CHAPTER 2

APPLICATION OF TRADITIONAL ECOLOGICAL KNOWLEDGE FOR SUSTAINABLE ECOLOGICAL RESTORATION

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Introduction

The concept of traditional ecological knowledge (TEK), along with synonymous or closely related terms like indigenous knowledge and native science, has some of its origins in literatures on international development and adaptive management. There is no universally accepted definition for traditional ecological knowledge (TEK). In the literature it is defined as an ambiguous term which has many theoretical arguments. Societies and cultures have been changing through the time and the space. Temporal and the spatial pattern of the living area influence the human adaptation to their surrounding or environment. Because of those experiences which have been taken from the environment, a unique knowledge about the eco system of the surrounding area is built. That kind of spatial knowledge about the environment can basically defined as a traditional ecological knowledge.

Many scholars prefer to identify TEK as a collaborative concept. Because of that many kinds of dissimilarities occur in the definitions of the TEK.

"Traditional ecological knowledge refers to the knowledge, practice and belief concerning the relationship of living beings to one another and to the physical environment, which is held by people in relatively non-technological societies with a direct dependence upon local resources."

(Berkes et al. 2000)

"Traditional ecological knowledge is not unique to Native American culture but exists all over the world, independent of ethnicity. It is born of long intimacy and attentiveness to a homeland and can arise wherever people are materially and spiritually integrated with their landscape."

(Kimmerer 2000)

Mainly these definitions prove that the native knowledge is a strong tool to identify the novel scientific themes. Because of these comparisons of the TEK and SEK, most of the scientists try to distinguish these topics. Traditional knowledge has much in common with scientific ecological knowledge (SEK), which is not surprising since both traditions derive from the same source: systematic observations of nature. Both knowledge systems yield detailed empirical information of natural phenomena and relationships among the ecosystem components. Both SEK and TEK have predictive power, and in both

ISBN ISBN 978-967-2216-76-6

intellectual traditions, observations are interpreted within a particular cultural context. TEK is being recognized as having equal status with scientific knowledge (UNEP 1998). Berkes et al. (2000) has mentioned that there are 9 differentiations among the TEK and the SEK as indicates in Table 1.

Traditional knowledge encompasses a wide range of biological information, which overlaps significantly with the content of a mainstream course in ecology or conservation biology. The scope of traditional ecological knowledge includes detailed empirical knowledge of population biology, resource assessment and monitoring, successional dynamics, patterns of fluctuation in climate and resources, species interactions, ethno taxonomy, sustainable harvesting and adaptive management and manipulation of disturbance regimes Berkes *et al.* (2000).

Table 1: Differentiations among the TEK and the SEK as categorized by Berkes *et al.* 2000

Traditional Ecological Knowledge	**Scientific Ecological Knowledge**
Mainly qualitative.	Mainly quantitative.
Possesses an intuitive component.	Purely rational.
Holistic.	Reductionist.
Mind and matter are considered together.	A separation of mind and matter.
Moral.	Supposedly value-free.
Spiritual.	Mechanistic.
Based on empirical observations and accumulation of facts by trial-and-error.	Based on experimentation and systematic deliberate accumulation of fact.
Based on data generated by resource users themselves.	Based on data generated by a specialized cadre of researchers.
Based on diachronic data, i.e., long time-series on information on one locality.	Based on synchronic data, i.e., short time-series over a large area.

Source: Berkes *et al*. 2000

Characteristics of Traditional Ecological Knowledge

Characteristics of traditional ecological knowledge (TEK) have been investigated by many researchers and the following paragraph has summarized the main characteristics and how those characteristics have been explained.

TEK adopts a more holistic approach, and does not separate observations into different disciplines as does western science (Mazzocchi, 2006). Moreover, according to the Freeman (1992) TEK systems do not interpret reality on the basis of a direct cause and effect, but rather as a world made up of complex web of interactions. Some of these TEK are based on their religion and even based on super natural incidents as well. These quantities may not be able to either measure or compare or even these may not be tangible (Sharma & Pegu, 2011). According to Somasundara (2006) TEK is mainly based on cognitive, ideational and social environments.

