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Traditional Knowledge used in Soil Taxonomy and Identifying Degradation: A Case Study in *Knuckles* Range, Sri Lanka

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ABSTRACT

Traditional Knowledge is an experiential knowledge built by people within a long duration and this knowledge has been decaying with time. Traditional soil taxonomies or classifications are most important in the process of identifying soil degradation. Therefore, this study was focused to ascertain the traditional knowledge used in identification of soil erosion and classification of soil in the Knuckles range of Sri Lanka. Seven Grama Niladhrari Divisions out of 56 laid in Knuckles range were selected as the study area. 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, observations and transect walks while international and local soil classification methods were applied for scientific validation. In this study four (04) traditional methods used to classify the soil was identified. Based on 6 different indigenous criteria, three (03) main soil types and 15 sub soil types were identified. Further, types of components existing in each indigenous soil type were identified using a soil index which comprises of 16 type of materials while nine (09) soil samples and nine (09) soil profiles were scientifically validated through international and local soil classification. The traditional soil taxonomy found in this research can be applied for identifying and minimizing the degradation of soil and securing the quality of the environment. Comparative studies between the scientific and traditional science like this would expose and disseminate more and more possibilities on future studies.

1. Introduction

Traditional Knowledge (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, medicines, 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. 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. TK is one of the main processes which can be used to identify the ecological system and disturbances of the ecological system. Identification of the ecological degradation has given boost on the ecological benefits which traditional people expected from the agriculture. Soil system is one of the important components in the agro ecological system. There has been a steady stream of studies which have analyzed the soil degradation processes in agricultural regions of the world (Trangmar,1986; Ulluwishewa,1991; Pawluk *et al*., 1992; Okoye,1998). Historical evidences prove that most of the traditional communities have been practicing traditional agricultural methods to identify the degradation processes and they have successfully restored the damaged agro ecological system to enhance the future agricultural productivity. In addition, the technological enhancement and the agricultural input package which have been introduced during the green revolution period have an adverse effect on the micro and the macro ecological systems including soil system. Accordingly, *Knuckles* range of Sri Lanka is one of the major bio diversity hotspots in Sri Lanka. Most of the senior citizens living in relatively isolated settlements in *Knuckles* Range are enriched with sophisticated traditional agro-ecological methods. However, TK has been decaying from generation to generation. Therefore, the impairment of traditional knowledge which they practiced in the past has a detrimental effect on their sophisticated knowledge used in agricultural work. There are many instances where traditional knowledge can be used to identify environmental degradation (Guillet, 1989; Allieri, 1990; Berlil, 1992; Froser *et al*., 2006). As Froser *et al*. (2006) states, there are 132 methods that are used to identify soil erosion and soil dynamism in the Himalayan region. Taxonomic knowledge is becoming increasingly important in environmental management. Most of the scholars have mentioned the importance of the TK in taxonomy. According to the experience of the traditional people, agricultural knowledge system always evolve with the perspective of taxonomy. Classification and the regionalization of the ecological processes play a major role in traditional science which they have produced and practiced. Martin's (1986) study on Askimo's snow classification is one of the studies which can be mentioned as an example for taxonomic value that exists in the TK all over the world. TK always interdepends on the implementation and the purpose. When the importance of the purpose or implementation decays, knowledge impairment increases (Ulluwishewa, 1991). Even though, traditional soil taxonomies are crucial in the process of identifying soil degradation in the agricultural regions, limited research have been undertaken in Sri Lanka relating to this area. With this limitation, the current study was focused to ascertain the traditional knowledge used in soil taxonomy and

identification of soil degradation. The specific objectives of this research were to; identify TK used to identify soil degradation; classify soil in the *Knuckles* range of Sri Lanka and verify the traditional soil classifications with the international and local standards (Thennakoon, 2017; Gamachchige and Thennakoon, 2019ab).

2. Materials and Methods

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 Niladhrari 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. When analyzing the traditionally defined soil species, and the way of identifying them, it is necessary that the particular soil species which are different from each other should be compared with the international and local soil classification. Therefore, nine soil samples and nine soil profiles were validated through international and local soil classification standards (Thennakoon, 2017; Gamachchige, 2018).

3. Results and Discussion

Traditional Knowledge used to identify Soil Degradation

Several basic characteristics can be seen in the study of methods which are used by conventional people to identify soil degradation. Those characteristics include identifying soil sites by categorizing soil based on the methods of measuring how much soil is eroded. This also includes methods of determining the hierarchy of the soil based on soil erosion, classifying soil according to the composition of materials and classifying soil according to the amount of fertilizer in the soil, and then preparing the soil for agricultural processes accordingly. Traditional methods of identifying soil degradation can be analyzed as follows.

Traditional Methods used to identify Soil Erosion

When determining what soil erosion was, 57% of the people in the study areas said that the eroded lands could be identified

according to the gravel composition in the soil and the colour composition of the soil. Approximately, 27% presented their views that the place and the structure of the soil could be used to identify soil erosion. The idea of 16% of the people was that there were many traditional methods to identify soil erosion. According to them, such variables which can be used for that are the hard and clay-like nature which is felt when compressing those compositions (the amount of the mulch, gravel amount and sand amount) by hand, the colour composition of the soil, the location of the soil, topography and the nature of the vegetation around the soil (Figure 1).

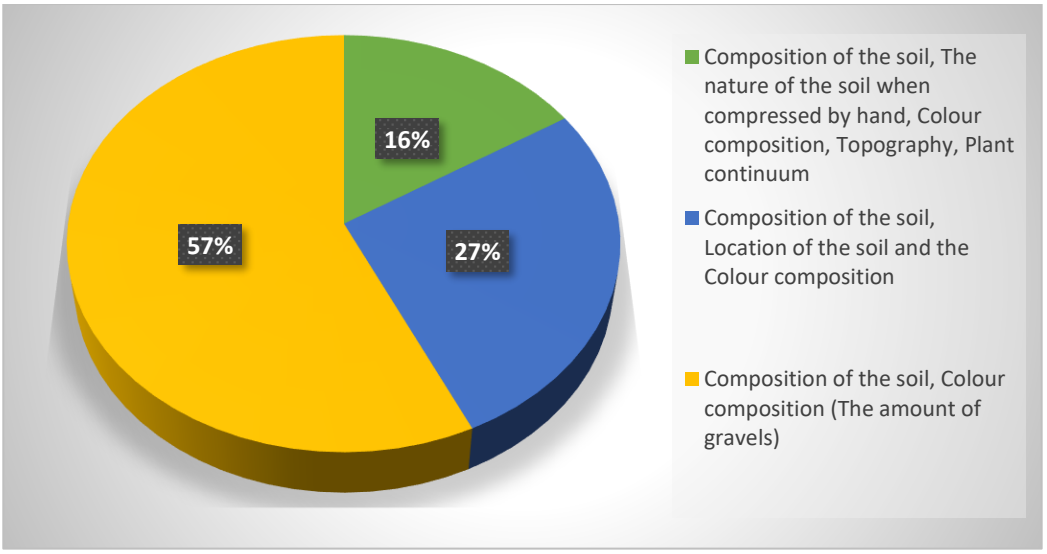

Figure 1. Percentage of people that used different criteria for identifying soil erosion

This category of farmers consists of more aged people; that is 88% of the total was above 60 years old. A significant fact revealed through this is that mostly the people who are above 60 years old have the knowledge of the traditional indicators of soil erosion. According to the data collected from the interviews and observations, the signs of identifying the eroded, soil which is being eroded and non – eroded soil were categorized as indicated in Table 1.

