BIOLOGICAL INDICATORS USED FOR FORECASTING

AND THEIR ASSOCIATION WITH

FOLK LORE AND MYTHS IN SRI LANKA

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Contents

Abstract

Background

Fauna and flora respond to different environmental conditions in different ways. Come animals and plants show behavioral change indicating changes of the climatic conditions and even disasters. For example, ants respond to forthcoming rain by carrying their eggs to high ground. Such biological indicators are used to assess subtle or dramatic changes in the environment whereby leaving room for remedial action for corrective adaptation. Such knowledge was embedded in traditions, myths and folk lore. In the process of modernization, such practices are given less recognition and are hence replaced by rather young technologies that are not time tested. Conducting a research on biological indicators of nature and how they are associated with the folk lore and myths can be considered as an important area that could be explored to benefit mankind in the future. Therefore a qualitative study was conducted in all nine provinces of Sri Lanka as a pilot effort. Triangulation of findings was done along with inputs from academics.

The problem

What are the existing biological indicators that are used in Sri Lanka?

What are the folk lore and traditions associated with such biological indicators?

What scientific reasoning can be given for currently used biological indicators?

Research design and methodology

Primary data was collected through conducting a series of interviews with 900 key informants in all nine provinces of Sri Lanka using a snowball sampling method on the existing areas that fall under biological indicators so that the information captured would include regional interpretations and translations in beliefs, folk lore and myths related to biological indicators. Supplementary secondary data was also collected using published and unpublished literature.

Expected results

A collection of biological indicators in Sri Lanka will be made available as a handbook. The hand book will include the biological indicator, folk lore associated with the biological indicators and possible scientific explanations to such beliefs.

1. Introduction

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Look for omens Than Auspicious Time – Salalihini Sandeshaya

The careful and scientific study of fauna and flora's response to environmental stresses is called the study of biological indicators (Wikipedia 2012). This means of scientific study is conducted as different species respond to different environmental conditions in different ways. While it is a common practice to microscopic species as biological indicators in laboratory testing (Zillioux, E. J. 2009), mega flora and mega fauna are used by environmentalists to analyze the changes of the climatic conditions, environmental quality and even disasters (Weerakoon and Seneviratne 2010). Even though such indicator species are being used in modern day science, the people in the olden day used biological indicators for forecasting climatic conditions to disasters to good and bad omens as well as auspicious and inauspicious times along with the use of ecological indicators and astrology. In an age where there were no sophisticated equipment to forecast the oncoming weather, farmers and fishermen had to rely on messages given by animals to take evasive action where necessary and to prepare themselves in advance.

For example, ants respond to forthcoming rain by carrying their eggs to high ground. Such biological indicators are used to assess subtle or dramatic changes in the environment whereby leaving room for remedial action for corrective adaptation. Such knowledge was embedded in traditions, myths and folk lore and was passed from generation to generation.

Such traditional knowledge embedded in folk lore and myths carry information that was applicable to the yester year as well as to the present day context. However, under the context of modernization such traditional knowledge is considered primitive and is disregarded, hence paving the way for disuse and ultimate extinction of rich cultural values. Through this process of disusing traditional knowledge on the identification and using appropriately the biological indicators, the present generations have become highly dependent on the electronic and telecommunication devices as well as systems for forecasting.

The increased dependence on the sophisticated forecasting mechanisms has at times proved unreliable and have become invalid. For example, the 2004 Tsunami disaster was approaching the South Asian shores following a large earthquake in Sumatra and the technology could not prevent destruction and loss of human life. However, the natives in the Andaman Islands (cultural survival, 2010) who were relatively less expose to sophisticated forecasting methods were highly reliant on the biological and ecological indicators that ultimately came for their rescue and resulted in low number of casualties. Similarly the 2011 earthquake in Fukushima, Japan proved how even the most sophisticated forecasting sciences could be unreliable hence highlighting the importance of having alternatives to technology for disaster forecasting. Therefore, biological and ecological indicators as a means of forecasting rain, drought, climate change, fortune and doom still has a value for its niche for human wellbeing.

