that may harm the meat gets dehydrated and hence this has a preservative effect on the meat. It takes usually around one month to dry and could be used for one year without getting spoiled.

Agro animal-based yarns & weaves

Chhanba- wool shearer

Wool shearing is the cutting off or clipping of the wool from sheep and goat. For this purpose, farmers use an indigenously made scissor which they call as *chhanba* in Kinnaur. *Chhanba* is basically a hand-powered tool. Wool shearing with the help of *chhanba* is done twice a year. *Chhanba* had gone through an evolution and with different generations, it has been improving over the generations by the local people.

Indigenous hand carder (shuarth) and hand spinners (thaguli)

Wool carding is the process of separating the fibres of wool. *Shuarth* was the instrument that was used for carding of wool in the Kinnaur areas of Himachal Pradesh. *Shuarth* was made up of iron spikes, animal skin and wood. *Thaguli* was an instrument for spinning the wool to make up the yarn. These yarns are then used for preparing traditional clothes.

Khurch- removal of the skin of goat and sheep

Khurch is basically a knife for removal of skin from meat portion in case of sheep and goat. As the skin of goat and sheep has multipurpose use, they need to be removed carefully and cautiously. Hence, *Khurch* is a knife designed for the purpose.

Veterinary Science and Animal Husbandry

Treatment of stomach problems in cattle

In cattle, stomach problems could be detected by symptoms such as bloated stomach and loss of appetite. They were treated by feeding them with mustard oil. Tribal farmers provide almost half-liter of mustard oil to the cattle for the treatment of stomach problems. Mustard oil was being used by an indigenous medical practitioner for many centuries. Chakraborty *et al.* (2006)¹⁰ also found that mustard oil is utilized by the local people for rheumatic swelling in cattle in West Bengal.

Churu: drought animal

Churu was a hybrid animal of Cow and Yak. *Churu* was utilized as a drought animal for the purpose of ploughing. *Churu* animals were generally managed by only a few farmers in a village. It was shared among the local farmers on the hiring basis. It has to be booked months before so that agricultural operations could be conducted in a timely manner.

Khudh- for keeping the livestock

Houses of the tribal areas of Himachal Pradesh state generally consisted of two to three floors. The house was constructed in such a way that the ground floor was especially made for keeping the livestock. *Khudh* consisted of separate rooms for cattle, poultry, sheep and goat. The height of the *khudh* was generally lesser than other floors of the house to keep it warm during winters. The walls of *khudh* were covered with the layer of cow dung which acts as a natural insulator and helps to keep the rooms warm for livestock.

The opening window of the *sumbhu* is connected with the *khudh* so that the fodder could be directly pulled out for the livestock. Because in winters, due to

heavy snowfall, it was difficult for the people to come out of the house and collect the fodder for livestock.

Sumbhu- Storage of fodder for cattle

For the most part of the year, Lahaul-Spiti is covered with snow. People here had developed a storage structure for fodder, which was mainly utilized in winters. *Sumbhu* was a vertically elongated room covering an area of around two to three floors. It was generally made at the backside of the house. It had an opening at the roof and a window attached to the rooms where the cattle are kept i.e., *khudh*. Roof opening was used for inserting the fodder in the *sumbhu*. A window at the lower portion of *sumbhu* was used to pull out the fodder mainly in winters. Dimensions of *sumbhu* are two to three floor i.e., around twenty to twenty-five feet high. Dimensions of window connecting to the *khudh* were of four by four feet.

Application of human excreta (night soil) as fertilizer

Tribal areas of Himachal Pradesh are located in the middle Himalayas. These lands are not much fertile due to slopes and rocks. Also, farmers were not supplied with enough fertilizers as road connectivity was the problem. People used human excreta as a source of nutrients for their crops. Human excreta also are known as night soil are mixed with cow dung and ash. Then it was transferred to the field. It was spread on the agriculture field one to two weeks before ploughing. Night soil was mixed with the soil by ploughing.