Table 1. The Indicators of Identifying Eroded and Non-eroded Soil

Eroded soil	The soil which is being eroded	The soil which is not eroded
"When compressed by hand, mostly soil and gravels are found." (K. M. P. G. Jayasena 2018.8.14,15) "When taking into hand and pressing with fingers, soil and stones are rubbed together." (Kapila 2018.8.18,19) "The color composition of the soil is similar to yellow, and sometimes it can be red or brown.' (Muthu Banda 2018.12.25,26,27) "Black coloured humid parts cannot be observed, and it never takes the colour of dark black." (Kumaradasa 2018.12.25,26,27) "Sometimes there are brownish scars in the sand-like parts." (R. G. Jayasena 2018.6.18,19) "Grass which is usually grown in unproductive, barren lands (infertile soil), grows in this soil." (M. G. A Ekanayake 2018.1.21,22)	"Graphite particulars have appeared." "The top layer of the soil is mostly sandy." (K. M. P. G. Jayasena 2018.8.14,15) "Gravels have appeared." (K. M. P. G. Jayasena 2018.8.14,15) "The roots of the trees in the area emerge and appear here and there from the soil." (Heen Banda2018.6.18,19) "When hoeing, upward pressure of the hoe can be observed at once due to the resistance of the soil system."(Muthu Banda 2018.1.21,22)	"Mulch can be seen over the soil." (Muthu Banda 2018.12.25,26,27) "The soil system consists of an upper layer which is black." (K. M. P. G. Jayasena 2018.8.14,15) "When stepping on the place where the soil is, some softness is felt." (R. G. Jayasena 2018.6.18,19)

As a traditional method, farmers decide the nature of the soil erosion mostly with the mamoty. There, different categories are recognized through the way how the soil is tilled with the mamoty, how it is dug and through the amount of the resistance felt to the hand, which is strapped by the soil towards the mamoty. As an example, it can also be observed that due to the reason that the eroded soil has less resistance towards

the mamoty, ultimately the soil turns into a rough nature and leads to increase the resistance. Also, when coming to muddy soil, they identify it by rubbing the mamoty with the soil. If sand appears when rubbing like that, then the soil is considered to be eroded, and if soil appears, then it is not considered as eroded.

Traditional Method of Identifying Soil based on the Composition of Materials

By analyzing the main indicators used by farmers to identify the nature of the soil and the condition of soil, it was categorized under five components in the soil, and accordingly, the following classification can be made (Figure 2) (Thennakoon, 2017; Gamachchige and Thennakoon, 2019a).

The types of soil are decided through the amount and composition of these main types, and the application and uses of them are also decided using the same criterion.

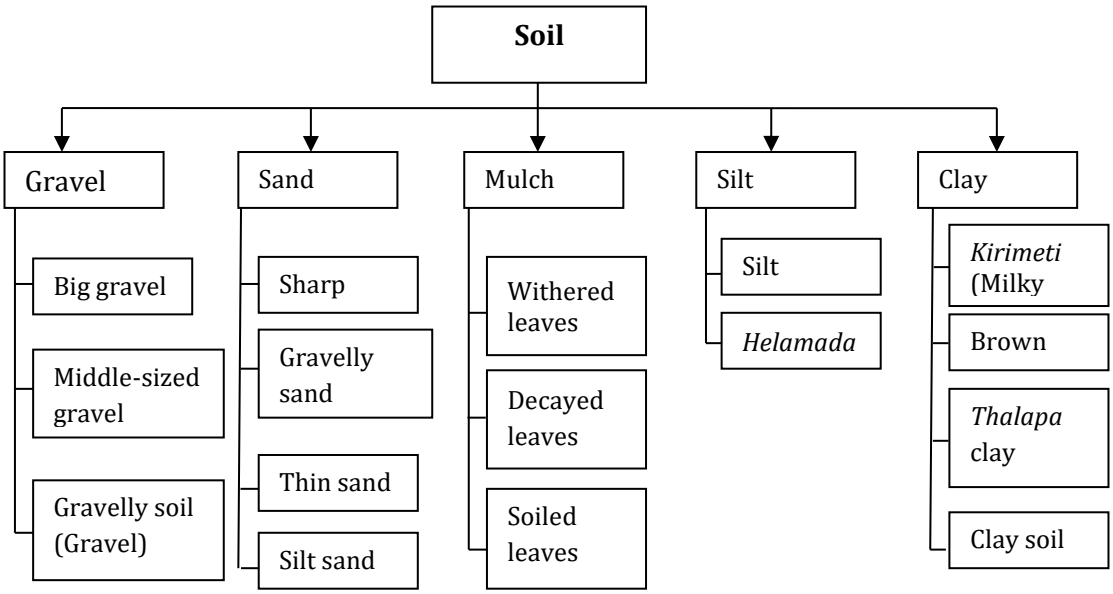

Figure 2. Traditional Method of Classifying Soil based on the Composition of Materials

Traditional Methods of Identifying the Sterility of the Soil

According to the responses regarding the sterility of the soil, the GND's that traditionally engage in agriculture, *Atanwala* and *Puwakpitiya*, use some standard methods. The main characteristic is that there is a difference in defining what barren soil is. They do not specify any soil as sterile and they believe that there is some nutrition in every soil (Mudiyanse 2018.1.22,23). The researchers observe soil erosion and the transformation of the soil ecosystem within a single context (Gamachchige and Thennakoon, 2019a). The preliminary meaning of this notion is that there are easier methods to recover a specific soil ecosystem, even if it is degraded; so it is disregarded as a serious issue but seen as a situation with potentials. Most of the time, soil erosion does not get analysed since they have natural prevention methods for that. Accordingly, they state that the harvest can be increased by changing the crop that is cultivated. However, the methods to identify the soil which is relatively barren and not specific to

each crop, were analysed here. They stated that the soil can be categorized into three categories depending on its fertility (Figure 3). Also, they mentioned several criteria which are considered relating to soil fertility as the following;

a. The amount of the harvest of the crop
b. The nature of the growth of crop (Spreading branches, time taken for flushing, the colour of the new leaves and leaves)
c. The growth rate of the other plants in addition to the crop.
d. The fresh or withering nature of the leaves
e. Lack of humidity
f. Change of the texture and formation as cracked land parts/ chunks

Traditional Soil Taxonomy in villages of *Knuckles* range

By using indigenous criteria mentioned above, farmers have categorized soil into three main and 15 sub-categories as depicted in Figure 3.

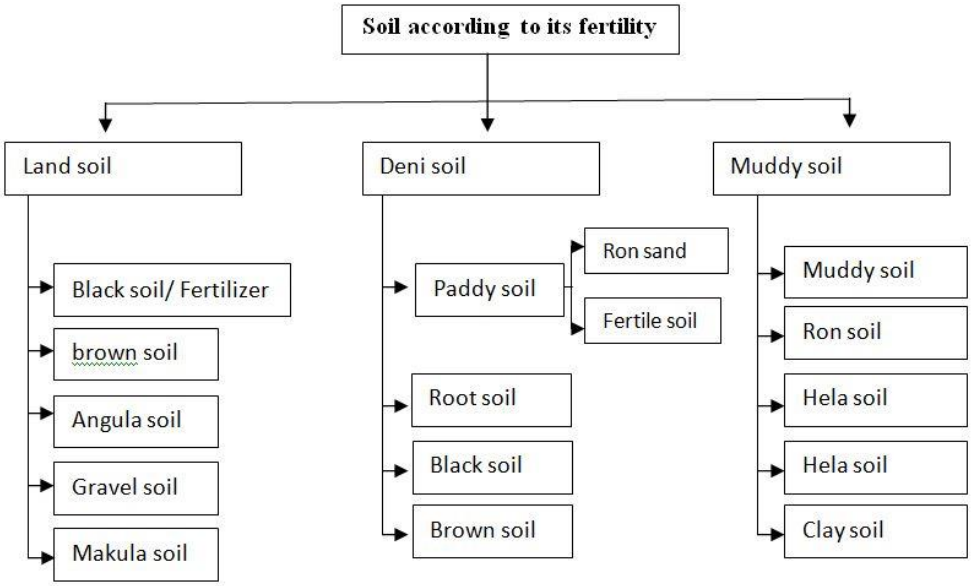

Figure 3. Main and Subcategories of Soil based on Decisions of the Indigenous Farmers

Black soil (*Kalu Pasa*)- This soil is mostly seen around valleys and low lands. In different areas, different names are used for this soil, and they are, Kalu pas (Balck soil), *Pohora pasa* (Fertile soil) and *Pohora misra kalu pasa* (Black soil mixed with fertilizer). Through those names, it is clear that this soil is mostly used as a fertilizer in agriculture. The summary of the components included in black soil and their levels are depicted in Figure 4.

