Perceived attributes and adoption of Indigenous Technological Knowledge on agriculture - a case study from Bhirkot municipality of Syangja District, Nepal

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Abstract: The authors conducted a study during August-September, 2020. This study to investigate the perceived attributes and adoption level of Indigenous Technological Knowledge in agriculture. A total of 356 farmers from different villages of Bhirkot municipality of Syangja district were considered for interviews that used a pretested questionnaire. More than half (64.89%) of the interviewed respondents had average level of knowledge regarding the use of indigenous means in agriculture. Utilization of farmyard manures to supplement the executives and erecting scarecrow for plant assurance were seen as most viable, observable, and triable. Mixed cropping, green manuring, utilization of animal and plant by-products,

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PUBLIC INTEREST STATEMENT
There is an antique dictum: “When an old knowledgeable person dies, a whole library dies”. UN Conference on Environment and Education in 1992, World Conservation Strategy of IUCN in 1980, and Brundtland Commission and World Commission on Environment and Development, 1987 recognized the need for precedence of Indigenous knowledge in the agricultural sector in every country, society, and culture. This paper explores the perceived attributes and adoption level, and knowledge level of farmers regarding the use of ITK. It puts forth the potential of traditional technological system. Although the value of indigenous knowledge is growing, it has not received much attention from professionals and academicians. We have discussed the use of various indigenous wisdom as the methods of increasing agricultural production. Knowledge is a part of culture. Also, the statement: “Think globally, but act locally” clarifies the need of indigenous knowledge on agriculture.
and seed storage in pot filled with ash were other common practices. However, there are several constraints such farmer's preference for readymade inputs, sociological constraints, long waiting period to get the desired results from adoption of ITKs, and the paucity of government support that hindered the adoption of ITKs. The study recommended that the government should identify, preserve, and well document indigenous methods along with their comprehensive review for authenticating scientifically.

**Subjects:** Agriculture & Environmental Sciences; Plant & Animal Ecology; Biotechnology

**Keywords:** Adoption; agriculture; attributes; constraints; indigenous practices

1. Introduction

Science blended with wisdom would sustain the existing farming system better, both in terms of stability and productivity. Mankind has passed through the stone age, the steel age and entered the space age with the help of technologies. Scientists, using logical judgments and practical experiences, started developing technologies, to fulfill their needs. In the process of intensive farming, the environment has been treated in an unfriendly manner (Rahman, 2012). Indigenous Technological Knowledge (ITK) is knowledge that is specific and identity to particular culture or society (Warren et al., 1989). This knowledge includes the cultural traditions, values, beliefs and views of local people (Agarwal, 1995). “Local knowledge” indicates the knowledge of any individual who had resided in an area for long duration (Langill, 2001). Louise Grenier had stated indigenous knowledge as “the unique, historic, local knowledge existing within and developed around the specific condition of women and men indigenous to a particular geographic area” (Grenier & International Development Research Centre (Canada), 1998). It balances biodiversity by maintaining soil purely organic, gene pools, conservation of indigenous varieties etc., (I. Sharma et al., 2020). ITK are the ideas and practices of indigenous community that are advanced over a long period of time (Devi et al., 2014) and are transferred from generation to generation through folk songs, proverbs, myths, stories, culture, puppetry and traditional methods (Swathi & Dineshbabu, 2009). This knowledge links farmer’s perspective to natural, physical, and socio-economic environment from an agro-ecosystem (Bonny & Vijayaragavan, 2001).

ITK methods of pest control have been adopted by different members of the communities to different extents, such as in plant protection, weather forecasting, storage techniques, nutrient management methods, animal husbandry practices, etc. Sustainable agriculture through traditional way is achieved through the use of locally available means like application of Farm Yard Manure, cow dung and urine, green manuring, intercropping, tillage, and so on. Nowadays, myriads of indigenous practices are at risk of becoming extinct owing to rapidly changing natural environments and fast pacing economic, political and cultural changes. Practices vanish, as they become inappropriate for new challenges or because they adapt too slowly (S. Sharma et al., 2009). Many practices vanish just due to the intrusion of foreign technologies that promise short-term gains or solutions to problems without being capable of sustaining them.

Indigenous knowledge should be preserved and well documented along with its comprehensive review for authenticating scientifically (Husain, 2013). Government of Nepal has recently introduced “National Intellectual Property Policy” in 2017 for the preservation, application and development of indigenous knowledge. Besides, this policy aims to develop traditional knowledge digital library for documentation and conservation of traditional knowledge and features the requirement of legal framework for geographical indication, plant variety protection, biodiversity, traditional knowledge, and cultural expression (Upreti, 2019). This paper attempts to explore and highlight the Indigenous Technological Knowledge of the farmers of study area regarding different aspects of crop production.
1.1. Objectives
The main objective of the study was to assess the perceived attributes of adoption of ITKs, find out practiced indigenous practices in agricultural sector, and determine the extent of use of selected indigenous knowledge. Constraints for the adoption of indigenous technology were studied and the relevant solutions were discussed.