In these tribal areas, toilets were generally constructed outside and away from the house. This toilet system consisted of the floor which was made out of the mud. The floor consisted of a rectangular hole. And below this floor, there was another room, where all the human waste was collected. The lower room consisted of three-sided walls and one side of the room remained open. In Kinnaur district, human waste was mixed with a mixture of horse waste, cow waste, and soil. In Lahaul-Spiti, the waste was covered with ash. People used this for two purposes: first, to prevent the foul smell and second, to convert it into manure. The manure was extracted from the opening in the lower floor. This opening was for the purpose of removing the manure easily.

Chicha: Drying and storing the fodder on trees

In Kinnaur district of Himachal Pradesh, fodder is sun-dried on the top of the tree. Fodder was then kept there for five to six months. During winters when

snow falls, snow covers the lower portion of the tree. As the level of the ground increases, people can get the fodder easily from the top of the tree. Also, snow can be easily removed from the top of the fodder. Fodder does not get wet because mercury level goes down below zero degrees Celsius in winters. Hence, it does not melt and the fodder remains dry.

Shaving off of Yak's hair in summer

Yak has a prominent role in the farming system of Spiti area. It plays an important role in ploughing. Also, it provides milk, fuel and is used for the transportation of goods for local farmers and traders. The people of Spiti cut the hair of their Yaks to prevent them from the summer heat. Yaks have a very thick layer of hair on their skin which can lead to accumulation of a large amount of heat.

According to Shihong *et al.* (1984)¹¹, distribution of Yak population depends on one of the most important factors i.e., temperature. He reported that the respiration rate of yak starts rising above 13°C and at 16°C, their heart rate and body temperature starts rising. When the temperature reaches 20°C, Yak tries to remain in shade, if available, without moving, grazing, drinking or ruminating. At the other extreme, yak can feed and move normally on grasslands with air temperatures ranging as low as -30°C to -40°C. Yak survive and perform adequately provided the annual mean temperature is below 5°C and the average in the hottest month does not exceed 13°C, though daily maximum temperatures can rise in the summer to much higher levels before falling again at night.

Storage of fat of sheep

People in these tribal areas consumed fat in a large quantity. These fats included ghee, oil and sheep fat. This sheep fat has to be stored for a long period of time especially in winters. So, the skin of the stomach of sheep was used to store it. They kept the sheep fat into the skin of the stomach of sheep itself and hanged it above the *tandoor*. *Tandoor* was kind of oven used to cook food and to keep the room warm. It was kept above the *tandoor* so as to keep it in melted form. This melted form of fat was directly used for culinary purposes. It was easy for storage and the heat of *tandoor* prevented the fat from fungus and bacteria.

Medicinal

Fafdha (Buckwheat) for diabetes and sugar control in humans

Fafdha i.e., Buckwheat (*Fagopyrum tataricum*) is believed to control diabetes and sugar levels in

humans. Kawa *et al.* (2003)¹² found that blood sugar level lowers in those diabetic rats which are fed with buckwheat extract. Yao *et al.* (2008)¹³ have reported that D-*chiro*-inositol (DCI) is an active compound in Tartary buckwheat with insulin-like bioactivity. Also, he showed that it could lower glucose level and enhance insulin immune reactivity in mice with a high glucose level.

Myths and Beliefs

The belief system in the treatment of sheep

Treatment of infection was done by piercing the nose with a needle. Tribal farmers assume that if that sheep lick their own blood, they will survive. If they do not, then there were fewer chances of survival of that sheep.

Further, validation of identified ITK was done through modified QuIK method by the key informants of the study area. They were asked to rank each ITK based on criteria identified by the respondents (Table 1). Based on their responses, the first 5 ITKs were selected from both the districts. The criteria based on which validation was done were utility, availability, cost-effectiveness, ease in use, time consumption and labour intensiveness in 5-point scale. The major findings of the study are given below in the following tables. From the study, it was revealed that farmers ranked Kothar for food storage as the most useful ITK in the tribal areas of Kinnaur district followed by Graat- a hydro flour mill, Suttar for soil conservation, tying of branches of the apple tree at tender age and chicha for drying and storing of fodder. The mean score of 4.27 indicated the high validity of Kothar. The mean score graat ($\bar{x} = 4.22$) was more than the mean score of suttar for soil conservation ($\bar{x} = 4.08$). Tying of branches of apple