According to Clarkson et al. (1992); Berkes et al. (2000); Doubleday (1993); Tyler (1993); Wavey (1993); Mitchell (1994), other common characteristics of traditional ecological knowledge are as follows;

- Knowledge is gained through intimate contact with the local environment, while noting patterns or trends in its flora, fauna and natural phenomena. It is based on data collected by resource users through observation and hands-on experience referred to as qualitative.
- Knowledge is transmitted by oral tradition.

- Social context that sees the world in terms of social and spiritual relations among all life forms which manifests that all parts of the natural world are infused with spirit. Mind, matter and spirit are perceived as inseparable referred to as spiritual.
- Promote balance and harmony between the well-being of the individual and the well-being of the social group referred to as mutual well-being, reciprocity and cooperation.
- Views time and processes as cyclical refers as non-linearity.

According to the above statements, the holistic view or approach compared to cause and effect view can be identified as the main characteristic of Traditional Knowledge. Also it has been identified as this knowledge cannot be measured or compared with current scientific methods. The qualitative, nonlinearity, spiritual and mutual well-being, reciprocity and cooperation can be identified as the key significant characteristics. Although the above characteristics have directed traditional knowledge towards more of practical knowledge, it is not possible to simply reduce TEK to practical knowledge that is exclusively based on experience as opposed to theoretical knowledge, which is developed through deductive or inductive reasoning.

Ecological Restoration

This refers to the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed. Although the idea of ecological restoration is introduced as a field of Biology in 1980, it is being practiced by community over thousands of years. This has strong linkage with TEK as well. Most of the TEK on agriculture focuses on agro productivity coined with ecological balance and restoration. Ecological restoration is mainly based on approaches of Sustainable Ecology, Cultural Ecology and Sustainable Adaptation Ecology. Restoring or recovering the damaged, degraded or disturbed environmental systems without compromising sustainability of human kind and ecological balance of the environment can be defined as Ecological restoration (Douterlungne et al.,2010).

In most of sustainable development projects, environmental conservation projects, the requirement of sustainable interrelationship between human and environment which arises from the ecological restoration is a vital fact and it is necessary to enforce rules or mechanisms to secure it.

The above concept of ecological restoration can be stated in five steps.

i. Understanding the ecological system.
ii. Understating the ecological process.
iii. Identifying the disturbances and damages of the ecological system.
iv. Restoration of ecological system caused by the above disturbances or damages.
v. Adapting to the restored ecological system.

Restoration of endangered species types, restoration or conservation of bio-diverse eco systems and restoration of cultural or environmental habitats are few common examples for ecological restoration. Among these ecological restoration & sustainability concepts, the restoration of agricultural systems and ecosystems which falls under restoration of cultural or environmental habitats becomes a higher priority due to direct relationship of agriculture and in human sustainability. With regard to agricultural ecological restoration, following methods are widely used around the world for various restoration processes.

i. Reforestation and re-vegetation to minimize soil erosion.
ii. Day lighting streams.

ISBN ISBN 978-967-2216-76-6

iii. Remove of non-native species and weeds.
iv. Reintroduction of native species.
v. Habitats and range improvement for targeted species.

Uprety et al. (2012) believes that the ER mainly depends on two approaches: scientific approach and multidisciplinary approach. Scientific approach mainly coordinates with scientific subjects including Biology and Geology, Chemistry, Climatology, Soil Science, etc. Social, cultural, physical and spiritual contexts are the key areas which will coordinate the ecological restoration under the Multidisciplinary approach. It tries to coordinate cultural and social environment with physical environmental conditions and spiritual contexts of a society for ecological restoration. TEK for ecological restoration is a vast area which comes under this multidisciplinary approach.