1.2. Limitations of the study
Lack of enough time and due to paucity of resources, it was difficult for us to cover the larger agro-climatic zone and needs an endeavor for detailed study. Thus, different villages of a municipality were considered as a type of representative of whole zone. The area of investigation is restricted to one district. Therefore, the findings have to be viewed in specific context and should not be generalized for a wider geographical area, as they are applicable wherever similar conditions prevail. Some knowledge has authentic or scientific value and some knowledge based on the local beliefs, superstitions, experiences which have not yet been proved, only hypothesis can be drawn. Since this is a type of anthropological study, it is sometimes difficult to understand in some cases. Personal observations of investigator may have the chance of bias. Nevertheless, it is hoped that this study would be able to throw light on the effectiveness of Indigenous Technical Knowledge in agriculture.

2. Materials and methods
The present study is anthropological in nature which is having qualitative explanation, so out of two broad spectrums of research—quantitative approach and qualitative approach, the qualitative approach is being used in the present research.

2.1. Description of study area
The Syangja district of Gandaki province of Federal Democratic Republic of Nepal was selected purposively for the present study. Being specific, the survey was conducted in Bhirkot Municipality ward no. 3 (formerly known as Banethok Deurali), lying in the Southern part of the province with latitude 28°1’42” N and longitude 83°50’34” E. Syangja district had ethnic and cultural background of cultivating different crops since ages which has culted most traditionalities in formulating a greater base for Indigenous Technical Knowledge. Bhirkot is one of the potential sources for indigenous knowledge as advanced and modern technology has not reached due to difficult topography. Traditional agriculture is still dominant in this region due to difficult terrain, inaccessibility, market, nominal use of chemical inputs like pesticides and weedicides, pesticides, and low economic status of farmers. Therefore, this survey was extensively focused on the indigenous information associated with traditional farming practices. Figure 1 shows the map of Nepal including the geographical map of Bhirkot municipality.

2.2. Data collection and sampling techniques
The study was conducted in the late summer of 2020. Farmers having knowledge of indigenous technologies were taken into consideration. The level of knowledge was determined through personal interview. Respondents of the study comprised tribal and non-tribal farmers which included old men and women, the local youth as key informants and the extension functionaries of the study village. Since, the study aimed at identification and documentation of indigenous technologies in agriculture and allied fields, the respondents who had knowledge and were also practicing the ITKs in these fields were selected. Sample size of 356 respondents were selected. Key Informant Survey (KIS) was carried out with older members of the community and Focused Group Discussions (FGD) were conducted to gather information about indigenous practices. Similarly, for secondary data collection various online open access journals, reports, books, related websites, articles, reports related to indigenous knowledge were reviewed during manuscript preparation. Relevant information was collected from available literature and finding from them were arranged systematically.
2.3. Data analysis

The obtained information from the survey were entered in MS Excel 2010 and IBM Statistical Package for the Social Science (SPSS) for descriptive analysis. Graphs were prepared by MS Excel.

3. Results and discussion

3.1. Demographic characters

A perusal of the characteristics of farmers in the study areas (Table 1) indicated that more than half of the respondents were having the age between 36 and 58 years. The data with regard to education indicated that majority of the farmers had education level of primary school, whereas approximately one-thirds were illiterate. It is observed from Table 1 that slightly less than three-fourths of the respondents were having “Nuclear family” set up and remaining were having joint family. The findings pertaining to farming experience showed that majority of the respondents had medium (8–15 years) level of experience. Almost half of the farmers had 0.6–1 hectare of land, whereas 37.08% were small (<0.5 ha) landholders and 14.89% were large (>1 ha) landholders. Most (55.06%) of the respondent's income was relied on agriculture only, followed by Services with Agriculture, Abroad and agriculture, and Business with agriculture. Less than three-fourths (71.07%) of the respondents had income level ranging from NRs. 18,000–30,000 (1 NRs. = 0.0085 USD).

Majority of respondents received the knowledge on indigenous technological knowledge through the Parents/relatives (27.53%), while some received through community leaders/elders, Farmers, folklores and extension agencies. Also, direct observation and Internet/mass media by farmers
enable farmers to understand about ITKs (Figure 2). In developed countries, consumers get to know a lot through the internet. Nepal, being a developing country, the consumers are not able to get accessed to the internet in many places (Khanal, 2020). Family and Friends are the most reliable source of information.

