

Use of Traditional Knowledge for Identification of Forest Degradation: A Case of Knuckles Range of Sri Lanka

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Abstract

Traditional Knowledge (TK) is an experiential knowledge built by people within a long duration and it extends in a wide range. This knowledge has been decaying with time and environmental degradation has become rapid. Finding the decaying traditional knowledge, analyzing its utility and using it for ecological restoration can be considered as heading towards a gap filling pertaining to researches. Even though, identification of forest degradation by applying TK in traditional societies is important in conservation of degraded forests, limited research have been undertaken relating to this research in Sri Lanka. With this limitation, the current study was focused to compile and classify the hidden traditional knowledge on forest conservation which has high level of utility in ecological restoration in Knuckles Range. Seven Grama Niladhari Divisions out of 56 divisions laid in Knuckles range were selected as the study area using the multi-functional optimization equation and judgmental sampling method. Out of 346 families living in the study area, 120 families were selected by employing simple random sampling method. Data was collected through questionnaires, interviews, transect walks and observations while 11 group discussions have been made to verify and validate the TK of traditional farmers. Mainly qualitative data analysis methods were used and TK of forest degradation has been compared with the formal forest classifications. The study ascertained that the degradation of the forest cover has been covered by focusing to four main criteria as; a). Qualitative degradation (value of the plant, service done by the plant species to the environment and man.); b) Quantitative degradation (according to the size of the land where the degradation occurs and the number of trees that are being cut.); c). Physical condition of the plant (distribution of the tree and height, connection with the sunlight.) and d). Function of the plant system (interconnection between plants, interdependence between plants). Further, it was revealed that the traditional farmers in the study area had applied six different indigenous criteria to identify the forest degradation, namely; plant species, extent of the land use, location of the plant, change of the composition of the plant, decrease of the harvest and quality of the plants. Under each of criterion, different indigenous methods have been adopted for identifying degradation of plants and conservation of the plant species and rural agricultural systems. As an important finding of this research, it can be highlighted that the traditional methods used to find forests degradation in this research can be applied for identifying and minimizing the degradation of forests which cannot be seen in other areas in Sri Lanka. It was also identified that there is a high potential in those traditional methods with regard to securing the quality of the environment.

Keywords: Traditional Knowledge, Indigenous Knowledge, Agriculture, Forests Degradation Knuckles Range

Introduction

TK represents knowledge systems implanted in the regional traditions, indigenous cultures, or local communities and it is also known as indigenous knowledge (IK) and local knowledge. Further it is identified by people as knowledge, know-how, skills and practices that are developed, constant and passed on from generation to generation within a community while creating part of its cultural or spiritual identity. Knowledge about technology, medi-

cines, weather/climate as well as agricultural practices is involved in TK. It is orally passed from generation to generation or from person to person in different forms such as folktales, legends, folklore, rituals, songs and even in community laws.

Some widely-used few definitions where TK has been described in various contexts with similarities and differences are as follows. According to World Intellectual Property Organization (2006),

TK or the knowledge of indigenous/ local communities usually involves innovations and practices unique to them as knowledge, know-how, skills and practices that are developed, sustained and passed on from generation to generation within a community, often forming part of its cultural or spiritual identity.

[1]According cumulative and dynamic body of knowledge, know-how and representations possessed by peoples with long histories of interaction with their natural milieu is considered as TK. It is closely tied to language, social relations, spirituality and worldview, and is generally held collectively. Too often, it is simplistically conceived as a pale reflection of mainstream knowledge, particularly in Science. The long-standing information, wisdom, traditions and practices of certain indigenous people or local communities. In many cases TK has been orally passed for generations from one person to another person. This knowledge is unique to a given culture or society” [2].

However, TK can be generally described as a specific knowledge related to a particular culture or society which has been passed from generation to generation. As most of the definitions illustrate, TK espouses a more holistic approach. It does not separate observations into different disciplines as western science [3]. Besides, TK systems do not infer reality on the basis of a direct cause and effect. It infers reality as a world made up of complex web of interactions [4]. There are many instances where TK can be used to identify environmental degradation ([5-8]. especially traditional soil taxonomy [9]. Identifying forest degradation and restoration [10,11]. Within the environmental degradation, forest degradation is a problem which has an adverse effect on rainfed agriculture which in turn results to decrease the harvest and income receive to the household and national economy. Thus, identification of forest degradation by applying TK in traditional societies, restoration and conservation of degraded forests is a very significant fields of study. The most of senior citizens who lives in relatively isolated settlements in Knuckles Range enrich with sophisticated traditional agro ecological methods. However, TK has been decayed from generation to generation. Therefore, the impairment of traditional knowledge which they practiced in the past create a detrimental effect on their sophisticated knowledge used in agricultural work [9]. Even though, identification of forest degradation by applying TK in traditional societies is important in conservation of degraded forests in the agricultural regions, limited research have been undertaken relating to this research in Sri Lanka. With this limitation, the current study was focused to compile and classify the hidden traditional knowledge on forest conservation which has high level of utility in ecological restoration in Knuckles Range.