Brown Soil (*Dumburu Pasa*)- Although fertility-wise this soil is of a middle level; it is said that sometimes there is a chance for most crops to have harvest through this soil rather than the black soil. Most of the time, such trees are called "deep-rooted trees"; i.e. the tress of which the root system goes deep down. The summary of the components included in brown soil and their levels are depicted in Figure 5.

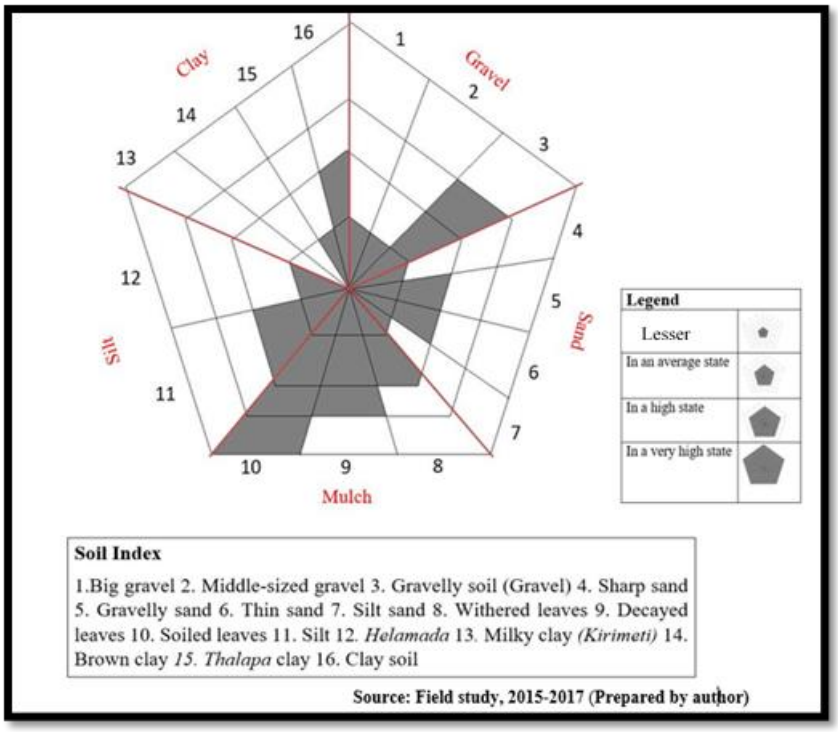

Figure 4. Summary of Components included in the Black Soil and their Levels

T**able 2**. Soil Profile 1 in *Atanwala* verified with Humic Cambisol (international) and Yellowish Brown Earth (local) Soil Classifications

Diagnostic horizon	Depth cm	Structure	Texture	Coarse Material (%)	Rooting	Colour	Colour chart
^{A}h ochric	1-10	medium crumby/wormcast		50	Very dense	dark yellowish brown	10 YR 3/4
^{B}w1 cambic	11-34	Granular/ Moderate medium angular blocky	silty clay loam	60	Medium	dark yellowish brown	10 YR 3/6
^{B}w1 cambic	35+	strong coarse angular blocky	silty clay loam	40	Medium	dark yellowish brown	10 YR 4/6

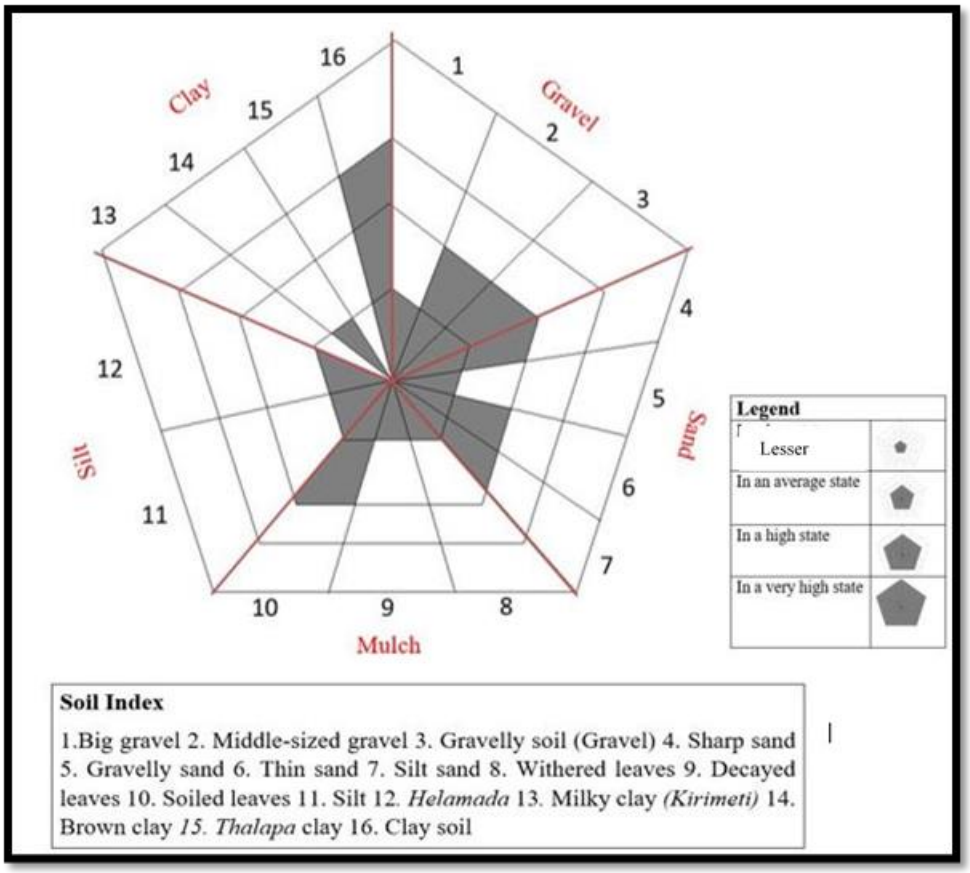

Figure 5. Summary of Components included in the Brown soil and their Levels.

Table 3. Soil Profile 2 in *Puwakpitiya* verified with Humic Cambisol (international) and Yellowish Brown Earth (local) Soil Classifications

Diagnostic horizon	Depth cm	Structure	Texture	Coarse Material (%)	Rooting	Colour	Colour chart
^{A}h Ochric	0-3	Medium crumby/ wormcast		60	medium	dark yellowish brown	10 YR 4/4
B Cambic	4-55	Granular/ Moderate medium angular blocky	sandy silty loam	60	medium	dark yellowish brown	10 YR 4/4-4/6
B/C Cambic	56+	single grained	sandy silty loam	60-80	Weak	dark yellowish brown	10 YR 4/6

Table 4. Soil Profile 3 in *Meemure* verified with Humic Cambisol (international) and Yellowish Brown Earth (local) Soil Classifications

Diagnostic horizon	Depth cm	Structure	Texture	Coarse Material (%)	Rooting	Colour	Colour chart
[A] hochric	0-3	Medium crumby/ worm cast		10	Dense	dark yellowish brown	10 YR 3/6
[B] w1 cambic	4-30	Granular/ Moderate medium angular blocky	silty clay loam	30	Medium	dark yellowish brown	10 YR 3/6
B/C cambic	31+	single grained	silty clay loam	30	Medium	dark yellowish brown	10 YR 3/6

A main fact revealed through the studies of these soil aspects is that there are regional differences in determining Brown Soil according to traditional methodology. More different nature of soil than the Brown soil identified by the sampled people in *Puwakpitiya* is shown by the people in *Meemure*. This indicates that the classification of soil by people is based only on the upper layer of soil. However, according to the international soil classification, the soil type called *Humic Cambisol* has been identified as Brown Soil.

Angula Soil (*Angula Pasa*) - This soil is also called as red soil and red clay soil. However, this is brown and consists of clay-mixed wetness. Several perceptions of farmers on *Angula* soil are given below as short quotations.

"There is no sand in *Angula* soil. *Angula* soil can be easily used in cultivation" (I. Appuhami 2018.8.20, 21) change these dates

"*Angula* soil is a good soil." (Amaradasa 2018.1.22,23)

These statements show that this soil is fertile for many crop species. Several statements are there that make overlap this soil with the type of soil called 'Gravel clay'/ '*Boralu Metta*.'