Due to a century of gradual disuse, traditional knowledge on biological and ecological indicators is left only among a minority of people mainly in the less urbanized areas of the countries that share similar socio-economic settings that too confined to the older generation. This scenario on the other hand sounds alarm on the possibility of losing all relevant knowledge within the next few decades. Therefore, it is important to collect information on the biological indicators still practiced by people and the ones that are not practiced, but are remembered by the existing members of the communities. Producing literature and preserving such knowledge for the generations to come would be a worthy cause. It would pave the way for further scientific research and creating interest among the public to preserve such valuable practices that could even come as a life saver but are on most occasions merely discarded as superstition. Value addition of such practices would be possible through providing scientific justifications for folk lore and associated traditional practices of concern.

Research Questions

1. What are the existing biological indicators that are used in Sri Lanka?
2. What are the folk lore and traditions associated with such biological indicators?
3. What scientific reasoning can be given for currently used biological indicators?

Research Objective

To initiate such an activity at the regional or global level, it is important to check the feasibility of collecting such information at a smaller scale. Therefore, **"collecting information on the diminishing knowledge on biological indicators and how such information is incorporated in the folk lore and myths"** was carried out in Sri Lanka as a pilot project.

Research Method

This was a qualitative study that used a snow ball method of sampling to interview key informants in all nine provinces of Sri Lanka (100 interviews from each Province) using an interview guide. Literature depicting biological indicators was referred to supplement the information collected. Further refinement of the scientific explanations of folk lore and beliefs was done where possible. The midterm review provided guidance and enhanced the conceptual framework, academic quality and appropriateness of findings.

Research Outcome

4. A ***collection of biological indicators*** in Sri Lanka is made available.
5. It will include the biological indicator, folk lore associated with the biological indicators and possible scientific explanations to such beliefs.

2. Literature review

As described in the introductory chapter, biological indicators have been used since the ancient past and is still being used by traditional primary sector communities as well as scientists. In this study's conceptual framework, three major terms are used.

6. **Biological Indicators**: Are species used to monitor the health of an environment or ecosystem.
7. **Folklore**: The traditional beliefs, practices, customs, stories, jokes, songs (etc.) of a people, handed down orally or behaviorally from individual to individual.
8. **Myths**: A traditional story, especially one concerning the early history of a people or explaining a natural or social phenomenon, and typically involving supernatural beings or events

Apart from the current study, many research have taken place elsewhere in the world on the use of biological indicators to predict environmental change. For example environmental health monitoring use biological indicators that involve DNA sequence screening to monitor pollutant level in the environment (Ambio, 1989).

In general although there are studies that use biological indicators, there are not many studies taken up on biological indicators. Considering that the South Asian countries have rich and vibrant histories and traditional knowledge embedded in cultures for thousands of years, it highlights the importance of the area.

Megha Patala Shasthra (unpublished ancient writings of which authors are unknown) literally meaning Cloud Science was an accepted science in the past with South Asian Origins which was another science like Koopa Shasthra (unpublished ancient writings of which authors are unknown) which was a science related to springs and wells.

Sri Lanka's cultural practices and traditions have come under the greatest influence of Buddhist principles and perspectives. There are major areas that are relevant to justify the case of

biological indicators and to broadly examine the bonds that humans have with nature. The following scripts can be cited through the analysis of Buddhist literature.

In Pali language "nature" is everything in the universe. Nature is described as *loka* (world) and *yathabhuta* (things as they really are). *Niyama dhamma* is the natural law which one cannot escape from. *Anichcha* is the simple term given to explain the phenomenon of impermanence. *Sabbe sankhara anicca* (Anguttara Nikaya) and the phenomenon of continuous disintegration and changing nature or in Pali language, *lujjati ti loko* (Samyuktha Nikaya). Unlike in the science according to Western philosophy, the Buddhist teachings explain that the composite matter is formed through solidity *(pathavi),* liquidity *(apo),* heat *(tejo)* and mobility *(vayo),* building blocks of nature. Buddhism recognizes the lengthy process of evolution and dissolution and also recognizes that it would be man's greed that will be self destructive. It is explained in Anguttara Nikaya that According to a discourse in the Anguttara Nikaya, when immorality becomes widespread in society, timely rain will not fall and will lead to crop failure, pest intrusion and plant diseases.