trees at the younger stage was also highly valid technique for the tribals to practice ($\bar{x} = 4.01$). Key Informants in Lahaul-Spiti district ranked Khudh for housing the livestock as the most popular ITK of the area followed by potato storage in pits, sumbhu for storage of fodder, shaving off of yak's hair in summer and sem for grain storage. Khudh was the highly validated indigenous practice for managing the livestock in extremely cold conditions. These findings from the study revealed that all these ITKs were highly integrated into the tribal community to manage their day to day life. So, there is an immediate need to scientifically validate the technology for the upscaling and out-scaling of these indigenous technologies.

Discussion

The abundantly available stones, pinewood and its leaves are meticulously used by the tribal people for various purposes. Thirty important ITKs were documented under the categories soil and water management, cropping system, farm implements, post-harvest technology, storage, horticultural crops, food product development, agro animal-based yarns and weaves, veterinary science and animal husbandry, medicinal and myths and beliefs. Quantification of Indigenous Knowledge (QuIK) method was used as a participatory validation of the documented ITKs. The most important identified ITKs were *graat*- a hydro flour mill, *kothar* for food grain storage, mulching and preventing soil erosion by *suttar* (leaves of pine tree), tying of branches of younger apple tree, *khudh* for keeping the livestock, *sumbhu* for storage of fodder for cattle, *chichi* for drying and storing the fodder on trees, shaving off of yak's hair in summer, *fafdha* (buckwheat) for diabetes and sugar control in humans.

Table 1 — Ranking of ITKs in Lahaul-Spiti district of Himachal Pradesh

ITKs	Utility \bar{x}	Availability \bar{x}	Cost effectiveness \bar{x}	Ease in use \bar{x}	Time consumption \bar{x}	Labour intensiveness \bar{x}	\bar{x}	Ranking
<i>Suttar</i> : for soil conservation	4.4	4.6	4.2	4.2	3.6	3.5	4.08	III
<i>Graat</i> : hydro flour mill	4.6	3.5	3.8	4.5	4.7	4.2	4.22	II
<i>Kothar</i> : food grain storage structure	4.6	4.4	3.8	4.4	4.1	4.3	4.27	I
Tying of branches of younger apple trees	4.3	4.1	4.1	3.9	3.8	3.9	4.01	IV
<i>Chicha</i> : for drying and storage of fodder	4.1	4.3	3.9	3.7	3.9	3.3	3.86	V
Potato storage in pits	4.7	4.5	4.3	4.3	3.5	3.7	4.16	II
<i>Sumbhu</i> : storage of fodder	4.4	4.4	4.1	3.8	3.9	4.1	4.12	III
Shaving off of Yak's hair in Summer	4.2	3.8	4.1	4.3	4.0	4.0	4.06	IV
<i>Sem</i> : storage of food grains	4.4	4.2	3.9	3.6	3.5	4.0	3.93	V
<i>Khudh</i> : for keeping the livestock	4.6	4.5	4.3	4.1	4.3	4	4.30	I

Agricultural fields in the mountainous region are generally sloped. People in the mountains go for terrace farming. Even with the terrace farming, lands are still undulated and sloped. The farmers know that because of the hill slopes, the soil is prone to erosion and if flood irrigation is applied, it can lead to erosion of the topsoil. To prevent that, tribal farmers in Himachal Pradesh (H.P.) have developed techniques by utilizing the locally available resources such as *suttar*. *Suttar* is the locally available needle leaves of the pine tree. Before they irrigate the agriculture fields, this *suttar* are spread on the fields to slow down the velocity of water and hence allow more percolation of water into the soil. Also, it contributes to the spreading of water in the field evenly and uniformly. *Suttar* is abundantly available with the farmers in the tribal area. It has multipurpose use in the tribal farming system. It also conserves soil moisture, hence used as mulch and store soil nutrients when incorporated into the soil. *Suttar* is used to improve soil texture and soil fertility.