Localization, ethical consideration and adaptation are three main arguments which have been stated by scholars about usability of TEK. Those arguments give an important idea about the method which can be used to overlap the scientific system of ER and the TEK. According to localization argument, some of the scientists have different opinion due to inherited nature of TEK. Since TEK is not fully scientifically sounded or understandable, some of the scholars have been skeptical about the usability of this knowledge beyond limited region (Hobbs & Harris, 2001). According to Mazzocchi (2006), TEK contains mysterious rituals, beliefs, folk tales, etc. which are hard to justify with modern scientific methods and indistinct information available about the origin of this knowledge questions many methods of traditional knowledge.

According to ethical consideration, many scholars concern on the ethic of exploiting or exploring these culturally related things for the academic or policy purposes. Bell et al. (1997) believes that by investigating, verifying or challenging their cultural identities, landmarks will harm or disrupt their cultural sustainability. They propose to conserve the TEK.

According to the adaptation argument, scholars have stated that science is not a medium which can fully understand the TEK. They believe that understanding of TEK should be based on the perception of traditional people. This concept has been used to understand the usability and the outcome of the TEK. In their study, they have used this adaptive method to identify the keystone species in Canada. As mentioned above, though there are peeks and falls in use of TEK, it is important to account TEK for better ER and investigate TEK without harming or disrupting the culture which it resides. When considering the name “TEK”, although there are some differences in the terms, indigenous knowledge, traditional ecological knowledge, traditional ecological knowledge and wisdom, traditional environmental knowledge, local ecological knowledge, etc. They refer to the same context in many materials (Hobbs & Norton, 1996).

Understanding limits of the modern science and how TEK can extend those limits is important. This can be explained in two ways. The modern science or scientific method requires practical experiences or incidents to construct a hypotheses or model. Since these experiences or incidents are rarely constructed in lab environment, scientists mainly rely on investigated phenomenon observed by real world. Though modern science evolves continuously, it requires above phenomena or observations to expand its limits. Since TEK contains enormous amount of observations, mechanisms and methods, this gives rise to new models, hypotheses, etc. for modern science (Mazzocchi, 2006).

As of the second point, due to inheriting nature of the TEK, the mechanisms and methods contained in

it had been evolved for centuries and due to these iterative processes TEK consists of previously gathered ecological data by providing concordant and additional information at a finer geographic scale than scientific data. The limited ability of modern science to deal effectively with environmental issues of increasing magnitude and complexity can be comprehended much easily with above data (Mazzocchi, 2006).

In 1980, Restoration ecology has been introduced as the scientific study for supporting ER practices. Restoration ecology is also introduced as the academic study of the process of ER. This concept mainly comes under conservation biology and it aligns with scientific study protecting and restoring bio-diversity. Some researchers believe that restoration ecology provides effective conceptual and practical tools for restoration of ecosystems (Hobbs & Harris, 1996). They argue that restoration ecology has to be an integral component of land management as well. Apart from the common theme of "scientific study", some of the researchers have explored on various other fields where there are interconnections between restoration ecology such as landscape ecology and cultural ecology, etc. (Bell et al., 1997).

Although many researchers have taken various paths, almost all the researches are based on two fundamental concepts, which are namely "ecosystem health" and "ecosystem integrity" (SER, 2002). The four main key processes categorized by Hobbs & Nortan (1996) are as follows;

i. Identifying and dealing with the processes leading to degradation,
ii. Determining realistic goals and measures of success,
iii. Developing methods for implementing the goals and incorporating them into land-management and planning strategies and
iv. Monitoring the restoration and assessing its success.

Goals of Ecological Restoration

This can be linked with the above-mentioned restoration ecology; that these goals can be identified as the conceptual goals derived from restoration ecology models. When the ER goals are considered, many researches and organizations have identified various goals which cover many aspects of the ecosystems. They are,

i. Improvement of biological diversity in degraded landscapes,
ii. Increment of the population levels and widening the distribution of rare and threatened species,
iii. Enhancement of landscape connectivity,
iv. Increasing the availability of environmental goods and services, and contribution to the improvement of human well-being

These are considered as the key goals (SERI & IUCN, 2004). As shown in Figure 01, for a successful ecological restoration there should be a combination of economic, environmental and social sustainability.