Methodology

Mainly Sri Lankan society has been developed from an agricultural ecosystem and the Knuckles Range has been one of those

earliest agricultural areas in Sri Lanka. Although there were lots of places which had been normed as agricultural areas in past, due to adaptation of modern westernized techniques and effects of colonization, the traditional agricultural ecosystems are almost extinct. Due to the difficulty of the reachability, the Knuckles range has been relatively isolated and has been less developed compared to other areas. Even in the colonial era, the region had been unaffected by the changes introduced in the agricultural system. Moreover, due to the rich Biodiversity in this area, TK practices may have been different compared to other areas. As evidence, the Knuckles Range has been declared as a World Heritage site by UNESCO under section 6 and 10 due to its vast bio-diversity and pre-historic cultural value which runs to early stage of Sri Lankan inhabitants (UNESCO, 2018). Moreover, it is one among the few places in Sri Lanka which had been relatively isolated for a long period from modern culture. Since this area has not been exposed to westernization, it is evident that traditional culture, techniques, procedures and beliefs are still functioning in this region.

Seven Grama Niladhari Divisions (GND's) such as Puwakpitiya, Atanwela, Mahalakotuwa, Pitawala, Meemure, Kahagala, Pusse Ella out of 56 divisions laid in Knuckles range were selected as the study area using the multi-functional optimization equation and judgmental sampling method. When collecting data, mainly the total number of families living in those GND's was considered as the population and 120 out of the population of 346 were selected by employing simple random sampling method. Data was collected through questionnaires, interviews, case studies and observations while traditional knowledge methods were identified by transect walks. Qualitative data analysis methods such as content analysis, classifications and categorizations were applied for analyzing qualitative data. [10,11,9].

When reviewing the customarily defined vegetation patterns, and the way of identifying the degradation processes, it is necessary that the certain vegetation patterns and the way they define them are dissimilar from each other should be compared with the formal forest classification. 11 group discussions have been made to verify and validate the TK of traditional farmers.

Results and Discussion

Forest degradation is mainly defined as the ability to identify the impact on the forest cover. When studying on this, it is an observable fact that chena cultivation and methods related to that manifest some important features. Approximately, 99% of the whole sample accepted that the minimization or minimizing of the forest cover for a long time was not normally done by the public as a habit and that the environmental degradation also took place there. Using the statements of the sampled people, the effect towards the forest cover or the degradation can be categorized on the basis of their knowledge as shown in Figure 1.

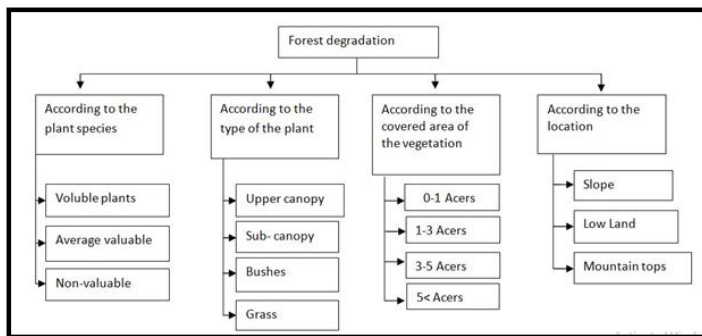


Figure 1: Indicators used to identify forest degradation by traditional farmers Source: Field study, 2018

This classification depicts the criteria that had been decided by the sampled rural people. According to their statements, it could be seen that the degradation of the forest cover can be focused with four main criteria. They are,

- a. Qualitative Degradation (Value of the plant, service done by the plant species to the environment and man.)
- b. Quantitative Degradation (According to the size of the land

where the degradation occurs and the number of trees that are being cut.)

- c. Physical condition of the plant (Distribution of the tree and height, connection with the sunlight.)
- d. Function of the plant system towards that environmental system. (Interconnection between plants, interdependence between plants.)

Six people stated that when cutting or removing trees, the fact of the duration of time that takes to reinstate has to be focused. There, it is said that if the need is long-termed, then the degradation is permanent and that if it is needed to prepare a temporary farm or chena, it is important to focus on the area and the environment using the above criteria.