There were various other methods by which soil productivity and soil fertility are maintained by the tribal farmers. One of the ways was community-based manuring by sheep and goat. It is not only an efficient way of organic manuring but also it is a pasture management technology. Overgrazing is one of the reasons for desertification and erosion. When goat and sheep are moving from one place to another place, overgrazing is naturally stopped and the ecological balance is maintained. Such kind of practices evidently shows the collective resource management behaviour of tribal farmers. But these practices are slowly vanishing due to less livestock population and may disturb the life of tribal people.

Farmers in these tribal areas understand the detrimental effects of monoculture. Hence, they avoid it by cultivating a leguminous crop, peas, for fixing the lost nitrogen in the agriculture field. This helps to restore the fertility level of soil and ultimately enhances production. Barley, pea and potato constitute the common crop rotation. It also prevents the spread of pests and diseases from one crop to another.

Villages in tribal areas of H.P. are very remotely located. It takes a long journey for the farmers to reach the market located in the town. During winters, when heavy snowfall occurs, roads might get closed, electricity might get cut, transportation might hamper. Hence, they need to secure food for themselves so

that they can survive even when no market is available. For this, a number of storage structures have been developed based on indigenous knowledge. These are *kothar* (an indigenous storage structure), potato storage in pits, *sem* for storage of food grains and storage in the skin of sheep. All the locally available materials are used in a holistic approach to minimize the construction cost and to store food grains for a quite long period of time in the construction of *kothar*. Generally, these structures are constructed outside the house as there is no dearth for land in hilly areas. A similar kind of storage structure made of deodar wood is in practice in Uttaranchal. In such kind of storage structures, food grains can be stored up to 8-10 years (documented by Govind Singh Rana, Sukhi, Jhala, Uttaranchal).

The potato was produced abundantly in these areas as it was one of the important crops of the tribal farmers. They cannot store it in their houses, as they are large in quantity and no cold storage facility. They cannot store under the sunlight, as it can cause greening of potato which is not fit for consumption. Hence, they developed a method for storing the potatoes in the pits. Potato storage in pits is one of the common methods not only followed in these tribal areas, but also in other parts of India and the world. This method of storage of potato and another traditional method of storage in Madhya Pradesh has been reported by Ezekiel *et al.*, (2014)¹⁴. In Dimbudh village of Tamar block in Ranchi district of Jharkhand, the potato was stored inside the heap of straw and was plastered by soil¹⁵.

Apple is one of the important horticultural cash crops in Himachal Pradesh. Rana *et al.*, (2008)¹⁶ reported that changes in climatic pattern i.e., increasing trend of temperature and decreasing trend of precipitation in Himachal Pradesh has led to the shift of apple belt to a higher altitude. Due to this, farmers in the region of higher altitude have started planting apple trees in their farms. Farmers of these areas have developed a technique of tying branches in younger apple trees. This was to prevent the tender branches from breakage due to the heavyweight of snowfall during winters. This practice was denounced by the subject matter specialist and other experts as it can have some detrimental effect on the growth of the plant. But, the tribal farmers still follow this practice.

Usually, ploughs are used by men. But in tribal areas of Himachal Pradesh, women were handling it,

especially for sowing purpose. It involved a small plough, which was made up of locally available wood. This activity required three to four women. It involved a small size of the plough, pulled by two women with the help of ropes. Third women controlled a small plough and created a line in which seeds were placed by fourth woman and sowing was performed. It evidently shows the involvement of tribal women in agricultural activities and the drudgery experienced by them. Even though this practice is disappearing, it shows the drudgery realized by women. All India Coordinated Research Project on Home Science (FRM component) in Himachal Pradesh found that tillage was the most drudgery prone task of all the farm activities.