3.2. Identification of Indigenous Technological Knowledge used by farmers

Indigenous knowledge has been practiced by the farmers of this region over the centuries. There is no any proper documentation of their practices. Although, their practice is effective for subsistence production but they need be modified scientifically for their rationality. During the investigation of indigenous farm technological knowledge (ITK) prevalent in selected area, the ITK was identified through informal discussions with randomly selected 356 farmers. Several group discussions were also held to get complete information about every aspect of indigenous farm practices. The indigenous practices (ITK items) so identified were categorized in consultation with the farmers.

Table 1. Socio-economic characteristics of the respondents

| Characteristics               | Frequency (N = 356) | Percentage (%) |
|-------------------------------|--------------------|----------------|
| **Age**                       |                    |                |
| Young age (<35 years)         | 96                 | 26.96          |
| Middle age (36–58 years)      | 219                | 61.52          |
| Old age (59 years and above)  | 41                 | 11.52          |
| **Education level**           |                    |                |
| Illiterate                    | 121                | 33.98          |
| Primary school                | 156                | 43.82          |
| Middle school                 | 62                 | 17.41          |
| High school                   | 10                 | 2.8            |
| College                       | 7                  | 1.96           |
| **Farming experience**        |                    |                |
| Low (<7 years)                | 76                 | 21.34          |
| Medium (8–15 years)           | 228                | 64.04          |
| High (16 years and above)     | 52                 | 14.6           |
| **Land holding**              |                    |                |
| Small (<0.5 ha)               | 132                | 37.08          |
| Medium (0.6–1 ha)             | 171                | 48.03          |
| Large (>1 ha)                 | 53                 | 14.89          |
| **Annual income (in NRs.)**  |                    |                |
| Upto 18,000                   | 45                 | 12.64          |
| 18,000–30,000                 | 253                | 71.07          |
| 30,000 above                  | 58                 | 16.29          |
| **Family type**               |                    |                |
| Nuclear                       | 259                | 72.75          |
| Joint                         | 97                 | 27.25          |
| **Source of Income**          |                    |                |
| Agriculture only              | 196                | 55.06          |
| Services with Agriculture     | 75                 | 21.07          |
| Abroad and agriculture        | 53                 | 14.89          |
| Business with agriculture     | 32                 | 8.99           |

Note: 1 NRs. = 0.0085 USD
The farmers were asked to categorize each identified ITK item on five-point rating scale, viz., (i) most widely practiced ITK item in the area, (ii) widely practiced ITK item in the area, (iii) practiced ITK item in the area, (iv) sometimes practiced ITK item in the area, and (v) not at all practiced ITK items now in the area, with a score of 5, 4, 3, 2 and 1, respectively. Table 2 shows the extent of practice of Indigenous method of agriculture in the study area.

### 3.3. Indigenous nutrient management method

#### 3.3.1. Use of farmyard manure
Farmyard manure is the major soil nutrient additive in this region. Farmyard manure is prepared by animal dung and forest litter that is used for bedding purpose. These bedding materials are kept with animal dung and urine in such way to form heap and wait for its decomposition. Later, it is taken to the field manually with the help of Doko, Thunchhe before ploughing.

#### 3.3.2. Clearing and incorporating terrace riser
This is very common practiced method for the nutrient management. Grasses on the terrace riser are cleared with the sickle and spade and incorporated in the field for decomposition. Besides, it is also believed that this practice cleans hiding area of rat.

#### 3.3.3. Use of indigenous species for green manuring
Asuro (Adhatoda vasica), Titepati (Artemisia vulgaris) and Khirro (Sapium insigne) are the dominantly used as the green manure in the nursery of paddy and finger millet. These species are also used for mulching in vegetables. Use of Asuro, Titepati and Khirro 10 t/ha have increased rice yield by 49%, 23% and 21%, respectively, as compared to the use of inorganic fertilizers 60:30:30 kg NPK/ha. (Jeanette et al., 1992).