ISBN ISBN 978-967-2216-76-6

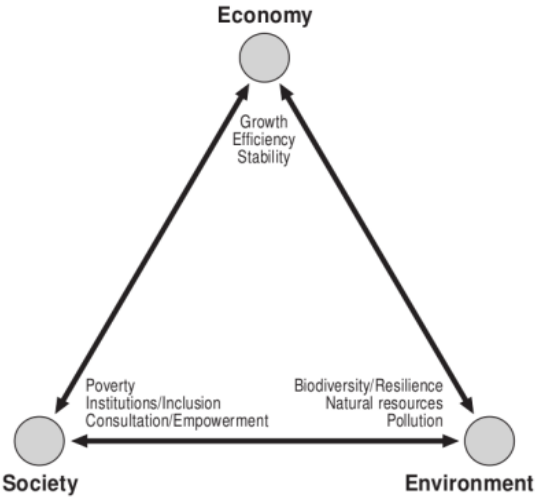

Figure 1: The relationship between social, economic and environmental sustainability (adapted from Jepma & Munasinghe, 1998)

As a single rigid goal of ER, the return of an ecosystem to its pre-disturbance state could be identified and it is believed that the knowledge of historic conditions is the starting point of restoration design (Kimmerer, 2000; Egan & Howell, 2001; Lamb et al., 2005)..

Reference Eco-system

In ER, it is important to understand how restoration ecologists measure their success and how they identify the degraded ecosystems. Both of the above ideas need a reference eco system, which can give a basic reference to an ideal ecosystem. Determination of reference conditions or reference ecosystem becomes the central component of ER (Higgs, 1997). The reference ecosystem provides a model to follow and is also used as a standard for evaluation and monitoring (Meffee & Carroll, 1994). Finding a reference ecosystem can be done either by a predictive basis or a historical basis. Predictive basis is mainly based on scientific methodologies dealing with concepts of sustainability. Although predictive basis methodologies are more aligned with ER scientific approach for constructing reference ecosystems, TEK and historical information play vital roles in the determination of the reference eco system for both methods. In this study, a concept of reference eco system will be examined in respective villages and TEK will be the main factor which is going to be utilized for construction of reference eco system.

An ecosystem is mainly based on the composition of existing animal species, forestry and landscape. Many ecologists believe that the site selection for restoration plantation is as important as species selection (Shebitz, 2005). According to Higgs et al. (2014), a model of temporal and spatial scales encompassed by historical-ecology data can be described as follows.

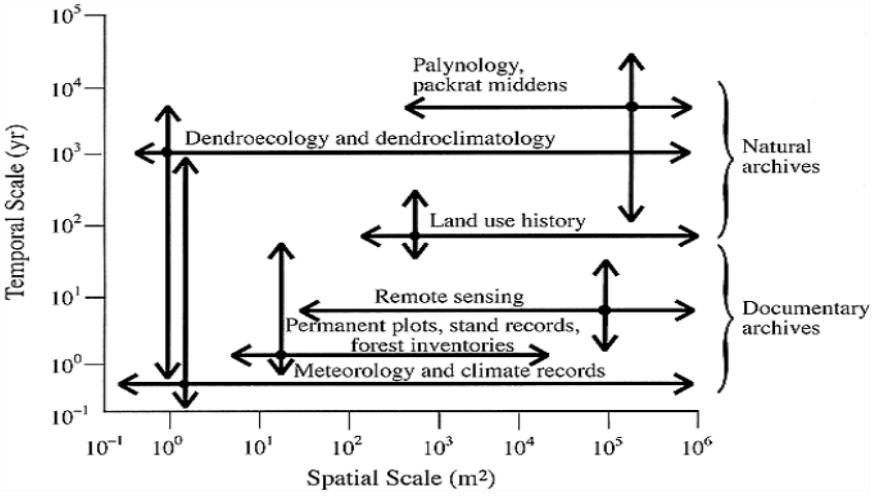

Figure 2: Model of temporal and spatial scales encompassed by historical-ecology data (Higgs et al., 2014)

According to Higgs et al. (2014), this study prefers to refer documentary archives for deriving historical information and knowledge for the reference eco system.