Identifying Forest Degradation based on Plant Species

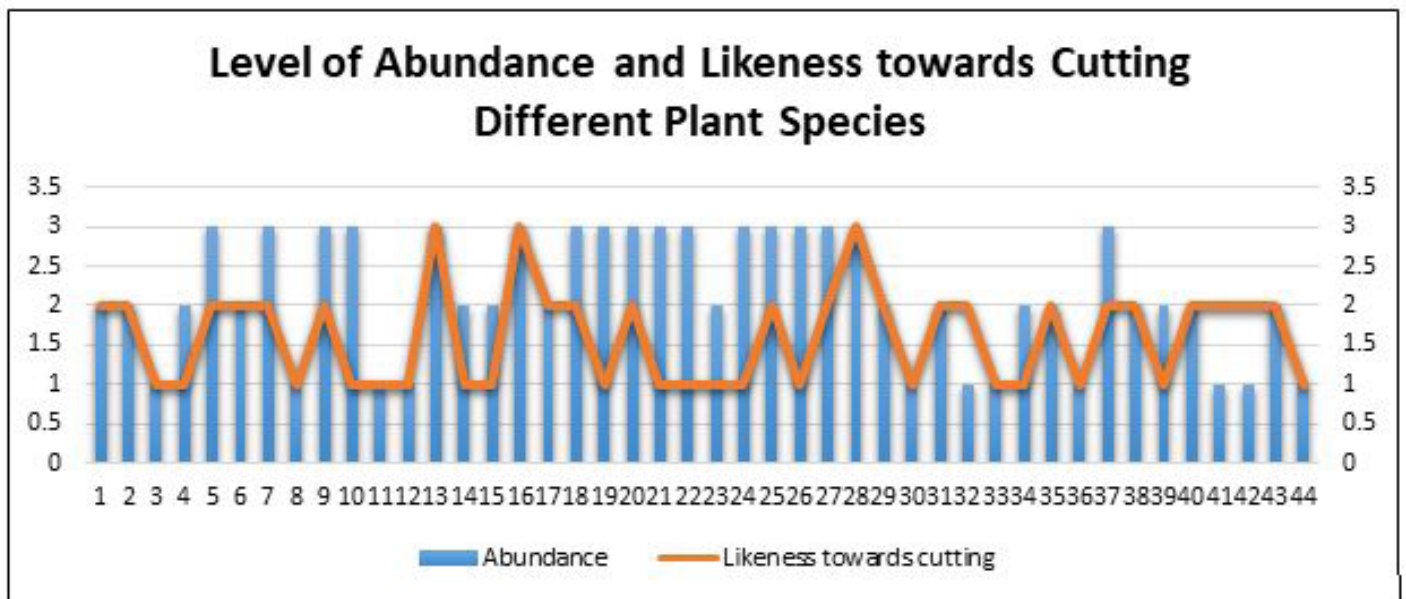
In this part, it can be identified what the species of plants are and what function is fulfilled towards the environment and man through them. They focus on what the species of vegetation are when preparing a Chena, their nature and functions. According to the statements, it can be sorted and presented as valuable, average-valuable and valueless. Level of abundance and likeness towards cutting different plant species is shown in Table 1 and Figure 2.

Table 1: Level of Abundance and Likeness towards Cutting Different Plant Species plant species.

Local Name of the plant	Scientific Name	Abundance	Likeness towards cutting
<i>Atamba</i>	<i>Magifera zeylanika</i>	Medium	Medium
<i>Milla</i>	<i>Vitexaltissima</i>	Medium	Medium
<i>Bala</i>	<i>Nathopegic beddoma</i>	Low	Low
<i>Hal milla</i>	<i>Berraya cordifolia</i>	Medium	Low
<i>Moonamal</i>	<i>Mimuscops eleogi</i>	High	Medium
<i>Dankenda</i>	<i>Aeronychia pedunculata</i>	Medium	Medium
<i>Mora</i>	<i>Democarpus longana</i>	High	Medium
<i>Walla</i>	<i>Gyrirops walla</i>	Low	Low
<i>Na</i>	<i>Mesua ferrea</i>	High	Medium
<i>Burutha</i>	<i>Chloroxylon swieteria</i>	High	Low
<i>Kalumediriya</i>	<i>Diospyros quaesita</i>	Low	Low
<i>Kaluwara</i>	<i>Diospyros ebenum</i>	Low	Low
<i>Wal gammiris</i>	<i>Piper syvester</i>	High	High
<i>Ma weval</i>	<i>Calamis thawltesil</i>	Medium	Low
<i>Kithul</i>	<i>Caryota urens</i>	Medium	Low
<i>Niyagala</i>	<i>Gloriosa superba</i>	High	High
<i>We Warana</i>	<i>Alseodaphne semiearpitolia</i>	Medium	Medium
<i>Welan</i>	<i>Piterospernum caneseas</i>	High	Medium
<i>Veera</i>	<i>Drypetes seiang</i>	High	Low
<i>Bim kohomba</i>	<i>Munronla punoila</i>	High	Medium
<i>Mee</i>	<i>Muduca longilla</i>	High	Low
<i>Bo mee</i>	<i>Litsea glutinosa</i>	High	Low
<i>Meeriya</i>	<i>Gordonia ceylanica</i>	Medium	Low

<i>Aralu</i>	<i>Terminalla chebula</i>	High	Low
<i>Bulu</i>	<i>Termindia belenica</i>	High	Medium
<i>Nelli</i>	<i>Phyllanthus embellca</i>	High	Low
<i>Hathawariya</i>	<i>Asporagus sp</i>	High	Medium
<i>Kala wel</i>	<i>Derris scandos</i>	High	High
<i>Titta wel</i>	<i>Anamirta cocurlus</i>	Medium	High
<i>Cane (Weval)</i>	<i>Calamus rotang</i>	Low	Low
<i>Kiri wel</i>	<i>Morinda umbellata</i>	Medium	High
<i>Mediya wel</i>	<i>Cayraha pedata</i>	Low	High
<i>Damunu</i>	<i>Grenia damine</i>	Low	Low
<i>Nuga</i>	<i>Picus sp.</i>	Medium	Low
<i>Nawa</i>	<i>Cordia dichotoma</i>	Medium	High
<i>Leeniga</i>	<i>Helicteres isora</i>	Low	Low
<i>Bata (Bamboo)</i>	<i>Gigantochloa sp.</i>	High	High
<i>Haven</i>	<i>Cyperus pangerei</i>	Medium	Low
<i>Watake</i>	<i>Pandanus sp.</i>	Medium	Low
<i>Pan</i>	<i>Cyperus sp.</i>	Medium	High
<i>Thunhiriya</i>	<i>Cyervas sp.</i>	Low	High
<i>Pila</i>	<i>Tephrosia purpurea</i>	Low	High
<i>Katupila</i>	<i>Flueggea leucopyrus</i>	Medium	High
<i>Dodan-pana</i>	<i>Glycosmis pentaphylla</i>	Low	Low

Source: Field study, 2018



Source: Field study, 2018

Figure 2: Level of Abundance and Likeness towards Cutting Different plant species.