#### 3.3.4. Intercropping cereals with legumes
Due to limited land holding, farmers practice intercropping of cereals and legumes unknowing about their benefit to soil health. Legumes like rice, beans are sown at the edge and a year-long beans is mixed cropped with maize during sowing of maize on the Bari (Rainfed upland). Horse gram is intercropped with finger millet in Bari (Rainfed upland) whereas soyabean are planted on the bund during paddy cultivation Khet (Lowland). Lentils are relay cropped with paddy before harvesting. Legumes cultivation in the field helps to improve nutrient status of soil by nitrogen fixation.
| Sr. No. | Identified ITK methods | Mean Response Score |
|--------|------------------------|---------------------|
| **INDIGENOUS NUTRIENT MANAGEMENT METHOD** | | |
| 1 | Use of farmyard manure | 4.82 |
| 2 | Clearing and incorporating terrace riser | 4.36 |
| 3 | Use of indigenous species for green manuring | 4.1 |
| 4 | Intercropping cereals with legumes | 3.43 |
| 5 | Green leaves available are spread in paddy field 15 days before puddling and then incorporated in the field at the time of puddling, which ensures the addition of organic matter to the soil and this checks the emergence of weeds. | 3.1 |
| 6 | Neem cake is applied to the soil at the time of sowing cereals seed® 20–25 kg/acre | 2.61 |
| 7 | Mixed cropping of wheat/barley + beans helps in crop diversification and maintains soil productivity besides conserving the soil. | 1.35 |
| **INDIGENOUS PLANT PROTECTION METHOD** | | |
| 1 | Setting up bamboo stick or branches of tree | 4.23 |
| 2 | Burning the residue of crop | 4.2 |
| 3 | Use of ash | 3.65 |
| 4 | Spraying cow urine | 3.2 |
| 5 | Use of locally available plant materials | 2.76 |
| 6 | Selecting seeds from healthy plants for next year seeding | 2.69 |
| 7 | Erecting scare-crow in standing crop to scare birds | 2.34 |
| 8 | Fumigating rat burrows by burrowing paddy husk | 2.21 |
| 9 | Mixed cropping of maize and soybean is practiced to minimize insect pest attack. | 1.9 |
| 10 | Rat control in the field by spraying extract of flower/inflorescence of glyricidia plant mixed with water | 1.64 |
| 11 | Use of dried garlic rhizome for controlling beetle | 1 |
| **INDIGENOUS TRADITIONAL PLANT STORAGE PRACTICES** | | |
| 1 | Storing seeds in earthen pot with ash | 4.84 |
| 2 | Use of thin cow dung cake to store cucurbit seeds | 3.2 |
| 3 | Mixing neem leaves with stored grains | 3.02 |
| 4 | Storing Jowar along with husk | 2.4 |
| 5 | Storing vegetable seeds in dried fruit itself. | 2.1 |

(Continued)
3.4. Indigenous plant protection method

3.4.1. Setting up bamboo stick or branches of tree
Setting up bamboo stick or branches of tree near the rice and maize field allows the birds to sit and eat way insects.

3.4.2. Ploughing
Farmers plough the field with the help of “Halo” before showing will expose egg, larva and pupa to predators and sunlight.

3.4.3. Burning the residue of crops
Crop residues left in the field after crop harvest, are burned by some of farmers if pest infestation in the field is too high. This practice helps to kill egg, larva and pupa of insect and spore of fungus that has remained in the crop debris after crop harvest. The ash obtained from the field burning helps to improve fertility status of soil.

3.4.4. Use of ash
Many farmers of our study area either spread ash on the ground around the base of plant or dust on the foliar part of the plant to enrich nutrient status of soil and to prevent attack of pest. Application of ash in soil is beneficial for plant as it is rich in phosphorous. Besides, ash causes

| Sr. No. | Identified ITK methods                                                                 | Mean Response Score |
|---------|---------------------------------------------------------------------------------------|---------------------|
| 6       | Using Neem (Azadirachta indica) leaves to store food grains like paddy and wheat       | 1.4                 |
| 7       | Mixing of kerosene with food grains for seed storage purpose                           | 1.1                 |

**INDIGENOUS ANIMAL HSUBANDRY MANAGEMENT METHODS**

| Sr. No. | Identified ITK methods                                                                 | Mean Response Score |
|---------|---------------------------------------------------------------------------------------|---------------------|
| 1       | Feeding Sali (raw paddy) to cows to remove retained placenta                           | 3.4                 |
| 2       | Drenching mixture of jaggery, onion to cure constipation                               | 3.12                |
| 3       | Moving FMD infected animals through mud or hot dust to cure FMD infection               | 2.28                |
| 4       | Drenching castor oils to animals to cure tympany                                        | 1.47                |

**INDIGENOUS WEATHER FORECASTING METHODS**

| Sr. No. | Identified ITK methods                                                                 | Mean Response Score |
|---------|---------------------------------------------------------------------------------------|---------------------|
| 1       | If wind is blowing east to west, it confirms that heavy rainfall will occur after a few days | 4.11                |
| 2       | If grass hopper (jhingurs) is in a group of 10–12 then, it is supposed that rain will occur in next 24 hour | 3.65                |
| 3       | If the rainbow is seen in western sky, heavy rain fall will occur.                      | 2.8                 |
| 4       | When the rain is about to begin, the spider makes its web in opposite direction i.e., vertical to the earth and sky and after rain the direction of web is horizontal to the earth and sky | 1.6                 |
corrosion on the epicuticular waxes causing death of pest and makes foliage part unappetizing for foliage feeder insect (Verma, 1998).

3.4.5. Spraying cow urine
Spraying of cow urine is very common method to control invasion of pest in various plants. Cow urine can be used as bio-pesticide, bio-fertilizer and pest repellent that shows insecticidal, fungicidal and pesticidal properties. Further, cow urine acts as a disinfectant and exhibits plant growth promotion property (Dhama et al., 2005).