Alcohol has found a prominent place in the culture of tribal people. Apple and barley are the major agricultural crops and hence, most of the alcohol is prepared from these agricultural products. The alcoholic beverage prepared from these products is called *ganthi* in Kinnaur and *aara* in Lahaul-Spiti. It is consumed both during summer and winter. In winters, when the mercury goes below zero degrees, it acts as a source of warmth for the tribal people. It is an important beverage, being served in festive times too. As it is prepared from barley and apple, it also supplies a lot of nutrients and minerals to them. Hence, it is very important from a nutrition point of view. The inoculum from which the alcohol is prepared has been studied by Kanwar *et al.* (2011)¹⁷ and it is called as *phab*. In recent years, it was found that *phab* was being replaced by the yeast formulations, which are available readymade in the market. Also, local people are under the legal obligation to produce and keep only 24 L of alcohol at a time. This can be used for domestic as well as commercial purposes.

Tribals are dependent on crops and livestock for their livelihood and survival. Goat, sheep, yak and cow are important livestock in the tribal areas of Himachal Pradesh. Milk products of these animals are the major source of nourishment. In addition to milk products, other products such as goat's skin were used as a storage structure and as a butter making vessel. The sheep and goat meat, an important source of animal protein for tribal people, is consumed in a large quantity to warm up their body during winters. Goat or sheep fat is consumed regularly in a large quantity. When the butchering of sheep or goat is performed, a whole family cannot consume all the

meat at once. Therefore, it needs to be stored in such a way so as to prevent it from decomposition for some period of time. Hence, salt is applied which creates an osmotic effect on microorganisms which ultimately kills them, which can be stored for a longer period. Apart from being a source of food and storage structure, the skin and wool were used as garments and as bedding materials. These are very warm and very much suitable for protection against the cold in winters.

As the livestock are sometimes affected by the disease, they are treated by tribal farmers using their indigenous knowledge. Cattle are fed with mustard oil for stomach ailments. Similar kind of indigenous practice i.e., mixing mustard oil with edible soda is reported in many studies.

The indigenous equipment like *chhanba*, a wool shearer and *shuarth*, a hand carder are used by tribal people for long years before and is being improved over the generations by the local people. Both of them are hand tools utilized in the process of preparing yarns and weaves. Earlier, *shuarth* was made up of iron teeth and the outer covering was completely made of leather. But recently, due to a decrease in the population of livestock, leather parts of hand carder were replaced by locally available wood. It is a very cost-effective and durable tool. This process is mostly performed by old people during their idle time. It not only helps in carding but also, it is a physical exercise for the old people belonging to these tribal areas. Hand spinner that is utilized for spinning is common in many places not only in India but also in different parts of the world. It has also been reported that it is utilized not only for spinning of wool fibres but also silk cocoon in Karnataka¹⁸. Similarly in West Bengal, *mataka* spinning is utilized which is also a *takli* spinning.

Generally, in towns and cities, the flour mills consume electricity for their working. But in Kinnaur district, tribal farmers have developed hydro flour mill called as *graat*, which is run by flowing water as the name suggests. These reduce the recurring costs of electricity. These structures are prevalent from the last 100 years. However, they are at a decline due to the decreasing trend of snowfall in these areas and ultimately reduce the amount and velocity of water available for mill purpose. It has very high utility for the tribal farmers. They perceived that the flour made of *graat* is much tastier than the flour produced from the electric flour mill.

As these places are very remote, there are very few health centres. In the case of major illness, they have to be taken to towns and cities. But for day to day illness, they have developed their own knowledge for treating the ailment with the help of locally available medicinal plants. One of them was documented in the present study. It was *Fafdha* (Buckwheat) for lowering the blood sugar in humans suffering from diabetes. There are various other medicinal plants in the north-western Himalayas that had already been documented by Negi *et al.* (2009)¹⁹, Lone *et al.* (2014)²⁰ and Samant *et al.* (2007)²¹ which are very beneficial for keeping the good health of the tribal people.

All the above ITKs clearly show that the life of tribal people is revolving around the naturally available resources like *pine* tree, *deodar* tree, wooden logs, boulders, animal meat, goatskin and sheep wool, etc in their ecosystem. It evidently describes that the tribal people know about the use of their resources. Even though these tribal farmers are constrained about a lot of resources, they strike a balance with the mother earth and lead a decent life, which is very much essential for maintaining sustainability.