According to Table 1 and Figure 2, it can be noticed that there is a positive correlation between the two variables, the abundance of a plant and the likeness towards cutting the plant. It reflects a method of avoiding the cutting of the plant based on its scarcity and the high usage of plants which are abundant in nature. It is considered as a basic characteristic of ecological restoration. Statements (Statement Box 1) taken from traditional farmers reflects the different perceptions on usage of plant species.

Statement Box: 1

Atamba– “A small fruit that protects the cool nature. Not considered as a much valuable plant. Even though it is used for the fence where there is a hut in the chena, usually it is cut when the hut is inside.” (*Amaradasa 2018.1.22,23*)

Milla– “A type of wood. It has been prohibited to cut these by now. Can remember that these trees were used to build houses in grandfather’s time.” (*K.M.P.G.Jayasena (Wedamahaththaya) 2018.8.14,15*)

“**Milla** makes the surrounding cool and it is a sin to cut a lot of Milla trees at once because it takes a long time to grow.” (*Sumanapala 09.08.2018*)

“It was used as wood in ancient times, but now it is prohibited to use like that. It was mostly used for the top wood (Mudun Leeya), rafters and doors. (*Bandara Manike 2018.8.19*)

Hal Milla– A tree used to make wooden boards. It enriches the soil and is said that it is a sin to cut Hal Milla, too. It is a medicine for toothaches. All the five parts (roots, husk, leaves, flowers and fruits) are used. Usually cutting this is not done and if it is done, that is also very rarely.

Ankenda– A medicine prescribed for fractures and not considered as very special since it is abundant. Due to the reason that it is harmful to grow in cultivated lands, it is usually cut in chenas. (*Bandara Manike 2018.8.14,15, K.M.P.G.Jayasena 2018.8.14,15*)

A major fact revealed through these statements is that, farmers use to rank the forest cover according to the environmental contribution and the value of plants. Degradation can be identified through the methods of identifying the rare species of plants, identifying the value towards the eco-system and defining their destruction as degradation. They have identified the contribution of each plant system, shade, water, clamping and invisible interconnection. Based on that identification, they have also clearly identified how plants are decreased to a minimal number with time and what sort of degradation can be seen related to that. Table 2 indicates the level of degradation, reasons and effects of each plant species.

Table 2: Perceptions of traditional farmers on the level of degradation, reasons and effects of each plant species.

Plant	Degradation	Reasons for Degradation	Effect
Kaluwara (Diospyros ebenum)	High	Making furniture. Lack of replantation on removal of the plants around the tree when cutting it down.	Change of the combination of the vegetation. Becoming endangered.
Wallapatta (Gyrinops walla)	High	Cutting down for selling.	Because of the poisonous effect due to ‘Kuna baheema’ of this tree, all the other trees around it usually die, and therefore the whole system of vegetation is destroyed.
Veval (Calamus rotang)	Medium	Cutting down to make umbrellas. Lack of the use of correct methods when cutting it down. Not taking care of the tree which is being cut down.	Lack of shade in the forest: Therefore, the bushes that grow fast, grow in the speed of the growth of trees and it leads to an increase of the combination of the vegetation.

Source: Field study, 2018

When commenting on the plant, many statements revealed that Kaluwara is a plant which is abundant in villages. It is evident from the survey that, the furniture of 12 old houses in the villages of Puvakpitiya, Kahagala and Atanwala were made of Kaluwara timber. As the villagers say, according to the traditional method, it takes about 500 years for Kaluwara plant to grow up as a big tree. Therefore, it was said that when cutting down such a tree, many people use to plant another two trees around that area while doing a puja before cutting it down. Another statement gave the

fact which says that no other plant around the Kaluwara tree was trampled before cutting it down, but nowadays that method is not followed by people. In the village Kahagala, it was said that this tree is considered as a sacred tree belonging to the god, Kalubandara or the demon, Kalukumara. However, giving a strong value for this tree is commonly seen in the society.

Although it is legally prohibited to cut down Wallapatta (*Gyrinops walla*) trees, recently many of these trees have been cut in the villages of Puvakpitiya, Mahalakotuwa and Pitawala. Villagers' idea is that it directly causes to create diseases in the plant system. According to them, when this tree is cut, the acidic liquid which pours from the chopped place causes to have infections on other plants and finally causes them to die because of the poisonous effect. They perceive that destruction as "Kuna Baheema." An important fact revealed through this analysis is that when fulfilling their needs and engaging in chena cultivation, villagers make decisions to destroy or harm some plants based on the value of that specific plant. They consider it as a sin to cut down the trees which have a huge environmental value and a merit to protect such trees. It could be seen that based on the plant species and its uses, during the time of chena preparation, the farmers usually choose a place which is suitable for the chena cultivation while choosing the species of plants which are supposed to be grown, too. When identifying the plant species, the distribution of the plant and the number of the plants are taken into consideration. Several methodologies had been used for the classification of the plants which based on the layer of the plant and the distribution of the plant.