This process is analyzed and theorized as five natural laws, *pañca niyama dhamma*. Out of the five natural laws, namely *utu niyama* (physical laws) and *bija niyama* (biological laws) provides a description as to how natural processes are inter-connected to one another. However, one cannot rule out the impact of *citta niyama* (psychological laws), *kammaniyama* (moral laws) and *dhammaniyama* (causal laws) as the five laws are inter-connected. (Atthasalini)

Therefore, when immorality is widespread, quality of man and nature deteriorate and vice versa. The analysis directs us to the concept of *cittena niyati loko* (world is led by mind) where man and nature are interdependent (Samyuktha Nikaya). *Sigalovada Sutta* explains how one should accumulate wealth as a bee collects honey and pollen from a flower without harming neither the beauty nor the fragrance of the flower (Deegha Nikaya).

Further, in *Macchuddana Jatakaya* the Bodhisatwa disposes leftover food into a river to feed fish. It is explained that the merit he accumulated through that helped him to be saved from an impending disaster.

Buddhists in Sri Lanka believe in obtaining the blessings of the Buddha, Dhamma and Sangha.

However, *devatas*, *yakkhas*, *prethas*, are considered to be mostly invisible beings that could aid or harm humans and natural processes and harmonize with teachings of Buddhism (i.e. Atanatiya Sutta).

In *Rathana Sutta*, elaborative expression is given on biological and non biological beings that could have an impact on humans.

"Yanidha Bhuthani Samagathani – Bhummani Waya Niva Anthalikkhe- Sabbewa Bhutha Sumana Bhawanthu – Athopi Sakkachcha Sunanthu Bhasithan" (Listen all the evil spirits, who are on the ground and in the sky with pleasure!)

"Thasmahi Bhutha Nisametha Sabbe – Meththan Karotha Manusiya Pajaaya Diwacha Raththocha Haranthiye Balin – Thasmahi ne Rakkhatha Appamaththa"(Listen all the heavenly beings, who have come leaving behind the heavenly comforts to listen to my preaching; take care of the human beings who bring you offerings day & night with compassion). It is an indication as to how the belief system of Sri Lanka acknowledged and accommodated not only the biological systems but also the dimensions not taken into consideration according to the Western form of belief and science.

The Hindu belief system predominantly practiced in the Northern and Eastern parts of the country as well as in some parts of the Central highlands too recognizes the availability of super natural beings that are beyond the visibility or audible range of the human eye and the ear. "*Bhagavat Geeta*" describes the world in terms of a Banyon tree with endless branches represented by animals, plants, demigods together with humans. Hinduism acknowledges three types of forests, *Shrivan*, *Thapovan* and *Mahavana* representing prosperity, spirituality and natural forest hosting species respectively. If there is only one tree full of flowers and fruits in the village, that area becomes a place of worship and respect- Mahabharatha. Similarly throughout Hinduism symbolic expressions have been given to respect and recognize gods and animals associated to them. Shiva's consort Parvati represents the earth. Shiva's vehicle is depicted as a cow. Snakes symbolize the power to heal, guardians, creativity, wisdom, wealth. Vegetarianism is promoted in the Vedas, Upanishads, Dharma Shastras, Yoga Sutras based on the theory of sustaining with earthly resources. Ghanesh is depicted with a head of an elephant,

to represent the memory capacity. Bel tree (*Aegle marmelos)*, is associated with Shiva. *Tulasi* tree with Vishnu, and fig (*Ficus glomerata*) with Dattatreya (the son of Trimurty). Murka god is considered to be found in forests.