3.4.6. Intercropping
Farmers in our study area grow two or more crops in same field at the same time. Insect detect their host through visual, olfactory and tactile cue but the non-host plant in the field can meddled with the insect ability either by physically concealing the presence of host plant or by releasing volatiles that befuddle the insect (Smith & Liburd, 2012). Intercropping maize with legumes is beneficial to control the infestation of stem borer, maize leaf hopper, termites, whitefly etc. as compared to mono cropping (Seran & Karunarathna, 2010).

3.4.7. Use of locally available plant materials
Use of locally available plant materials for management of pest in various crops is common in the study areas. Table 3 shows some of the locally available plants that are used for the management of the pest.

3.5. Indigenous traditional storage practice
Indigenous traditional storage practice to store the grain for many years without any crumbling by the storage grain pest is gaining popularity in many parts of the country. Farmers practice sun drying of grains after crop harvest and before storage. Sun drying helps to reduce moisture content

| S. N | Local name | English Name | Scientific name | Plant parts used | Application                  |
|------|------------|--------------|-----------------|------------------|------------------------------|
| 1.   | Lasun      | Garlic       | Allium sativum  | Bulb             | Used as pest repellent       |
| 2.   | Bojo       | Sweet rush   | Acorus calamus  | Fine powder after crushing corns/rhizomes | Used as insect repellent |
| 3.   | Timur      | Nepal pepper/ prickly ash | Zanthoxylum aramatum | Fruits and seeds | Used as insect repellent |
| 4.   | Bakaino    | China berry  | Melia azedarach | Leaves and seed extracts | Used as insecticide and insect repellent |
| 5.   | Neem       | Neem         | Azadirachta indica | Leaves and seed extracts | Used as insecticide and insect repellent |
| 6.   | Asuro      | Malabar nut  | Adhatoda vasica | Leaf extract     | Used as insecticides         |
| 7.   | Titepati   | Mugwort      | Artemisia vulgaris | Leaf extract     | Used as insect repellent and insecticides |
| 8.   | Khirro     | Milk tree    | Sapium insigne  | Latex and fumes from stem | Latex is used as insecticides and fumes from the stem is used as insect repellent |
of grains and pulses thus reduces crop risk of stored grain pest in pulses and grains. Some of the indigenous practices are listed in Table 4.

3.6. Indigenous traditional storage structure

Almost every farmer in our study area uses traditional storage structure made up of bamboo for the storage of grains mainly paddy. This woven bamboo mat-like structure that is rolled into cylinder form is commonly called “Bhakari” in Nepali. The woven bamboo mat is first smeared with the mustard cake to make pest repellant and then rolled in the form of cylinder to make “Bhakari”. Size of the structure may vary according to quantity of grains to be stored. This structure is made airtight by plastering it with rice straw and cow dung, mud or mustard cake. Many farmer store maize by hanging in cluster called “Jhutti” in traditional structure called “Tand”. Pulses like lentil, soybean, green gram, black gram, etc. are stored in closed container like metallic bins and large copper pitcher with lid called “Rocha” in Nepali.

3.7. Perceived attributes of ITK

In the present investigation, attributes of indigenous practices were studied to find out the influence of attributes of ITK itself on the adoption of indigenous practices. In all, five attributes namely, relative advantage, compatibility, complexity, triability and observability were considered. For the purpose, responses of the interviewed farmers were invited on five-point rating scale consisting of statements pertaining to select 10 indigenous practices.

The point on the scale at the extreme left was the most favorable position and the fifth or the point at the extreme right always was the least favorable (most unfavorable) position relative to adoption. The frame of reference, on the basis of which favorableness of a characteristic to be judged on the continuum of the scale, was always in relation to the practice. The high side (most favorable position) covered two appropriate positions with weightages of five and four, which were considered favorable for adoption. These grades were most advantageous-advantageous, most compatible-compatible, most triable-triable and most observable-observable. The low side of the scale considered unfavorable for adoption had two appropriate positions with weightages of two and one. These grades were not advantageous-not at all advantageous, non-compatible-most non-compatible, not triable-not at all triable and not observable-not at all observable. Table 5 reveals the perceived attributes of Indigenous Technological Knowledge in the study area.