Based on the height of a plant, the traditional farmers have special notions about the value of that specific plant and the results of the degradation. Accordingly, they change and control the vegetation around their habitats. According to their definition, plants can be categorized into several types in terms of height as illustrated in Figure 3.

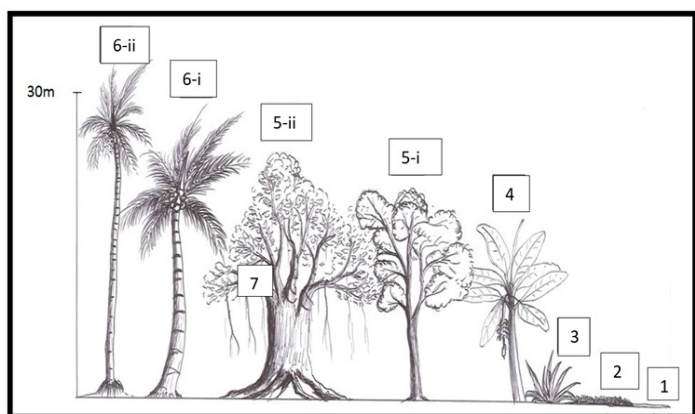


Figure 3: Type of Plant based on height Source: Field study, 2018

1. Species of mosses (Bryophyta)
2. Species of grass – Balathana (*Elusine indica*), Kuppameni (*Acalypha Indica*)
3. Bushes – Babila (*Sida rhombifolia*)
4. Tall bushes – Banana (*Musa acuminata*)
5. Tallest (Roossa) trees – Burutha (*Chloroxylon swietenia*), Banyan (*Ficus benghalensis*)
6. Palmyrah trees – Coconut (*Cocos nucifera*), Betel-nuts (*Areca catechu*)
7. Vines – ThiththaVel (*Anamirfa Cocoulon*)

According to the statements of the local farmers, it could be identified that the degradation of a forest cover can be divided into 4 categories using the above types (Statements Box 2)

Statement Box: 2

“If there are no mosses or grasses, the soil is infertile.” (Ariyadasa 2018.03.20)

“If the grasses grow well, that place is also fertile.” (K.M.P.G. Jayasena 2018.8.14,15)

“There are many animals and insects in the places where bushes are available and the soil is also fertile.” (P.G Nandasena 2016.8.18,19)

“In Puvakpitiya, the paddy fields became rich in harvest because of the growth of betel-nuts (*Areca catechu*) there. Betel-nut is a good fertilizer.” (Dharmadasa 2018.1.22,23)

“If there are no Roossa trees, the water of the stream decreases. There are gods in Roosa trees.” (Muthu Banda 2017.12.25,26,27)

“The forest is controlled by Roossa trees.” (Wijepala2018)

“The animals are protected by vines.” (Muthu Manika2018)

“Vines darken the forest.” (Dharmananda 2018.2.4,5)

When considering the statements in box 2, the increase and the decrease of these plants can be seen as a measurement to identify the degradation. Table 3 depicts the level of degradation in each types of forest in the selected villages

Table 3: The level of degradation in each types of forest in the selected villages

Vegetation type	Puwakpi-tiya	Kaha-gala	Atanwala	Meemure	Pitawa-la	Mahalako-tuwa	Pusse-ela	Status
Forest	✓	✓	✓	✓	✓	✓	✓	No degradation
Scrub		✓		✓	✓	✓		No degradation
Grassland	✓	✓	✓	✓				Medium degradation
Cleared forest	✓	✓	✓					Medium degradation
Home garden		✓	✓	✓	✓			Medium degradation
Cleared scrub			✓	✓		✓	✓	Medium degradation


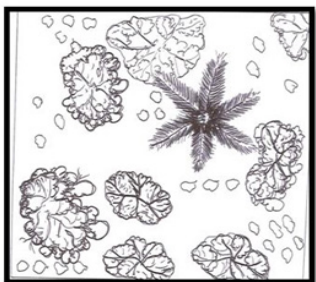
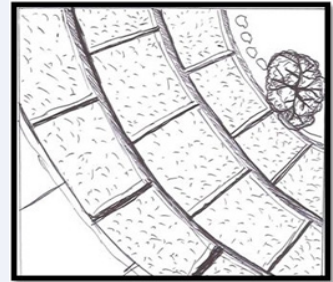
Source: Field Study, 2018

As indicated in Table.3, it is evident that the dependence of the layers of the plants on each other as a system of vegetation can be used as a criterion to identify the degradation. It can also be identified according to the TK that the level of the degradation of forest covers such as forest, jungle, grasslands (*Patana*), fired or cleared forest and home garden can be used to decide on the layers of the plants. And also it was proven through the statements of four people that there is a possibility to identify the degradation based on the distribution of the plant. According to the statements, the nature of the degradation can be decided by the falling of the sun rays on earth and the size of the area covered with that.