"Red soil and gravel clay are the same." (Rathnayake 2018.6.25,26)

"*Angula* soil is softer than gravel clay." (Muthu Banda 2018.12.25,26,27)

"Red soil is a clayish soil." (R. G. Jayasena 2018.6.18,19)

It is clear that these types of soil have been categorized differently concerning village areas, however, such soil has been categorized in various ways (Thennakoon, 2017; Gamachchige, 2018). It is also revealed through the statements of many people that these types of soil works only with specific crops, and not with all. The summary of components included in *Angula* soil and their levels are depicted in Figure 6.

As per the Figure 6, it is shown that *Angula* soil consists of more gravel and clay than other materials.

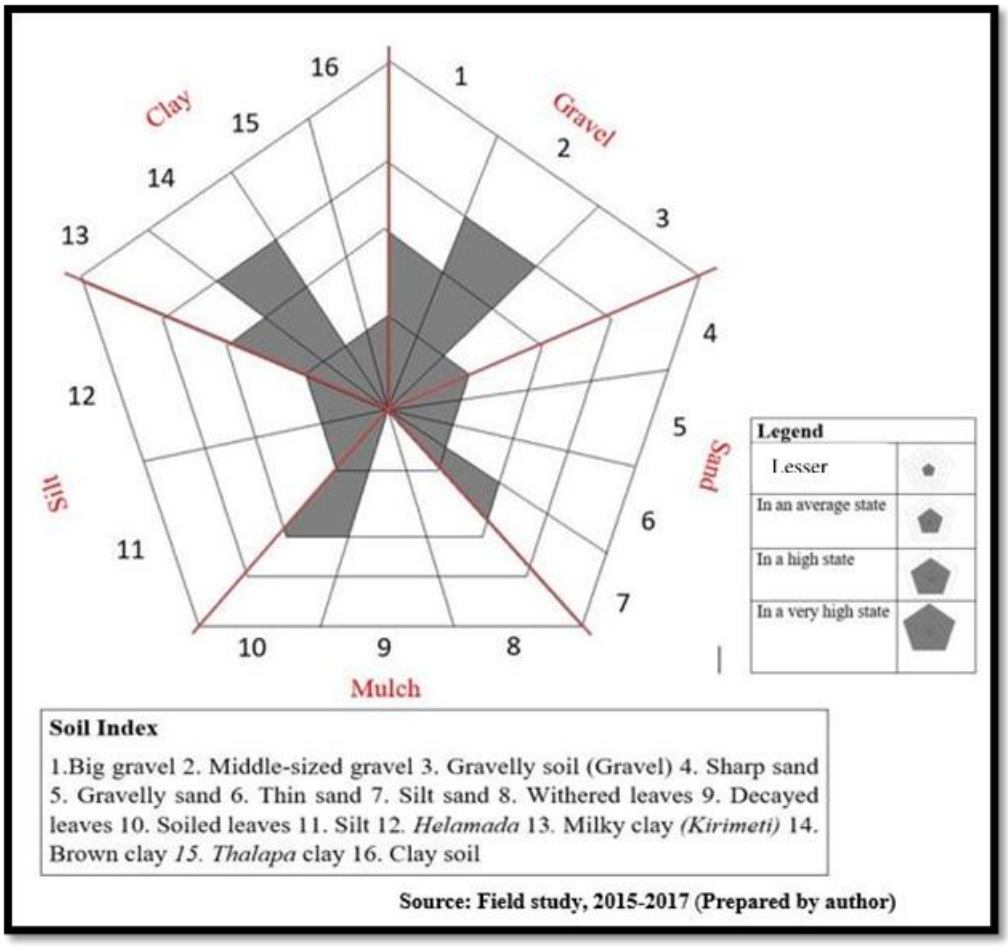

Figure 6. Summary of Components included in the *Angula* soil and their Levels

Table 5: Soil Profile 4 in *Mahalakotuwa* verified with Humic Cambisol (international) and Yellowish Brown Earth (local) Soil Classifications

Diagnostic horizon	Depth cm	Structure	Texture	Coarse Material (%)	Rooting	Colour	Colour chart
^{A}h Ochric	0-3	Medium crumby/ wormcast		50	medium	dark yellowish brown	10 YR ¾
B Cambic	4-55	Granular/ Moderate medium angular blocky	sandy silty loam	50	medium	dark yellowish brown	10 YR 4/4-4/6

B/C cambic	56+	single grained	loamy loam	60-70	medium	dark yellowish brown	10 YR 4/6

According to Soil Profile 4, although this soil is called Humic Cambisol under the International Classification, it can be considered as a sub-soil category in Cambisol under traditional agricultural knowledge. Therefore, it can be stated that these traditional people have a deep understanding of the soil, which surpasses the scientific method.

Gravelly Clay (*Boralu Metta*)- Gravelly clay is a clayish soil which is mixed with gravels and takes the colours similar to yellow or red. It is challenging to cultivate in this soil, and the statements prove that its fertility is at a low level. This can be seen as a soil mixed with laterite, and it can be mostly seen around slopes. Figure 7 indicates the summary of components included in gravelly clay (*Boralu Metta*) and their levels.

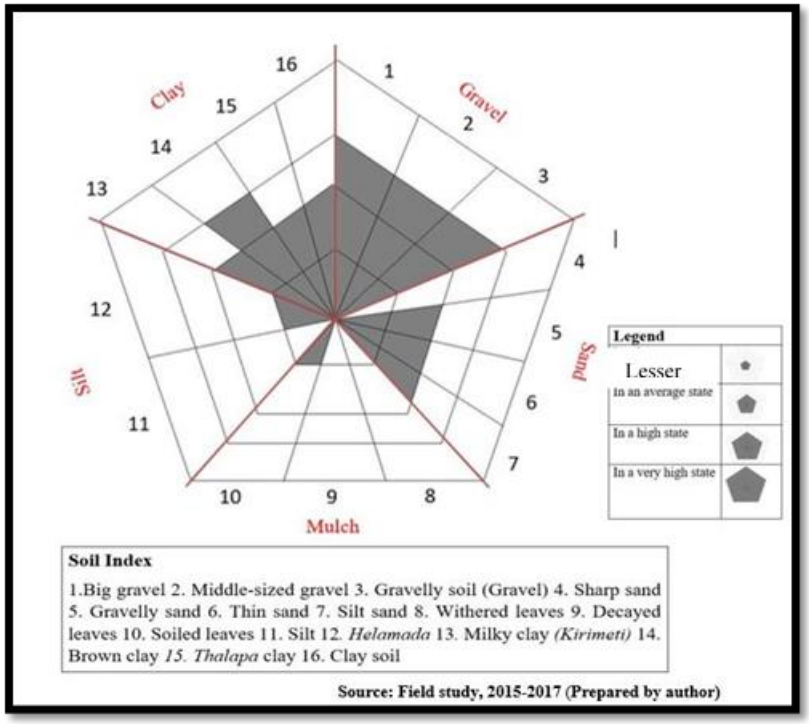

Figure 7. Summary of Components included in the Gravelly clay and their Levels

Table 6. Soil Profile 5 in *Pitawala* verified with Ferralic Cambisol, (international) and Yellowish Brown Earth with high content of coarse material (local) Soil Classifications

Diagnostic horizon	Depth cm	Structure	Texture	Coarse Material (%)	Rooting	Colour	Colour chart
^{A}h Ochric	0-5	Moderate fine crumby/ wormcast		20	very dense	dark yellowish brown	10 YR ¾
^{B}w1 cambic	6-25	Granular/ Moderate fine blocky	loamy loam	40	Weak	dark yellowish brown	10 YR 3/6 46
^{B}w1 cambic	26+	Moderate coarse subangular blocky	loamy loam	50	Medium	dark yellowish brown	10 YR 4/6

Table 7. Soil Profile 6 in *Pusse Ela* verified with Chromic Luvisol (international) and Red-Brown Soil (local) Soil Classifications

Diagnostic horizon	Depth cm	Structure	Texture	Coarse Material (%)	Rooting	Colour	Colour chart
^{B}pt1 cambic	0-17	moderate medium subangular, polyedric blocky	clay loan	20	Medium	reddish brown	5 YR 4/4
^{B}pt2 cambic	18+	moderate medium subangular, polyedric blocky	clay loan	40	weak	reddish red	5 YR 4/6

Gravelly sand (*Boralu Wella*) - Names such as "*Hedunu pasa*" (Washed soil) and "*Nisarupasa*" (Barren soil) are also used for this type of soil. This is a soil which is eroded by rain or over flowing of rivers. It is said that this soil has to be prepared using different methods to grow something in it. There is a lesser portion of red soil and clay mixed with gravel and sand. Figure 8 indicates the components included in gravelly sand and their levels.