Relevance of History to Restoration Ecology

As mentioned in reference ecosystem selection, the history of the region gives a basic overview of the native species, landscape and cultural identities. Various sources of historical feature events and incidents reveal future of the regional landscape, cultural characteristics, environmental conditions, climatic information, etc. Identifying this information and knowledge gained from it can be used for several aspects of ER. Accordingly, history as information and reference, history as enriching cultural connections and history as revealing the future are identified as some guidelines for ER (Higgs *et al.*, 2014).

As information and reference, it is directly related to the classical ER definition "ecological restoration attempts to return an ecosystem to its historic trajectory" (Society for Ecological Restoration, 2004).Word historic trajectory gives the meaning of past state of the ecosystem. This is directly linked with historical information and reference with regard to the time-line of the region.

Historical knowledge strongly reinforces the sense of history as place. Glassberg (2001) introduce the second aspect of history as an enriching cultural connection. The knowledge of history not only produces maps of land use, but also what people actually did on the land, what they thought about it and how they coped with crises. A critical connection to that landscape (Allen, 2002) gives a holistic view of an ideal ecosystem which can be referred as a reference eco system.

With regard to history as revealing the future, an unexpected outcome of identifying different kinds of historical knowledge can be used to reveal potential future conditions of the eco system. Historical studies can help make predictions based on similar occurrences and give guidelines for cautious steps that need be taken.

Concepts of Ecological Restoration in Traditional Ecological knowledge

Although there is some overlap between ER and Traditional Ecological Knowledge, they are basically two different fields. ER has been one of the most important topics in environmental science since 80s. Restoration ecology, goals of ER, reference eco system, relevance of history in ER and restoration vs.

ISBN ISBN 978-967-2216-76-6

rehabilitation can be found as the most important concepts in the context of ER in this research. Measuring ER using traditional ecological knowledge, localization and validation of traditional ecological knowledge, are the mainly focused concepts in TEK.

Relating traditional ecological knowledge to ecological restoration

TEK is defined as a cumulative body of knowledge, practice and belief that evolves by adaptive processes and handed down through generations by cultural transmission, and centers on the relationships of humans with one another and with their environment (Berkes *et al.* 2000). Examples of TEK include: impacts of historical land loss on affected communities, changes in flora and fauna, natural resource use and degradation of those resources over time, a history of man-made structures and impacts on the ecosystem and community and the identification of priority areas of community significance or concern. A substantial body of TEK exists in traditional communities, particularly in the traditional groups that have historically lived in their own forests and made their living directly from the ecosystem services offered by those forests. That source of information is virtually unused in the restoration planning process. There are evidences that restoration managers and scientists have started to recognize the value of incorporating TEK into ER.

Measuring Ecological Restoration using Traditional Ecological Knowledge

TEK has been found to be an effective and efficient method for the monitoring and assessment of restoration projects (Monela *et al.*, 2004). Most traditional monitoring methods used by indigenous cultures are rapid, low-cost and easily comprehensible (Moller *et al.*, 2004). Monitoring resource status is a common practice among many indigenous or traditional people, and it is often accompanied by the monitoring of ecosystem changes (Berkes, *et al.* 2000). Local people observe day-to-day changes and are among the first to notice if resources are no longer readily available (Berkes *et al.*, 2000). Potential value of TEK for the management of natural resources was identified by several organizations that are in belief that it might be useful in conservation of education as well as in development planning and environmental assessment (World Conservation Union, 1986).

Traditional ecological knowledge based monitoring methods are useful in ecosystem monitoring and timely planning resource allocations and reinforcements, before resource reaches a critical level. In particular, TEK can provide information about the spatial and temporal distribution, composition,health, condition and behavior of many species and the factors that affect them (Stevenson, 2005). It can also provide information about the trajectory of the restoration, disturbance factors and further interventions, if necessary, at low cost and with little delay. Monitoring not only enables ecological bodies to determine if the objectives of the restoration are being met, it also provides information on the capacity of the restored ecosystem to supply desired goods and services to the local people.