Statement Box: 3

“If the branches of the trees touch each other and there are tall bushes under the trees, then less sunlight falls on the ground. If there is a dark nature in the forest without such sunlight, it is a good forest. When there are only tall bushes and no *Roosatrees*, sunlight falls here and there. That is a jungle.” (Muthu Banda 2015.12.25,26,27)

Statement 3 manifest that when the plants grow as a continuum, it is defined as an environmental system which is not covered as a natural environment while depicting the fact that the areas where there are trees that bring more sunlight onto the ground and where there is less rain can be identified as degraded zones. Based on these criteria, degradation can be depicted in three parts according to the nature of the cover (Figure 4).

		
Forest	Home garden	Paddy field
No degraded	Medium-degraded	Degraded
Falling sunlight on the ground is at a very low level. Covered by canopies. A dark nature. No grass or plants grow well on the land.	Falling sunlight on the ground is at medium level. Tall bushes and trees are abundantly seen. There are different types of grass and plants.	Sunlight directly falls on the ground. Trees have been cut down and the area is cleared. No <i>Roossa</i> trees except for one or two. There are only bushes, plants and grass.

Source: Field Study, 2018

Figure 4: Level of Forest Degradation in each Plant Zone; Forest, Home Garden and Paddy Field

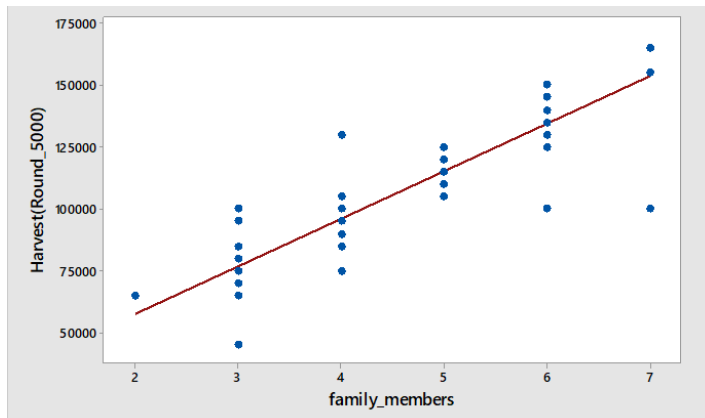
Identifying Forest Degradation based on the Extent of the Land Use

There is a way to measure the degradation according to the extent of the land use. When tilling a chena, choosing only up to the extent which can be tilled by the farmer is concerned as important here. Their idea was that if more land than the needed extent for the family is fired, that can be identified as degradation. It is further to clear from the below statement.

Statement Box: 4

“Chena is tilled after doing a puja for the God Kiribandara. God is not irritated if it is tilled up to the extent only for the use of the family, but if the land is more fired and sown only a little, then both the god and the demon curse.” (Palingu Manika 2016.8.21,22)

Through this statement, it becomes clear that it was the villagers’ custom to till a particular extent of the land only according to the number of the family members. It was proven that three members can be totally maintained by one acre of the land. According to the research, it could be identified that there was a connection between the number of the family members and the extent of the cultivated land (Figure 5).



Source: Field study, 2018

Figure 5: Correlation between the number of the family members and the extent of the cultivated land

As figure 6 depicted, in the past, there was a strong positive connection between the number of the family members and the extent of the land which could be used to cultivate in chena cultivation. What is manifested through this is that the people have contributed to the environmental degradation only for their consumption needs. Accordingly, when comparing the past and the present in these seven villages, the individual consumption of chena can be depicted as in Table 6.

Table 4: Past and present average of individual consumption of chena land in the selected villages (acres)

Village	Past Average	Present Average
Atanwala	0.57	0.36
Puwakpitiya	1.2	0.43
Pitawala	1.3	0.34
Mahalakotuwa	1.2	0.28
Kahagala	0.92	0.33
Meemure	0.67	0.21
Pusse Ella	2.68	0.47

Source: Field Study, 2018

According Table 6, when comparing the size of the cultivated lands in the past and present, it can be seen that there is a rapid decrease in the size of the land by now. The reason for that is the prohibition to cultivate in forest areas under the Forest Conservation Order. Only in the village, Pusse Ella, the individual cultivation of chena lands has been increased and it shows that the forest degradation in that village is relatively at a higher level than the other villages.

Identifying Forest Degradation based on the Location/Place
According to the TK, the topography of these areas has influenced to decide the nature of the vegetation and its combination. Thus, mostly it was defined as degradation when there was harm towards the plant due to the nature of the slope or the topographical and environmental zone where the plant/ vegetation was. These characteristics were mostly seen in Meemure and they defined the forest degradation as cutting or harming the vegetation in a bund. Based on the statements of the villagers in Box 5, it could be realized that normally there were circumstances where the degradation was defined as cutting or harming the vegetation in different places.