Makula soil (*Makula Pasa*)- If this soil is there around the cultivated lands, it is considered to be harmful to them. It is white and very soft in nature and is said to be found very rarely.

Deni soil (*Deni Pasa*)- Usually this type of soil can be seen around paddy fields and marshes and bears the characteristics of both land soil and muddy soil. It can be seen that this soil exists in the areas called "*ovita*" (meadow) which consists of both the land and the paddy field. This soil is considered as very useful for

chena cultivation and in many other functions because it can increase the harvest of potato cultivation due to its light nature. Therefore, *Deni* soil is known as fertile soil when compared with other types of soil. It could be observed that there are four subcategories of this soil. Although there are no unique differences among them, it is said that this classification can be useful in terms of developing the variety of getting the harvest of the cultivation. Figure 9 depicts the summary of components included in *Deni pasa* and their levels, and Figure 10 represents the distribution of *Deni pasa.*

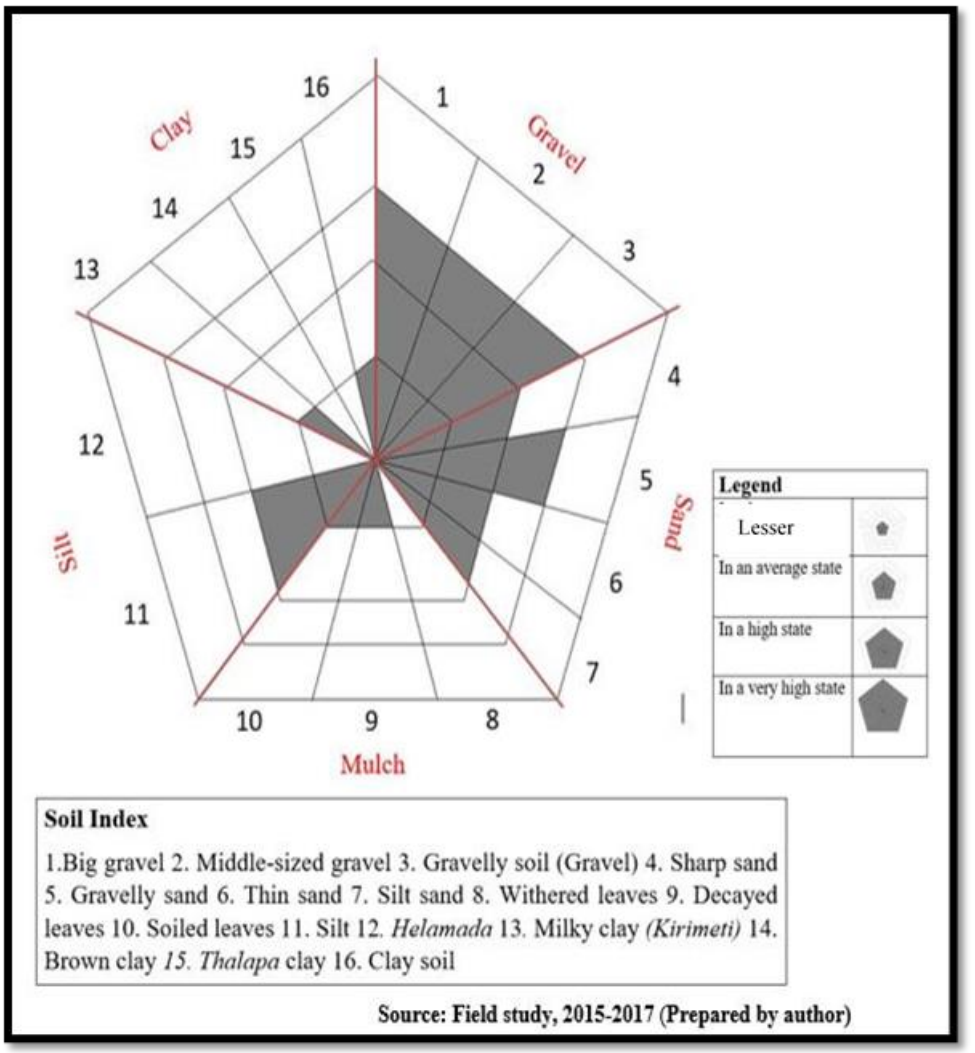

Figure 8. Summary of Components included in the Gravelly sand (*Boralu Wella*) and their Levels

Table 8. Soil Profile 7 in *Puwakpitiya* verified with Ferralic Cambisol, (international) and Yellowish Brown Earth with high content of coarse material (local) Soil Classifications

Diagnostic horizon	Depth cm	Structure	Texture	Coarse Material (%)	Rooting	Colour	Colour chart
^{A}h Ochric	0-3	Medium crumby/ wormcast		60	Medium	dark yellowish brown	10 YR 4/4
B Cambic	4-55	Granular/ Moderate medium angular blocky	sandy, silty loam	60	Medium	dark yellowish brown	10 YR 4/4-4/6
B/C Cambic	56+	single grained	sandy, silty loam	60-80	Weak	dark yellowish brown	10 YR 4/6