Conclusion

The study documented 30 ITKs under the following categories soil and water management, cropping system, farm implements, post-harvest technology, storage, horticultural crops, food product development, agro animal-based yarns and weaves, veterinary science and animal husbandry, medicinal and myths and beliefs.

Documented ITKs, under the category of soil and water management, were: preventing soil erosion by use of *suttar* (leaves of Pine tree), mulching by *suttar*, community-based manuring by sheep and goat. Under the category of cropping system, documented ITKs were crop rotation with leguminous crops, sowing of peas by women in the traditional method, *boskhyar* for leveling of land. Documented farm implements included *farua* and *chau*. *Graat* is a hydro flour mill under the category of post-harvest technology. Under the storage category, identified ITKs were: *Kothar* for food grain storage, potato storage in pits during winter, *Sem* for storage of food grains, storage of barley grains inside skin of sheep. Tying of branches of younger apple trees was the ITK documented under the category of horticultural crops. Food product development category includes preparation of alcohol

beverage using traditional knowledge, '*dongmo*' for churning of butter tea, Goat's skin for making butter and storage of meat. Agro animal-based yarns and weaves include *chhanba*- a wool shearer, indigenous hand carder (*shuarth*) for carding and *thaguli* for spinning the yarns, *khurch* for removal of skin of goat and sheep. Veterinary science and animal husbandry consisted of ITKs such as: treatment of stomach problems in cattle, *churu*- a hybrid of cow and yak used mainly for the drought purpose, *khudh* for keeping the livestock, *sumbhu* for storage of fodder for cattle, application of human excreta (night soil) as fertilizer in the farm fields, *chichi* for drying and storing the fodder on trees, shaving off of yak's hair in summer, storage of fat of sheep was documented under medicinal category, *fafdha* (buckwheat) for diabetes and sugar control in humans was documented under myths and beliefs, tribal's belief regarding ailing sheep was documented

These ITKs were validated through Quantification of Indigenous Knowledge (QuIK) method by the key informants of the study area. Based on their responses, the first 5 ITKs were selected from both the districts. Validation criteria used were utility, availability, cost-effectiveness, ease in use, time consumption and labour intensiveness- it was measured on a 5 pointer scale. From the study, it was revealed that farmers ranked *Kothar* for food storage as the most useful ITK in the tribal areas of Kinnaur district followed by *Graat*- a hydro flour mill, *Suttar* for soil conservation, tying of branches of apple tree at tender age and *chicha* for drying and storing of fodder. The mean score of 4.27 indicated the high validity of *Kothar*. The mean score of hydro flour mill *graat* ($\bar{x} = 4.22$) was more than the mean score of *suttar*-soil conservation ($\bar{x} = 4.08$). Tying of branches of apple trees at younger stage was also highly valid technique for the tribals to practice ($\bar{x} = 4.01$). Key Informants in Lahaul-Spiti district ranked *Khudh* for housing the livestock as the most relevant ITK of the area followed by potato storage in pits, *sumbhu* for storage of fodder, shaving off of yak's hair in summer and *sem* for grain storage. *Khudh* was the highly validated indigenous practice for managing the livestock in extremely cold conditions.

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Conflict of Interest

It is to certify that all authors have seen and approved the final version of the manuscript being submitted. They warrant that the article is the authors' original work, hasn't received prior publication and isn't under consideration for publication elsewhere.

Authors' Contribution:

S S: Investigation, Writing - original draft; V S: Conceptualization, methodology, Writing - review & editing; P S: Conceptualization, methodology, Writing - review & editing; R R B: methodology, Writing - review & editing; SP: methodology, Writing - review & editing; PV: methodology, data curation and analysis; A B: Software supervision and analysis; T S: Writing - review & editing.