Statement Box: 5

“It is not good to cut down Roossa trees at the top of the mountain, because landslides or scarcity of water can occur at such moments.” (Palingu Manika 2018.8.21,22)
 “It is not good to cut the plants in the slopes, because the soil becomes infertile.” (R.G.Jayasena 2018.6.18,19)
 “It is not good to cut the paddy plant near the paddy field, because it decreases the richness of the paddy field.” (Rathnayake 2018.6.25,26)
 “It is not good to cut any tree near the river, because the erosion of the river increases.” (R.G.Jayasena 2018.6.18,19)
 “It affects to change the taste of the water when the trees around the river, such as *Mee* and *Godapara* (*Dillenia retusa*) are cut down.” (Palingu Manika 2018.8.21,22)

Source: Field Study, 2018

What can be realized through the statements in box 5 is that they have categorized the effect on the canopy according to the topography as harmful or non-harmful. Accordingly, it can be seen that cutting down or destroying a plant or a tree in an improper place was strongly controlled and such circumstances are identified as degradation.

Identifying Degradation based on Change of the Composition of Plants

Traditional farmers have knowledge on the vegetation that grows naturally in a specific area and also on the weed that grows as more and less around them. According to them, degradation is considered as a change in the combination of those plants and weeds. Their knowledge about the environmental system directly influences that. As Atanwala Heenbanda (age of 65) states, environmental systems can be identified in different ways based on the topography and the climate. To identify their combination, the knowledge about the combination of the plants in the history is also important. Specially, a method was available to identify the degradation in a particular area based on the types of weed grown in a specific area or a place. This method was utilized by his father and grandfather to check fertility in the cultivate lands. Table 5 shows the types of plants used to identify fertility of the land.

Table 5: Types of plants used to identify fertility of the land

Local Name	Scientific name
<i>Wal dunkola</i>	<i>Lobelia nicotianifolia</i>
<i>Monara kudumbiya</i>	<i>Dicranopteris linearis</i>
<i>Diya meneriya</i>	<i>Commelina benghalensis</i>
<i>Girapala</i>	<i>Commelina diffusa</i>
<i>Black-jack</i>	<i>Bidens pilosa</i>
<i>Sudana</i>	<i>Conyza bonariensis</i> L.
<i>Kadu pahara</i>	<i>Conyza floribunda</i>
<i>Ath adi</i>	<i>Eupatorium oderatano</i>
<i>Balu nakuta</i>	<i>Stachytarpheta artificiofia</i>
<i>Inguru</i>	<i>Zingiber zylindicum</i>

Source: Field study, 2018

If the species in Table 6 are mixed and distributed in a particular place, farmers believe that it is a fertile land. Further, this can be clearly identified from the statements of farmers in Box 6

Statement Box: 6

“If there are different kinds of trees and plants in the same place, it is a fertile land.” (I.Appuhami 2017.1.21,22)
 “If different kinds of trees are available in the same land which is suitable for any cultivation”. (Dingiri 2015.12.25,26,27)

When the diversity of plants decreases or when the same kinds of bushes exist, it is considered as

a degraded forest cover or a barren land and if the species of plants (Table 6) spread in the same land, it is usually considered as a very fertile land. Farmers said that these areas should not be destroyed for any purposes.

Table 6: Types of plant species used as indicators to identify very fertile lands

Local Name	Scientific Name	Local Name	Scientific Name
Niyagala	<i>Gloriosa Superba</i>	Karanda	<i>Milletia pinnata</i>
Kumbuk	<i>Terminalla Arjuna</i>	Kappitiya	<i>Groton lacifor</i>
Heen Gotukola	<i>Hydrocotyle Asiatica</i>	Nika	<i>Vitex negunde</i>
Kuppameniya	<i>Acalypha Indica</i>	Heen thambala	<i>Carmona microphylla</i>
Karalsaboo	<i>Achyranthes aspera</i>	Domba	<i>Calophyllum Inophyllum</i>
Ehala	<i>Cassia Fistuala</i>	Ranawara	<i>Cassia Auriculata</i>
Thotila	<i>Oraxylon Indicum</i>	Tippali	<i>Piner longum</i>
Iriveriya	<i>Plectranthus Zeylanicus</i>		

Source: Field Study, 2018

If there is a forest cover where these species of plants (Table 6) are abundant, it is a fertile land which should be protected as an environmental system, and since there is a connection among those plants, if they are harmed, they all can be destroyed (Veda Mahaththaya, 2018)

The species of plants indicated which directly influence the environment and the forest cover of the area are Haveri Nuga (*Alstonia Macrophylla*), Ginisapu (*Michelia champaca*) and Ennasahal (*Elettaria cardomomum*). Since these plants are harmful towards the other plants, it was identified that they usually affect the forest degradation.

Identifying Degradation through the Decrease of the Harvest

This method is a common method which could be seen in all villages. If the harvest of the most of the vegetation is decreased at the same time, the vegetation of that zone is identified as degraded. This is a common fact for cultivation, home gardening and forests. It was revealed through the interviews conducted in the areas, Meemure and Pitawala, that the landslide prone areas can also be identified by these characteristics. It was stated by Sumathipala (age of 61) in *Atanwala village* (2018) that there were circumstances where the landslides were identified through the decrease of the harvest of Kithul trees, in the past. Table 4.10 indicates the characteristics of the plants and nature of degradations in each cultivation.