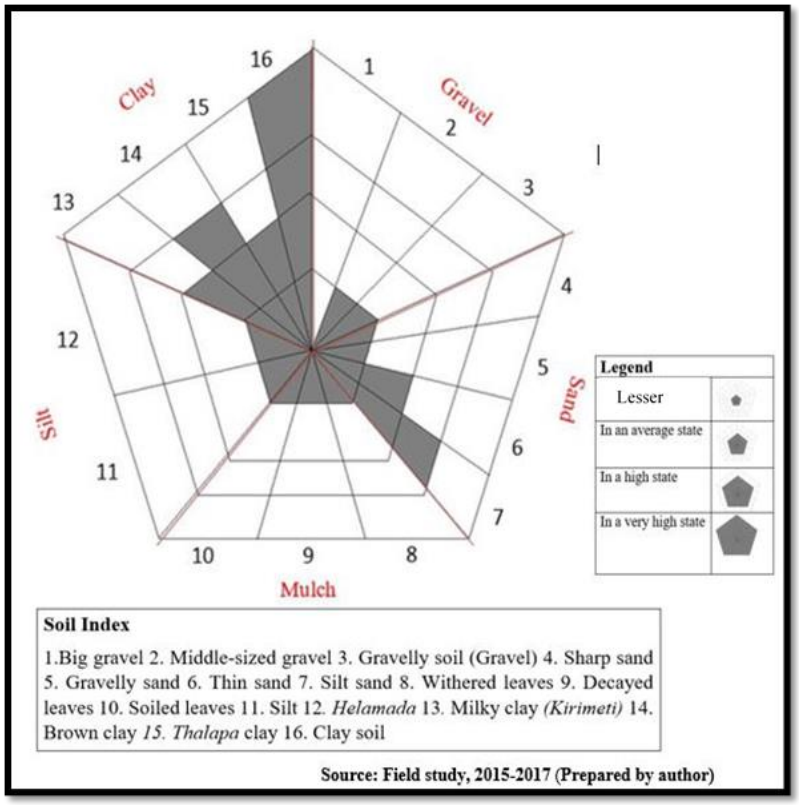

Figure 9. Summary of Components included in *Deni Pasa* and their Levels

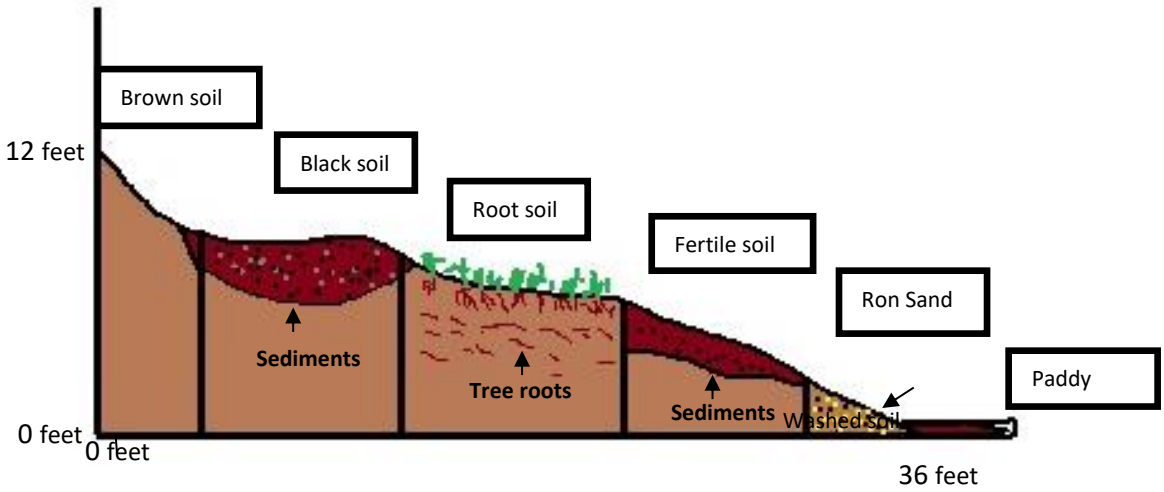

Figure 10. A profile of the locational distribution of *Deni Pasa* based on Farmers Decisions

Figure 10 shows how the species of *Deni pasa* have been placed spatially according to the topography. This classification can be identified as an analysis which manifests the impact caused by the variables, topography of the soil, water and vegetation on the nourishment of the soil.

Table 9. Soil Profile 8 in *Mahakotuwa* verified with Ferralic Cambisol, (international) and Yellowish Brown Earth (local) Soil Classifications

Diagnostic horizon	Depth cm	Structure	Texture	Coarse Material (%)	Rooting	Colour	Colour chart
^{A}h Cahric	0-B	Medium crumby/wormcast weak medium angular blocky		10	dense	dark yellowish brown	10 YR 3/6
AB cambic	9-15	crumby/ medium angular blockey	sandy clay loam	25	dense	dark yellowish brown	10 YR 4/6
B cambic	16+50	moderate medium angular blocky	clay loam	30	Medium	dark yellowish brown	10 YR 3/6
B/(C) cambic	31+	strong coarse subangular blocky	sandy loam	30	medium	dark yellowish brown	10 YR 4/6

Paddy Soil (*Kumburu Pasa*) - This is the muddy soil which can be usually seen in the border where the '*ovita'* (meadow) ends at the paddy field. There are two types of this and "*Ron wella* / sand" is a sedimentary soil mixed with sand, which is formed through the erosion of the muddy soil in the paddy field. Clay and sand can be mostly seen in this soil, because of the erosion caused by the water of the paddy field and the storage of the sand and other sedimentary parts of the paddy field. It could be seen that cultivations are rarely done in this zone except for crops such as '*Kohila'* (Lasia spinosa) and '*Gahala'* (Colocasia esculenta). Such crops are grown to reap more harvest and prevent the sterilization of the soil. Fertile soil is a separate part of that and is very close to the land. This soil consists of the storage of humus which flows from the highland of the area. Therefore, these zones are recognized as regions of fertile soil. It was said that edible leaves and plant species that root in the upper layer are grown in this soil because the upper layer of this soil is more nutritious than the lower layer. Only as the area *Atanwala* reported, sweet potatoes/ yams (Ipomoea batatas) were cultivated in this region. It shows that this soil can be defined as a type of soil which is relatively useful and fertile. Figure 11 depicts the summary of components included in Paddy (*Kumburu*) soil and their levels.

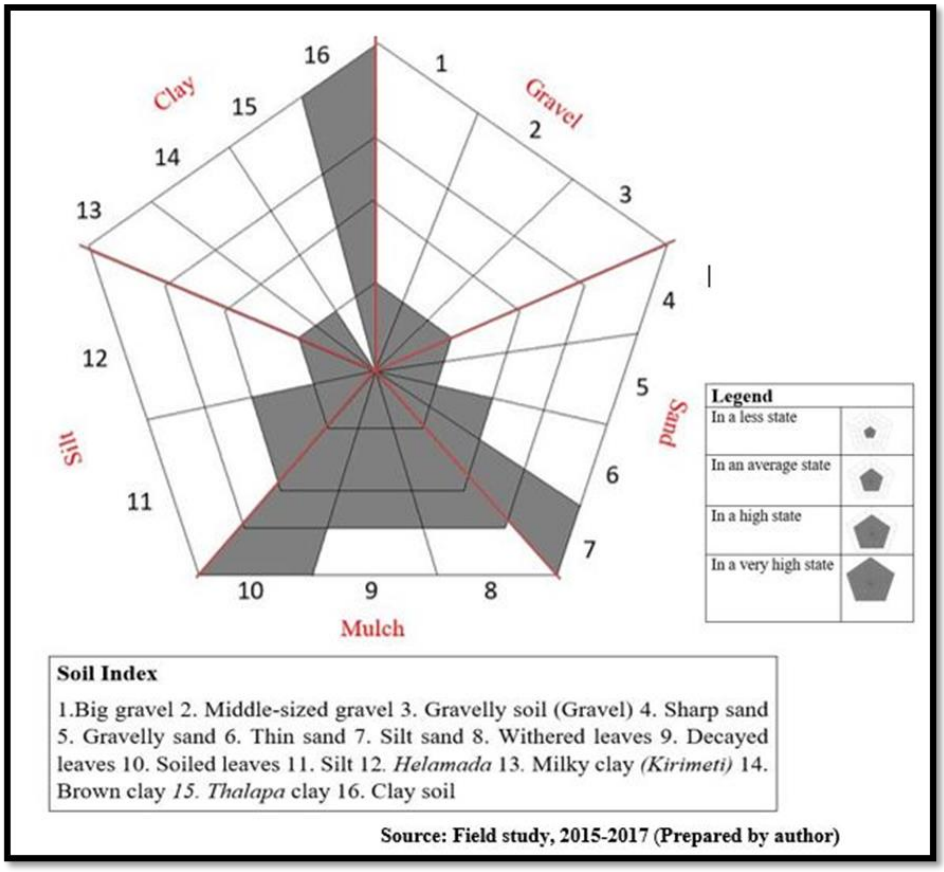

Figure 11. Summary of Components included in Paddy soil (*Kumburu Pasa*) and their Levels

Root soil (*Mul Pasa*) – *Mul pasa* is the part which is over the paddy soil. Most of the time, roots of various species of grass and vines can be seen there, and it was proven through the statements that special nutrition of those roots combines with the soil and thus causes to increase the lightness of it. Crops such as different kinds of potatoes (*Solanum tuberosum*), finger millet (*Eleusine coracana*), *meneri* (*Panicum miliaceum*), green gram (*Vigna radiate*) and ginger (*Zingiber officinale*) can be successfully grown in this soil. Figure 12 indicates the summary of components included in Root soil (*Mul Pasa*) and their levels.