Lord Shiva's entangled hair symbolizes the forest. The Ganga originating from tress depicts the watershed. Serpents coiled around the neck symbolize coexistence with the ecosystem. By the trident and leopard skin attire destruction is symbolized. This is followed by an episode of creation through the incorporation of *bhuta*s or principal building blocks of nature which gives rise to sprouts crops, grasses and forests. The necklace of *rudraksha* (*Elaeocarpus* species) on Shiva's neck highlights the links with the forest.

Therefore, the co-existence with nature has always been the principal practiced by a majority of the Sri Lankans for centuries. This way of life was further enhanced and promoted through the Buddhist and Hindu value systems. Therefore, Sri Lanka's have naturally blended with the nature and associated with nature for mutual existence.

Although biological indicators have been used by Sri Lankan's it is neither confined to Sri Lanka or to South Asia. Ancient Greek literature (373BC) indicates how animal behavior changed a few days prior to a great earthquake (Kirschvink and Joseph 2000 as well as Schaal 1988). Earthquake prediction by animals is currently an abundantly studied area. Weerakoon and Seneviratne (2010) have opened the idea of using biological indicators for forecasting in Sri Lanka after they have tried to correlate the occurrence of natural disasters by observing animal behavior in recent years. It is even more important and applicable due to the increase in disasters which cannot be predicted easily. Their study in Matara has observed an entire colony of fruit bats (Sub order Megachiroptera) taking off to the sky approximately 20 – 30 minutes before to the tsunami.

The Farmer's Almanac 2012 describes how observing farmed animals, nature and extent of fog, how fish predict rain, and brings out some of the traditional sayings in the European culture such as "t*rout jump high, when a rain is high", "If the rooster crows on going to bed, you may rise with a watery head"* and *"wind from the West, Fishing's the Best- Wind from the East, Fishing's the least".* In the Alaskan region Rozzel 1996 many descriptions are given on the biological indicators specific to snowy Alaska.

One could argue whether it is scientifically justifiable to unearth the diminishing cultural practices on biological indicators in an era where forecasting is an advanced subject area that has acquired novel technology to its utmost limit. While there are many instances where such technologies have proven failures (Nature 2011) there are many strengths of other life forms in comparison to *Homo sapiens* as a species that could be used appropriately.

The major strength of *Homo sapiens* is its brain capacity that enables it to analyze and think critically. It is reflected through its brain capacity elaborated in Table 1.

Table 1: Comparison of brain capacities of selected species (www.talkorigins.org. 2010)

Animal	Brain capacity (in cubic centimeter)
Neanderthals	1450 cc
Humans	1350 cc
Orangutans	275–500 cc
Chimpanzees	275–500 cc
Gorillas	340–752 cc

However, animals depend heavily on their sensory organs for their survival. For example, Eyes- Light receptors, Ears- Vibration receptors, Nose- Chemicals (Chemo receptors), Tongue- Chemicals (Chemo receptors) and Skin- Mechanical pressure/ heat receptors. With regard to the evolution of sensory organs, Homo sapiens is a species that has less developed sensory organs or have got disused and stunted during the evolutionary process as explained in tables 2-7 (Hauser and Konishi 1999).

Table 2: Visible range of selected animals

Animal	Low Range (nm)	High Range (nm)
Human	390	750
Bee	300	650

Table 3: Eye resolution power of selected animals

Animal	Retinal cell density (cells/sq mm)
Human	100 microns
Butterfly	30 microns

Table 4: Flicker fusion rate of selected animals

Animal	Per second
Human	60/second
Fly	300/second

Table 5: Audible range of selected animals (Wikipedia)

Animal	Low Range (Hz)	High range (Hz)
Human	20	20,000
Dog	40	60,000
Cat	20	120,000
Mouse	1000	70,000
Dolphin	75	150,000
Bat	3000	120,000
Elephant	1	20,000
Moth	1000	240,000
Pigeon	0.1	30,000

Table 6: Olfactory membrane size of selected animals

Animal	Approx size (sq cm)
Human	4
Cat	14
Dog	150

Table 7: Taste buds of selected animals

Animal	Number of taste buds
Human	9,000
Pig	15,000
Rabbit	17,000
Earth worm	Entire body covered with taste buds