In this research, the concept of measuring ecological restoration using traditional ecological knowledge will be employed and agricultural TEK monitoring systems of the Knuckles region will be examined.

Localization

When considering TEK, it is important to understand that ecological knowledge may be localized in specific areas or regions. The validity or the methods may only work relevant to the area or regions. This concept should be incorporated in this study to investigate TEK methods relevant to different ecological conditions to derive effective TEK related ER.

Validation of Traditional Knowledge

Cultures from all over the world have developed different views on nature throughout human history.

Many of them are rooted in traditional systems of beliefs, which indigenous people use to understand and interpret their biophysical environment (Iaccarino, 2003). It is not possible to simply reduce them to practical knowledge that is exclusively based on experience as opposed to theoretical knowledge, which is developed through deductive or inductive reasoning.

Western science is deeply rooted both in the philosophy of Ancient Greece and the Renaissance, and TEK systems have radically developed different strategies to create and transmit knowledge. Most of the scientists believe that, it is exceedingly difficult to analyze one form of knowledge using the criteria of another tradition (Mazzocchi,2006).

Scientific method favors analytical and reductive methods as opposed to the more intuitive and holistic view often found in TEK. Western science is seen as positivist and materialist in contrast to TEK, which is spiritual and does not make distinctions between empirical and sacred (Nakashima & Roue, 2002). Furthermore, Western science is objective and quantitative as opposed to TEK, which is mainly subjective and qualitative. Western science usually isolates its objects of study from their vital context by putting them in simplified and controllable experimental environments which also means that scientists separate themselves from nature, the object of their studies; by contrast, TEK always depends on its context and particular local conditions (Nakashima & Roué, 2002).TEK systems do not interpret reality on the basis of a linear conception of cause and effect, but rather as a world made up of constantly forming multidimensional cycles in which all elements are part of an entangled and complex web of interactions (Freeman, 1992).

From the above brief comparison, it gives an understanding of how hard it is to compare the two systems of knowledge that are so profoundly different. Trying to analyze and validate TEK systems by using scientific criteria carries the risk of distorting such systems in the process. At the same time, scientists or valuators cannot extract just those parts of TEK that seem to measure up to scientific criteria and ignore the rest.

TEK seems to be better suited to cope with the uncertainty and unpredictability that are viewed as intrinsic characteristics of natural systems. Western science and TEK constitute different paths to knowledge, but they are rooted in the same reality.

This indicates that, though verification and validation of TEK is tedious, the concepts and ideas of TEK can be useful for the humankind. Traditional ecological knowledge that comes in many forms such as rituals, folk tales, gossips, etc. can be a good source for gaining new insights and ideas for real life problems. In this study, TEK can be validated using traditional methods which have been identified by the people who have been living there for many years.

Application of Ecological Restoration using Traditional Knowledge: South Asian Experience

As the third part of this chapter, application of ER using traditional ecological knowledge is discussed. As mentioned in part two, it is known that TEK can be used in ER assessment, site selection, identifying key stakeholders of the eco system, etc.

The researches which have been carried out relevant to this study have been described below. The South Asian region has more similarities with Sri Lanka in both environmental and cultural aspects and it is believed that it might have some similar characteristics which may have good resources for the study. Acording to Ghimier *et al*. (2008), Himalayan medicinal plants are threatened by over-harvesting for trade. They have analyzed the effects of harvesting patterns on the population ecology of two highly endangered Himalayan medicinal plants, *Nardostachys grandiflora* (Valerianaceae) and *Neopicrorhiza*

ISBN ISBN 978-967-2216-76-6

scrophulariiflora (Scrophulariaceae) in Shey-Phoksundo National Park and in its buffer zone in North-Western Nepal. They have first recognized local harvesting approaches of two main user groups: *amchi* (traditional doctors trained in Tibetan medicine), who harvest plants in a selective manner for local health care purposes, and commercial collectors, who harvest at much higher intensity for trade. Grimier et al. have applied the selective harvesting approach of *amchi* in an experiment to test the effects of different harvesting levels on the population ecology of two species. In this sector, Rotation harvesting method applied by local people was investigated by the scholars.