Table 4. Indigenous traditional storage practices

| S.N. | Indigenous practice                                                                 | Application                                                                 |
|------|-------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 1.   | Using Neem (Azadirachta indica) leaves to store food grains like paddy and wheat    | Neem leaves are used to repel rice weevil (Sitophilus oryzae)               |
| 2.   | Mixing of mustard oil with legumes like lentil, rice bean, green gram, black gram, etc. | Mustard oil repels stored grain pests                                        |
| 3.   | Mixing of kerosene with food grains for seed storage purpose                         | Kerosene repels stored grain pests                                          |
| 4.   | Mixing grains with wood ash for storage                                             | Ash absorbs the moisture and prevents the movement of pest from one grain to other |
| 5    | Use of bojho (Acorus calamus) and timur (Zanthoxylum aramatum) to store food grains like maize, paddy and wheat and pulses like lentil, rice bean, green gram, black gram, etc. | Bojho (Acorus calamus) and timur (Zanthoxylum aramatum) repels stored grain pest |
Table 5. Perceived attributes of Indigenous Technological Knowledge

| Sr. No. | Indigenous practices                                           | Attributes (mean score) |         |         |         |         |
|---------|---------------------------------------------------------------|-------------------------|---------|---------|---------|---------|
|         |                                                               | Relative advantage      | Compatibility | Complexity | Triability | Observability |
| 1       | Use of farmyard manure                                        | 4.41                    | 4.37               | 1.36         | 4.01         | 4.32         |
| 2       | Use of indigenous species for green manuring                  | 4.02                    | 4.12               | 1.25         | 4.2          | 4.35         |
| 3       | Selecting seeds from healthy plants for next year seeding     | 2.18                    | 4.09               | 1.48         | 3.87         | 3.9          |
| 4       | Wooden plough for ploughing                                   | 4.1                     | 4.2                | 1.22         | 4.42         | 3.63         |
| 5       | Storing seeds in earthen pot with ash                         | 3.43                    | 4.43               | 1.2          | 4.67         | 4.08         |
| 6       | Mixed cropping                                                | 4.21                    | 4.15               | 1.25         | 4.18         | 4.04         |
| 7       | Moving FMD infected animals through mud or hot dust to cure FMD infection | 2.35                    | 4.40               | 2.10         | 2.5          | 4.06         |
| 8       | Erecting scare-crow in standing crop to scare birds           | 4.15                    | 4.31               | 1.42         | 4.23         | 4.37         |
| 9       | Application of cow urine and ash for plant protection         | 2.62                    | 4.23               | 1.87         | 3.18         | 4.1          |
| 10      | Mixing of kerosene with food grains for seed storage purpose  | 2.1                     | 4.16               | 1.62         | 3.65         | 4.2          |
The attribute, complexity was however, assigned with reversed scores of 1, 2, 4 and 5 for responses as most simple, simple, complex and most complex, respectively, whereas, score of 3 was given for neutral or undecided item.

It was noticed that perceived relative advantage (mean score) was highest (4.41) in case of use of farmyard manure as compared to listed “ten indigenous practices”. It was followed by the Mixed cropping (4.21), whereas, mixing of kerosene with food grains for seed storage purpose was perceived to had relatively low relative advantage, as could be seen from the mean score of 2.1 (Table 5). It was further observed that five out of ten selected ITK were perceived to have high relative advantage by the farmers in the study area, which might have reflected in its use from so many years.

The observations with regards to perceived compatibility of indigenous practices revealed that the indigenous practices listed (Table 5) were generally perceived by the interviewed farmers as compatible with their culture and past experiences and had scored the compatibility means core above four, with a minimum score of 4.43 and the maximum score of 4.09. The tribal farmers rated the storing seeds in earthen pot with ash as relatively more compatible (4.43) while, the practice of selecting seeds from healthy plants for next year seeding was perceived to have comparatively low compatibility (4.09) among the ten indigenous practices, which were included in the present study.

Complexity of the practice or innovation refers to the degree to which ITK item is relatively difficult to understand and use (Rogers, 1971) and was measured on a continuum from most complex receiving a maximum score of 5 to least complex i.e., the simplest. It was observed that the practice of storing seeds in earthen pot with ash as the least complex (most simple among ten indigenous items) with mean score of 1.2, whereas, moving FMD infected animals through mud or hot dust to cure FMD infection as the most complex with mean complexity score of 2.10.

| Table 6. Level of Knowledge of Farmers regarding ITK |
|---------------------------------|-----------------|-----------------|
| Category                        | Frequency (N = 356) | Percentage (%)  |
| Low                             | 33               | 9.27            |
| Medium                          | 231              | 64.89           |
| High                            | 92               | 25.84           |

Figure 3. Attitude of respondents towards ITK in agriculture.
The data pertaining to the triability (Table 5) revealed that the interviewed farmers had perceived storing seeds in earthen pot with ash as the most triable practice (4.67) whereas, moving FMD-infected animals through mud or hot dust to cure FMD infection as the less triable (2.5).

Observability is the extent to which the results or benefit of using an innovation are visible to potential adopters (Victor, 2020). It has been noticed that observability score of all the technologies, except two, use of wooden plough for ploughing (3.63) and selecting seeds from healthy plants for next year seeding (3.9) was more than 4 indicating that all the practices studied have very good observability in the opinion of farmers of the study area (Table 5). The maximum observability was observed in use of indigenous species for green manuring (4.35).