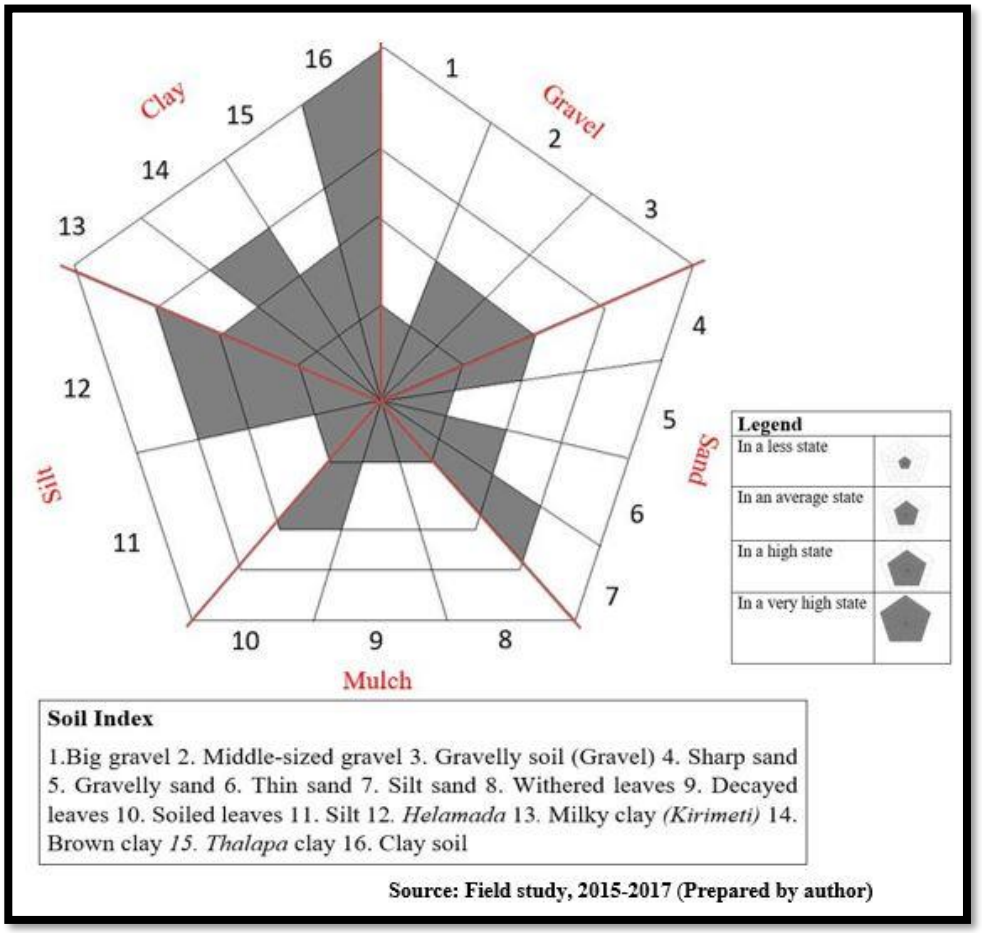

Figure 12. Summary of Components included in the Root soil (*Mul Pasa*) and their Levels

Meadow- Black Soil (*Kalu Pasa*) - This type of soil can be seen in the upper part of the '*ovita*' and is very fertile (Gamachchige, 2018). Mostly this upper part and the lower part consist of black humus and a light soil with clay respectively. The soil takes the

colour of dark grey. Figure 13 indicates the summary of components included in Meadow- Black Soil (*Kalu Pasa*) and their levels.

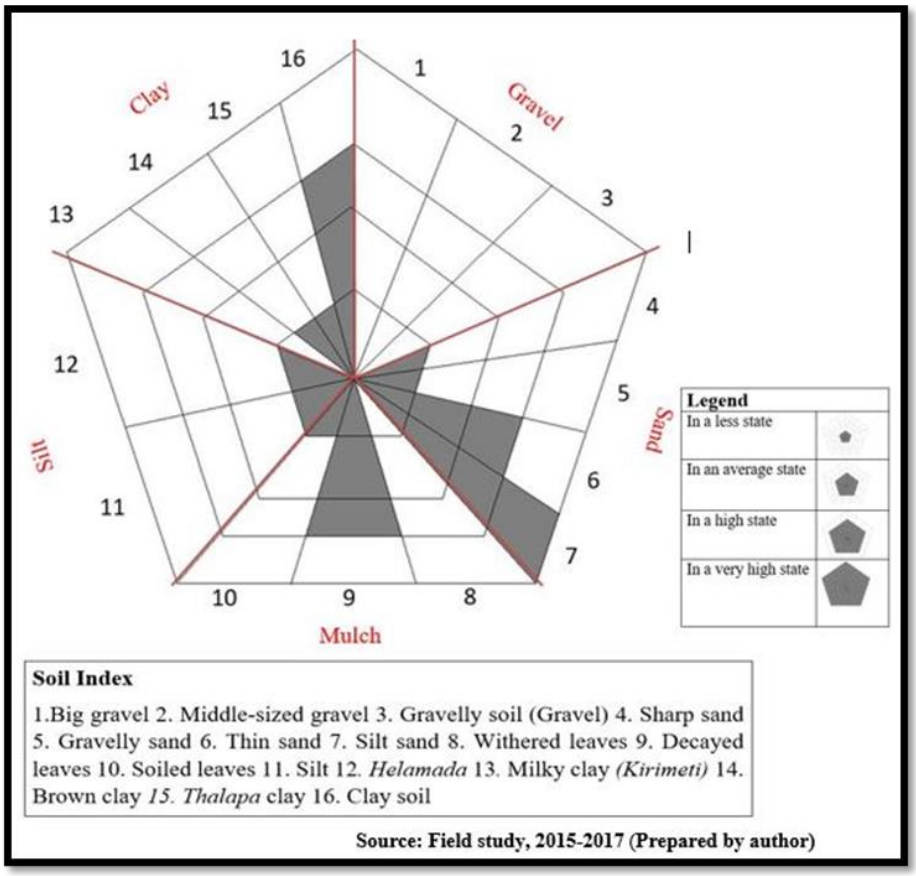

Figure 13. Summary of Components included in the Meadow - Black Soil (*Kalu Pasa*) and their Levels

Muddy soil (*Mada Pasa*) - The soil around the area of paddy fields and marshes is known as muddy soil. This soil is sticky in nature and farmers sort this depending on its composition which is checked by compressing with hand. It was also revealed through the statements of the farmers that the depth of the layer of soil and the amount of absorbed water is used for the classification of this soil (Figure 14).

Hela soil (Pela pasa)- *Pela pasa* is a soil which is muddier and sticky in nature. The speciality of this is that minerals usually gather over this soil. This nature of soil called '*kivula*' is attached to the soil as an upper layer. Since it is not that suitable for crops to have minerals on them, the idea of many farmers was that there was a difficulty in preparing this soil. Hela soil consists with more silt and clay and less gravel as indicated in Figure 15.

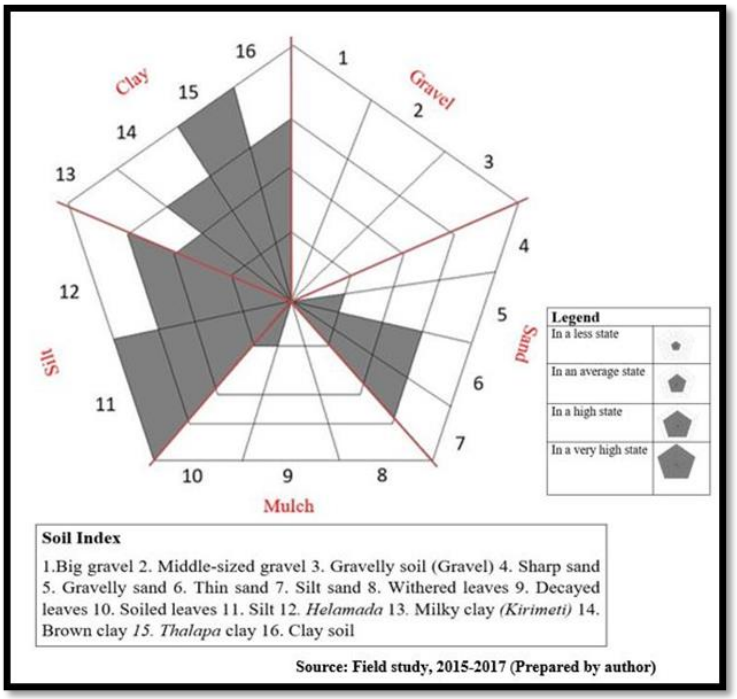

Figure 1. Summary of Components included in the *Muddy* soil (*Mada Pasa*) and their Levels