Traditional knowledge about harvesting and the sustainable usage of the land has been mainly considered by Ghimier *et al*. (2008) According to TEK rotation, harvesting provides enough time to restore population in old harvested sites. Their experiments revealed a positive effect of low harvesting levels on plant density, but recruitment and survival rates decreased with the increasing harvesting levels. They also analyzed the effect of high harvesting pressure for trade on the population ecology of *N. grandiflora*. Recruitment and survival rates were higher in *N. scrophulariiflora* than in *N. grandiflora*; the latter species is more vulnerable to harvesting than the former. The difference between them in sustainability of harvest is related to differences in their strategies of vegetative reproduction and in harvesting practices associated with these strategies. According to Ghimier *et al.* (2008), management of Himalayan medicinal plants can be improved by taking harvesting patterns, plant life forms and growth patterns into consideration. This research has mentioned that TEK harvesting methods are more sustainable than the new methods and they have subjected that TEK methods can be used for ecological restoration in the Himalayan region.

Another research carried out by Ramakrishnan (2007) on Traditional Soil Fertility Restoration Practices was used to restore soil fertility from erosion or leaching. In this study Ramakrishnan tried to come up with forest management techniques to restore forest ecology by combining modern conservation mechanisms with traditional knowledge gathered by forest inhabitants.

Traditional Knowledge Practices in Sri Lanka

TEK had been developed with the civilization of Sri Lanka. When analyzing TEK, it is important to consider the evolution of local civilization. As started in, Indian and local literature from the era of king "Ravana ", it is believed that a unique knowledge had been existed and it had been passed down from one generation to another (Ananda & Nahallage, 2014; ,Knighton, 2013).

Along with the "Mahindagamanaya" in 250 BC, this unique knowledge had been re-engineered and left with many rituals embraced with Buddhist philosophy. Not only that, due to strategic location of the island in the world such as being in the silk root, several knowledge channels from western to eastern had been shared among the natives. Since this mixing of knowledge happened in localized manner, the enhancements of local TEK took a regional-based differentiation. Coastal area (Amarasinghe et al.,1997), dry land (Ulluwishewa, 1991,1995) and highland area or the hill areas (Daskon&Binns, 2009) had been identified as the main regions which had their own knowledge systems and practices.

Among all those TEK systems and practices, agricultural knowledge (Ulluwishewa, 1991,1995; Ananda & Nahallage, 2013), irrigation technologies (Geekiyanage & Pushpakumara, 2013), traditional medication, architectural knowledge and mathematical knowledge were functioned up to 15th century. Remaining of ancient tank systems, ancient irrigation systems, remnants of buildings and other equipment recovered in archaeological sites are proofs for the vast TEK systems existed in Sri Lanka. In the present study, the main interest in on TEK or traditional ecological knowledge relating to agricultural practices. There can be two main types of knowledge or practice types in agriculture; i)

Physical knowledge and ii) Arcane knowledge. Physical knowledge includes all knowledge based on precipitation, nature of the soil structure, topography and species diversity.

The physical knowledge is separated as knowledge of pre-irrigation era and knowledge of post-irrigation era. The pre-irrigation knowledge had been long lost and the remaining parts are integrated to post-irrigation knowledge with enhancements.

Irrigation technology can be considered as the major turning point in ecological knowledge in agriculture where it organized knowledge in systematic manner and gave an opportunity to enhance the knowledge over the iterations. The tank technology, dam building mechanisms, canal systems and water management are the major knowledge parts. Harvesting of large areas of dry land with limited amount of water is one of the best examples showing how productive those traditional water management techniques were (Geekiyanage & Pushpakumara, 2013).“Bethma” method, “Kekulan” method (Upawansa, 1997)“Pangu” method,etc. are some other examples for the existence of physical agricultural TEK in SriLanka (Karunaratne&Herath, 1989, Wills-Johnson, 2004).