3.8. Knowledge level of farmers regarding ITK
Knowledge refers to a body of understood information possessed by an individual is one of the important components of adoption behavior, even it has been considered as a pre-requisite for adoption by many authors.

The data (Table 6) showed that 64.89 percent of the interviewed farmers had medium level of knowledge about ITK, whereas, slightly more than nine out of every hundred farmers were reported to have low knowledge. It was further reported that 25.84 percent of farmers were having high knowledge about ITK.

3.9. Attitude of respondents towards ITK in agriculture
Indigenous Technical Knowledge, since it is based on accumulated experience, much fitted to the local situation and social system, environment friendly and even sometimes superior than its counterpart that is modern technology should definitely find a place in agricultural research and extension system for sustainable agricultural development. Hence, it becomes necessary to find out the attitude of farmers towards Indigenous Technical Knowledge.

The Likert method of summated rating attitude scale was constructed to measure the attitude of farmers towards Indigenous Technical Knowledge in agriculture.

It is evident from Figure 3 that majority of the respondents (53.93%) had favorable attitude towards Indigenous Technical Knowledge, followed by highly favorable attitude, highly unfavorable attitude, neutral attitude, and unfavorable attitude, respectively. From the above findings it could be inferred it was revealed that majority of respondents had favorable attitude towards Indigenous Technical Knowledge in agriculture.

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Figure 4. Extent of adoption of Indigenous Technical Knowledge.

| NUTRIENT MANAGEMENT | PLANT PROTECTION | PLANT STORAGE | ANIMAL HUSBANDRY | WEATHER FORECASTING |
|----------------------|------------------|---------------|-----------------|--------------------|
| Low                  | Medium           | High          | Low             | Medium            |
| 4.28                 | 6.4              | 5.3           | 7.4             | 5.6               |
| 83.97                | 67.4             | 66.77         | 82.84           | 79.86             |
|                      | 12.46            | 26.2          | 15.1            | 13.67             |
|                      | 83.97            | 66.77         | 82.84           | 79.86             |
3.10. Extent of adoption of Indigenous Technical Knowledge
Data were collected from the farmers who are adopting the Indigenous Technical Knowledge in agriculture for various means, they were analyzed and the results are presented in Figure 4.

It is evident from Figure 4 that, majority (83.07%) of the respondents were medium adopters, followed by high (12.65%) and low (4.28%) adopters of Indigenous Technical Knowledge in Nutrient management. Majority of the respondents are having medium adoption (67.4%), followed by high (26.2%) and low (6.4%) adoption of Indigenous Technical Knowledge in plant protection levels, respectively. In case of plant storage, majority (66.77%) of the respondents were medium adopters, followed by high (28.7%) and low (4.53%) adopters of Indigenous Technologies. Indigenous Technical Knowledge in Animal husbandry, majority of the respondents were having medium adoption (82.04%), followed by low (9.45%) and high (8.51%) adoption levels. Majority (79.86%) of tribal farmers were medium adopters in case of Indigenous Technical Knowledge in Weather forecasting, followed by low (12.67%) and high (7.47%) adopters' levels, respectively.

3.11. Application of indigenous method to control pest
Substantial number of farmers were found to be involved in the use of indigenous technological knowledge in pest management in minor cases as it is economical, easily accessible and suited to local environment condition (Figure 5). However, in severe infestation majority of

| Table 7. Constraints in development of ITK in agriculture |
|---------------------------------|-----------------|-----------------|
| Constraints                                    | Average Score | Ranking |
| Preference of farmers for sophistication with reliance on readymade inputs | 0.76           | I     |
| More time required to get the desired results from adoption of ITKs | 0.71           | II    |
| Sociological constraints (Social perception of farmers towards use of traditional means) | 0.67           | III   |
| Labor intensive nature of ITKs | 0.62           | IV    |
| Lack of expert guidance/extension support for adoption of ITKs | 0.53           | V     |
| Weak coordination between Research and Development Organizations | 0.48           | VI    |
farmers (82%) were involved in the use of scientific practices like the use of chemical pesticides. Only few people prefer to use indigenous technological knowledge in heavy infestation of pest due to their slow acting effect.