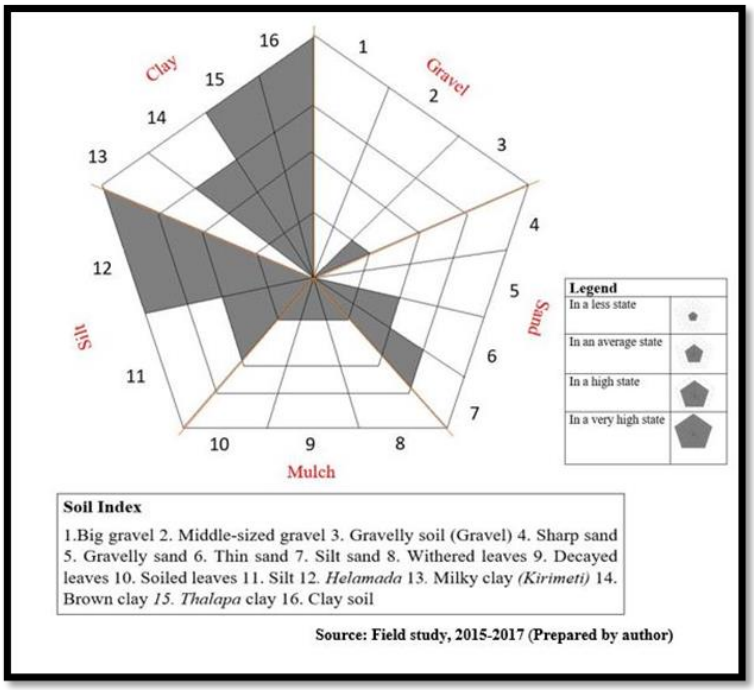

Figure 2. Summary of Components included in the *Hela* soil (*Pela pasa*) and their Levels

Marshy soil (*Vaguru pasa*) - Marshes are seen in this zone very rarely and although this soil is called 'marshy soil', it has no relation with marshes. It is a thick decayed layer with humus gathered in the lowest places of paddy fields. Marshy soil consists with more silt and clay and less gravel components as indicated in Figure 16.

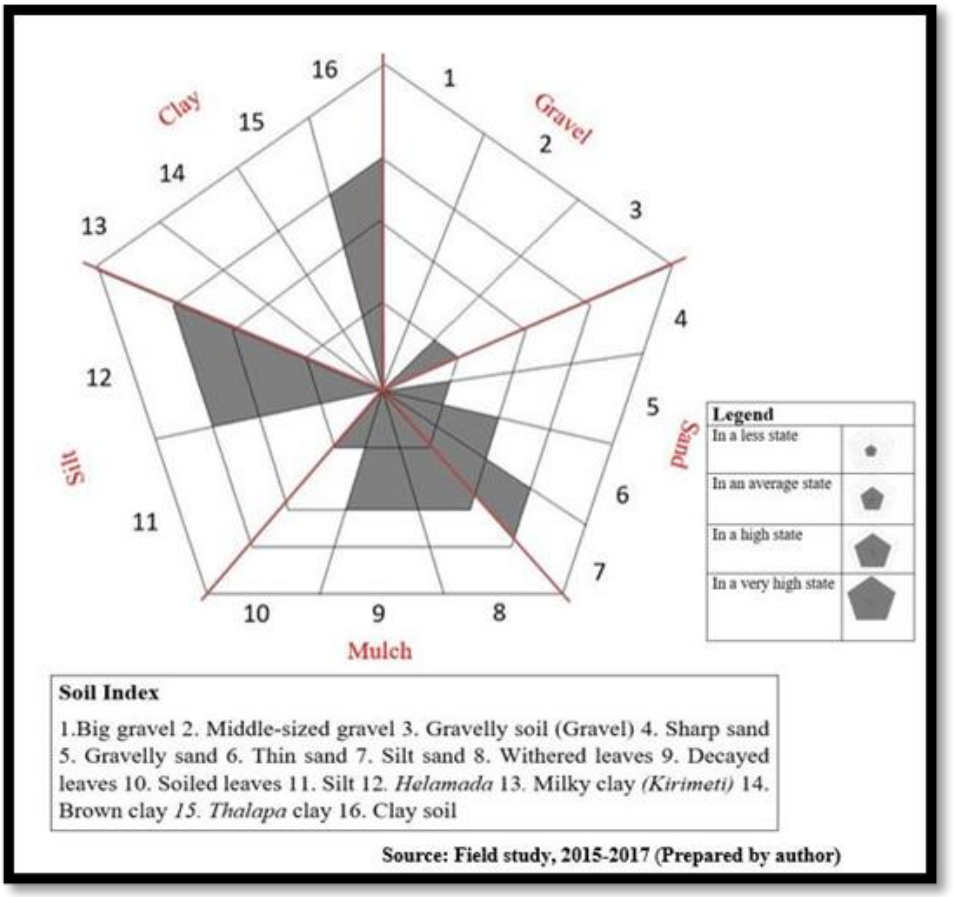

Figure 16. Summary of Components included in the Marshy soil (*Vaguru pasa*) and their Levels

Traditional soil classification which has been practiced in the *Knuckles* range is directly interrelated with the perspective of economic sustainability. That is why they pay more and more attention on the degradation and the restoration of the soil eco system. When comparatively analyze this scenario with study of Ulluwishewa (1991), it shows that traditional sustainable environmental strategies in Sri Lanka evolve with the effort which indigenous people have utilized to overcome the obstacles arising from the environment. They had a thorough knowledge on the disturbances which can happen to the environment through the agriculture and according to that factor they taxonomically validated the soil through the experiential knowledge. According to the ecological conditions, most of the TK on soil classifications depends on the adaptation

processes. In addition, soil regionalization and classifications play a major role in crop selection and harvest prediction. In this study four (04) traditional methods in the *Knuckles* region have been found to classify the soil. In this sector soil degradation is one of the indicators which they have used to classify and regionalize the soil ecosystem. Traditional farmers consider soil rather as a resource in which the characteristics deviate, than a resource which degrades. Accordingly, special attention has been paid on determining soil degradation pertaining to erosion in the *Knuckles* region. However, they have a basic characteristic of identifying soil and classifying it. They have used to study the physical characteristics of soil in order to identify soil erosion while building up strategies using TK on the quality of soil. Significant differences can be observed between the TK on soil classification in *Knuckles* range and the world scenario. When comparatively analyzed, the soil classifications with Nanni *et al.* (2006) and Ettema (1994), it is shown that there are lot of unique features in *Knuckles* range whereas composition and the materials were main indicators that have been used to distinguish the soil samples. Related literature highlights the importance of this traditional soil taxonomy in various implications. Comparative studies between the scientific and traditional science like this would expose and disseminate more and more possibilities on future studies.

4. Conclusion & Recommendation

Traditional knowledge used in the identification of soil erosion and soil taxonomy was identified with reference to the seven GND's in *Knuckles* Range. According to the study it was clear that six different indigenous criteria have been used by the farmers to classify soil in the region. Based on 6 different indigenous criteria, three (03) main soil types (*i.e.* land soil, *Deni* Soil and *Muddy* soil) and 15 sub soil types were identified by the farmers. Also, types of components in each indigenous soil type were identified using a soil index which comprises of 16 type of materials. Nine soil samples and nine soil profiles were scientifically validated through international and local soil classification. As a special finding of this research, it can be considered that the traditional soil taxonomy found in this research can be applied for identifying and minimizing the degradation of soil 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. Most of the literature has highlighted the importance of this traditional soil taxonomy in various implications in agricultural development. Comparative studies between the scientific and traditional science like this would expose and disseminate more and more possibilities on future studies. Several leading recommendations can be proposed in relation to this research. The research confirmed that the TK is decaying rapidly, and necessary steps should be taken to prevent this condition and conserve TK. The *Knuckles* region is full of TK, but they are in danger of fading away. There is a dire need of preserving TK methods and adding them into modern society. Since TK exists as regional specified characteristics, it should be analyzed and classified based on unique regional characteristics in order to utilize it in a successful manner. Although TK cannot be measured through scientific knowledge, sustainable modern methods can be created by using the existing scientific knowledge and validating and verifying those methodologies.

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