References

- Josephson A L, Ricker-Gilbert J & Florax R J, How does population density influence agricultural intensification and productivity? Evidence from Ethiopia, *Food Policy*, 48 (2014) 142-152.
- Corry S, Tribal peoples for tomorrow's world. Survival International. A Freeman Press Publication. (2011).
- Majumdar D N, *The Affairs of a Tribe: A study in tribal dynamics*. Ethnographic and Folk Culture Society, UP. Universal Publisher Ltd., 1950.
- Lennart, C, Ljungman, S, Martin R M, & Whiteman, A, Beyond sustainable forest management: opportunities and challenges for improving forest management in the next millennium – summary report. FAO Corporate Document Repository, 1999.
- Scheduled Areas (Himachal Pradesh) Order, Constitution of India. Government of India, 1975.
- Foley J A, Ramankutty N, Brauman K A, Cassidy ES and Gerber J S, Solutions for a cultivated planet, *Nature*, 478 (7369) (2011) 337-342.
- Ezekiel R, Paul V, Singh J & Shekhawat G S, Potato storage in India, *Indian farming*, 49 (9) (1999) 21-25.
- Rana R S, Bhagat R M, Kalia V & Lal H, The impact of climate change on a shift of the apple belt in Himachal Pradesh from: *Handbook of Climate Change and India, Development, Politics and Governance Routledge*, 2011.
- Angmo K & Bhalla T C, Preparation of Phabs-an indigenous starter culture for production of traditional alcoholic beverage, Chhang, in Ladakh, *Indian J Tradit Know*, 13 (2) (2014) 347-351.
- Chakraborty M K & Bhattacharjee A, Some common ethnomedicinal uses for various diseases in Purulia district, West Bengal, *Indian J Tradit Know*, 5 (4) (2006) 554-558.
- Shihong L, *The observation on yak's heat resistance. A research on the utilization and exploitation of grassland in the northwestern part of Sichuan province*, Sichuan National Publishing House, (1984) 171-74.
- Kawa J M, Taylor C G & Przybylski R, Buckwheat concentrate reduces serum glucose in streptozotocin-diabetic rats, *J Agric Food Chem*, 51 (25) (2003) 7287-7291.
- Yao Y, Shan F, Bian J, Chen F, Wang M, *et al.*, D-chiro-inositol-enriched tartary buckwheat bran extract lowers the blood glucose level in KK-Ay mice, *J Agric Food Chem*, 56 (21) (2008) 10027-10031.
- Ezekiel R, Traditional methods of potato storage in the Malwa region of Madhya Pradesh, *ICAR-Central Potato Research Institute Technical Bulletin No. 57*, (2014).
- Indian Council of Agricultural Research, Das, P, Das, S. K, & Mishra, A, Inventory of Indigenous Technical Knowledge in Agriculture: Mission Mode Project on Collection, Documentation and Validation of ITK, ICAR, 2003.
- Rana R S, Bhagat R M, Kalia V & Lal H, Impact of climate change on shift of apple belt in Himachal Pradesh. In: ISPRS Archies XXXVIII-8/W3Workshop Proceedings; Impact of Climate Change on Agriculture, (2008) p. 131-137.
- Kanwar S S, Gupta M K, Katoch C & Kanwar P, Cereal based traditional alcoholic beverages of Lahaul and Spiti area of Himachal Pradesh, *Indian J Tradit Know*, 10 (2) (2011) 251-257.
- Sanapapamma K J & Naik S D, Contemporary breakthrough in Ahimsa silk spinning, *Indian Tradit Know*, 7(1) (2008) 178-181.
- Negi V M & Chauhan N S, Medicinal and aromatic plants wealth of a tribal district Kinnaur in Himachal Himalayas, *Indian For*, 135 (6) (2009) 838-852.
- Lone P A, Bhardwaj A K, Shah K W & Tabasum S, Ethnobotanical survey of some threatened medicinal plants of Kashmir Himalaya, India, *J Med Plants Res*, 8 (47) (2014) 1362-1373.
- Samant S S, Butola J S & Sharma A, Assessment of diversity, distribution, conservation status and preparation of management plan for medicinal plants in the catchment area of parbati hydroelectric project stage—III in Northwestern Himalaya, *J Mt Sci*, 4 (1) (2007) 034-056.