Table 4.10: The characteristics of the plants and nature of degradations in each cultivation

Type of the tree	Characteristics	The nature of the degradation
<i>Mango tree (Mangifera indica)</i>	Fruits are fallen in the very immature period.	Soil becoming light in nature. Diseases are infected to the plant. Necessary nutrition is not provided.
<i>Banana (Musa acuminata)</i>	Bushes are increased. Bunches of banana are very small.	The amount of water provided to the plant is more than the required amount. 'Kuna baheema' of the plant. Low quality of the soil.
<i>Kithul (Caryota urens)</i>	The amount of Thelijja supplied per one day is decreased.	Landslides, soil becoming light, lack of water supply, increase animal damages.
<i>Paddy (Oryza sativa)</i>	Decrease of the harvest.	Increase animal damages, decrease of water, sterilization of soil, lack of sunlight.

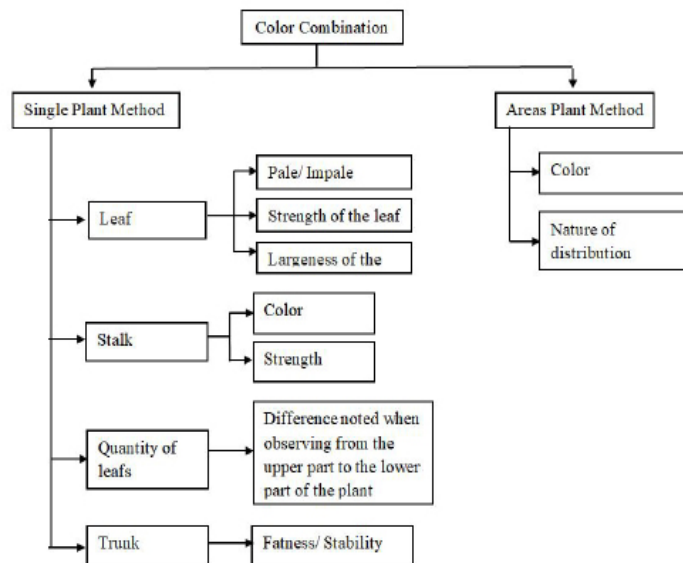
Source: Field Study, 2018

Identifying Degradation through the Decrease in the quality of Plants

This was seen as a very rare method which assists to identify the decrease in the value of the plant and basically, that was identified through the statements and explanations of the individual farmers in Puwakpitiya.

Comparing the color of the leaves of plants can be observed as a

method used to identify the forests degradation. However, this is recognized as a traditional method presented only by several people who were above 70 years, residing in the areas of Atanwala and Puwakpitiya. Although there was a personalized nature within this method, much identification showed similar characteristics. In this context, the color of the leaf was identified under 8 categories. This identification can be mainly divided into two parts according to the type of the plant and the number of the plant (Figure 6).



Source: Field study, 2018




Figure 6: Identification of the Colour of Leaves

Mainly, based on these basic characteristics, it is possible to assume the nutrient deficiencies of the plants and how much harvest can be expected from those plants. Also farmers have the ability to give some explanations not only about the plant, but also about the soil in which the plant grows, amount of the available sunlight on the plant, possibility of being exposed to the wind and the nature of the neighbor plants. This method differs according to the

cultivated plant species and they have also stated remedies for that.

Case study 1 -Identifying the Paddy plant

This can be considered as an effective and convenient method. Based on the overall colour of the paddy plants in a field and relevant characteristics, Mr. W.G. Appuhami prepared the colour structure as in Figure 7.

Stage	Period	Colour	Harvest
Planting stage	2 nd Week		High
			Medium
			Low
			Low
Grown stage	7 th - 10 th Week		High
			High
			Low
Reaping stage	15 th - 17 th Week		High
			Medium
			Low

Source: Field study, 2018

Figure 7: Colour structure of paddy plant identified 65-year-old farmer, Mr. W.G Appuhami, Puwakpitiya village Based on the colour of the leaves of plants, there is a possibility to identify the nutrition which is not provided to the plant.

Conclusion

Traditional knowledge used in the identification of forests degradation was studied with reference to the seven GND's i.e. Puwakpitiya, Atanwela, Mahalkotuwa, Pitawala, Meemure, Kahagala and Pusse Ella, out of 56 divisions laid in Knuckles range. Degradation of the forest cover has been covered by focusing to four main criteria as; a). Qualitative degradation (value of the plant, service done by the plant species to the environment and man.); b) Quantitative degradation (according to the size of the land where the degradation occurs and the number of trees that are being cut.); c). Physical condition of the plant (distribution of the tree and height, connection with the sunlight.) and d). Function of the plant system towards that environmental system. (interconnection between plants, interdependence between plants.). According to the study it was revealed that the traditional farmers in the study area had applied six different indigenous criteria to identify the forest degradation, namely plant species, extent of the land use, location of the plant, change of the composition of the plant, decrease of the harvest and quality of the plants. Under each of criterion, different indigenous methods have been adopted for identifying degradation of plants and conservation of the plant species and rural agricultural systems. As an important finding of this research, it can be highlight that the traditional methods used to find forests degradation in this research can be applied for identifying and minimizing the degradation of forests which cannot be seen in other areas in Sri Lanka. It was also identified that there is a high potential in those traditional methods with regard to securing the quality of the environment [12-22].

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