### 3.12. Constraints in development of ITK in agriculture

Various constraints hold back the use of Indigenous Technological Knowledge in agriculture Syangja district. The problems in adoption of indigenous means of disease and pest control in the study areas were identified and ranked on the basis of seriousness of the problems. Scaling technique, with six-point scale (1, 2, 3, 4, 5, and 6) was used to assess significant differences. Farmers were asked to choose different categories; 1 for the least important constraints and 6 for the highly important. This category was scored and the sum of the scores measures farmer's perceptions towards certain constraints as shown in Table 7. The index of importance was calculated through the following formula;

\[ I_{\text{imp}} = \frac{\left( \sum S_i f_i \right)}{N} / 6 \]

Where \( I_{\text{imp}} \) = Index of importance

\( \sum \) = summation

\( S_i \) = Scale value

\( f_i \) = frequency of importance given by farmers

\( N \) = Total number of farmers

Major constraints to adoption ITK in agriculture in the study areas were Preference of farmers for sophistication with reliance on readymade inputs, followed by more time required to get the desired results from adoption of ITKs, sociological constraints (Social perception of farmers towards use of traditional means), labor-intensive nature of ITKs, lack of expert guidance/extension support for adoption of ITKs, and weak coordination between Research and Development Organizations.

| Strategies                                      | Average Score | Ranking |
|-------------------------------------------------|---------------|---------|
| Validate the ITKs/Assess the ITK for scientific logic | 0.69          | I       |
| Building upon local people’s knowledge that is acquired through various processes such as farmer-to-farmer communication, and farmers experimentation | 0.62          | II      |
| Changing poor social perception of farmers       | 0.58          | III     |
| Increase awareness among the younger generation and develop appreciation of indigenous system | 0.55          | IV      |
| Financial support from Government and other agencies | 0.51          | V       |
| Focus on future research on adoption of ITK     | 0.46          | VI      |

Table 8. Strategies to promote use of ITK for agricultural development
3.13. Strategies to promote use of ITK for agricultural development

Several strategies, which need to be focused on were identified with the survey results. Table 8 illustrated the degree of importance of the strategies in the study areas.

Table 8 shows that the most important strategies to encourage adoption of ITKs were Validate the ITKs/Assess the ITK for scientific logic, followed by building upon local people’s knowledge that is acquired through various processes such as farmer-to-farmer communication, and farmers experimentation, changing poor social perception of farmers, increase awareness among the younger generation and develop appreciation of indigenous system,
financial support from Government and other agencies, and focus on future research on adoption of ITK.

3.14. Conclusion
The descriptive results illustrated that most of the farmers in the surveyed area were found to have average level of knowledge (64.89%) and favorable attitude (53.93%) regarding the use of ITKs in agriculture. Majority of respondents received the knowledge on indigenous technological knowledge through the Parents/relatives (27.53%), followed by community leaders/elders and farmers. Such knowledge was reported to be used in various fields such as nutrient management, plant protection, plant storage, animal husbandry, and weather forecasting. Use of farmyard manure, Intercropping/mixed cropping, green manuring, burning the residue of crop, use of animal products (dung/urine), storing seeds in earthen pot with ash, clearing and incorporating terrace riser, erecting scare-crow in standing crop to scare birds, and so on are the commonly practiced traditional practices in study area.

Also, rainfall pattern, wind direction and velocity, and animal movements were useful to predict the weather condition. Attributes of indigenous practices i.e., relative advantage, compatibility, complexity, triability and observability were studied to find out the influence of attributes of ITK itself on the adoption of indigenous practices. The results showed that on average use of farmyard manure and erecting scarecrow to protect from birds were perceived as most compatible, more triable, more observable, and less complex practice to farmers. However, several constraints holdback farmer’s adoption to ITKs such as preference of farmers for sophistication with reliance on readymade inputs, followed by more time required to get the desired results from adoption of ITKs, and sociological constraints. Therefore, validation of ITK, changing poor social perception of farmers, increase awareness among the younger generation, and financial and technical support from government is a must to develop the agricultural sector.

4. Future research work
Nowadays, the agricultural researchers and biological scientists have realized that extension of modern farming techniques may lead to difficulty in solving ecological and economic problems. Modern agriculture may not be able to meet the requirements of the ever-increasing population. Future research should be accentuated on changing the social perception of farmers and encourage them using own indigenous knowledge in agriculture. Training and extension support in Nepal have been limited in scope. The findings of this study present clear insights that will encourage farmers, indigenous knowledge holders, researchers and practitioners to blend modern practices with indigenous practices, so that the production can be enhanced ensuring the sustainability of the system.

Acknowledgements
The authors owe their sincere and deep gratitude to Subodh Gyawali from Institute of Forestry, Tribhuvan University for his continuous support throughout this research. Special thanks to our parents whose guidance is always with us.

Funding
The authors received no direct funding for this research.

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Disclosure statement
The author declares no conflicts of interest regarding publication of this manuscript.

Citation information
Cite this article as: Perceived attributes and adoption of Indigenous Technological Knowledge on agriculture - a case study from Bhirkot municipality of Syangja District, Nepal, Sushil Khatri, Saugat Khanal & Santosh Kafle, Cogent Food & Agriculture (2021), 7: 1914384.

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