Each of these methods has unique way of managing water and land quality. Bethma method used tank water for paddy fields which led to optimize the usage of seasonal rain water, where excess water in rainy season was stored and utilized in dry season. This ensures continuous harvesting as well as eco system protection in dry season. Alternative plantation of rice and gathering is known as Kekulan method and Karunaratne & Herath (1989) believed that Kakulan ensured the quality of soil through adding micro nutrients to the soil system.

Traditional agricultural knowledge not only focused on harvesting, but also there are many evidences for using this knowledge in land use techniques, water management techniques and bio- diversity maintenance techniques that enhanced the eco system continuity and possesses (Geekiyanage & Pushpakumara, 2013).
Some scientists believe that Sri Lankan TEK had a spiritual philosophy (Dharmasena, 2010). The Sri Lankan agri-technology can be described in three extensive processes:bio-agriculture (physical structure of plantation, maintenance and harvesting), socio-cultural process and spiritual philosophy (Senaviratne, 2001).

Traditional native farmers maintained sustainability via eco system continuity and ecological balance. The key concepts of TEK can be identified as working with the eco system and utilization of agricultural methods/environmental strategies which were parallel and compelled with existing ecosystem. Traditional people have identified over the generations, that practicing of eco system friendly strategies and methods prevents environmental issues such as disasters and hazards (Geekiyanage & Pushpakumara, 2013, Ulluwishewa, 1991).

According to Senaviratne (2001), Sri Lankan traditional farmers’ spiritual philosophy can be explained in three categories: astrology or constellation based spiritual philosophy, god and spirits based spiritual philosophy and charms, spells, amulet and symbols or emblems based philosophy.

In TEK, influence to the eco system by astrological objects such as solar systems, constellation, etc. has been described by astrology. In traditional agricultural practices from seed plantation to harvesting, almost all the main activities were identified as auspicious activities and all of them were commenced according to astrology. According to Jayaratne (1997), native Sri Lankans had enormous unique knowledge on astronomy and it provided the base and accuracy for the above astrological activities.

ISBN ISBN 978-967-2216-76-6

The incidents that could not be explained by general perceptions were explained using god and spirit concepts. The concepts of "Gopaludevi" (God supreme to cows) and "Gopalu yaksha" (Demon supreme to cows) are examples for those and some of the scientists believe that those "hyper-physical" activities may have some truth that the modern science could not explained yet. Traditional folks believed that worshiping gods' statues, shrines and sacrifices or offerings to gods were the basic methods to overcome those hyper-physical activities or to get favors (Kariyawasam, 1986) from those activities. "Muttinemema" ceremony is one of the best examples that can be seen even in modern days.

For charms, spells and amulets, "pirith" was used and these kinds of traditional habits are still functioning in rural areas. In Agricultural activities, amulets and "kem" methods are used and most of these methods are based on gods or spirits. Amulets are basically worn as a protection mechanism and for agricultural lands; these amulets are hidden in each corner of the lands. Sometimes it symbolizes the binding of some sort of spirits to the amulet and for each of these charms it contains unique regulations for the user and once the regulations are violated it is believed that the power of the charm or amulet will be weakening (Senaviratne, 2001).

Spells are mainly based on vocal patterns, rhythms and verbal patterns. It is believed that those rhythms and patterns contain special powers. The wild elephants controlling spells can be introduced as one of the best examples for these kinds of spells which contain such a rhythm and pattern.

Conclusion

TEK can be used as solutions for most ecological issues emerged in the recent decade. The process of preventing the environmental pollution and environmental degradation in order to reinstate the ecological system which is defined as the Ecological Restoration Process is considered as a scientific concept as well as a discipline of applied sciences in the contemporary era on the basis of such ecological issues. This article analyzed the application of Traditional Ecological Knowledge in restoring the degraded ecological systems sustainably with reference to recent researches. The compositions of those concepts, experience of the Asian region and differences in the application of them in Sri Lankan context have been mainly focused in this study. Sustainable ecological restoration methodologies are mostly explicit in the traditional knowledge of Sri Lanka and South Asia which claim to have the highest bio-diversity and a cultural history while there is a possibility of minimizing the environmental degradation and restoring the degraded ecological systems through using those methodologies under a scientific and culturally flexible perspective.

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