In spite of fauna's ability to detect environmental change, flora too have the capacity to respond to light, temperature, wetness or dryness of the environment which could be observed with a trained eye of a human. Further, plants also respond differently to different sounds and do react to pest attacks and communicate with other plants. For example, wounded tomatoes are known to produce the volatile odour methyl-jasmonate as an alarm-signal. Plants in the neighborhood can

then detect the chemical and prepare for the attack by producing chemicals that defend against insects or attract predators. (Cheong and Choi 2003)

According to the Newton's law of universal gravitation, all objects attract each other with a force of gravitational attraction. It applies to all objects (i.e: Sun and Earth/Saturn and Earth/ Moon and Ocean/ Ocean and human and so on.

The bottom line can be drawn as the humans are not alone and since we are a part of the environment we inter- depend. Amidst modernization the humans have lost the ability to communicate with the environment, but our ancestors have communicated with the environment and they have known how to give approximate or exact predictions based on the indications provided by the nature.

Biological indicators that are used to assess subtle or dramatic changes in the environment whereby leaving room for remedial action for corrective adaptation. Observing ***biological and ecological*** indicators have been practiced for millennia. In the process of modernization, such practices are given less recognition and are hence replaced by rather young technologies that are not time tested. It also reiterates the need to rescue falling abilities of people to predict environmental change using indications given by the environment.

3. Methodology

Considering the fact that the study is neither on an opinion nor it is an interview on an individual practice or experience, but a current practice of the community or a practice that has ceased to exist, the study design required capturing of as many interviewees as possible as the failure rate of interviews was expected to be significantly high.

Both males and females falling within the age category above 60 years were chosen as fit candidates to be interviewed considering the fact that it is most likely that remaining traditional knowledge of their generation and their older generations would survive mostly among the senior citizens.

The Districts, Divisions and GN Divisions were selected to capture inputs representing the nine provinces using a convenient sample mainly due to resource constraints as elaborated in Table 8. A snowball method of sampling was used within villages to capture information from informants most likely to have any traditional knowledge. The methodology employed for the study was completely a qualitative one comprising of 900 informal interviews with key informants using an interview guide.

Two Sinhala medium and one Tamil medium enumerators were trained for data collection. Data collection took two and half months to be completed. The enumerators were monitored throughout the process of field data collection through back checks. However, scrutinization checks were not carried out due to the information being totally qualitative and resource constraints.

The major limitations of the study was the lack of ample time and resources to conduct field work. Unlike a conventional interview or discussion, inquiring on traditional knowledge such as information on biological indicators that is in practice or currently disused or extinct, required making aware the respondent of the concept, time to probe, allowing respondents to think, gather recollections of appropriate knowledge and to interpret. This process not only consumed a lot of time, but also resulted in a high rate of irrelevant information.

Table 8: Sample distribution by Province, District, DS Division, Village/ GN Division

Province	**District**	**Division**	**Village/ GN Division**	**No. Interviews**
Western	Kalutara	Panadura	Thanthirimulla	25
			Malamulla	25
Mathugama			Mathugama	25
Kalutara			Katukurunda	25
Southern	Galle	Bentota	Induruva	20
	Matara	Weligama	Mirissa	20
			Kathaluwa	20
Hambantota		Ambalantota	Barawakumbuka	20
			Kaalla	20
Eastern	Ampara	Akkaraipattu	Akkaraipattu	50
	Batticaloa	Koralaipattu North	Vakarai	25
		Koralaipattu South	Oddamavady	25
Northern	Vavuniya	Vavuniya	Moonthrumurippu	25
			Rambaikulam	25
Padanichchoor				25
Pandarikulam				25
North Central	Anuradhapura	Anuradhapura	Anuradhapura	50
		Madyama Nuwaragampalatha	Halabagaswewa	25
			Upatissagama	25
North Western	Kurunegala	Galgamuwa	Giribawa/ Warawewa	25
			Solewewa	25
Puttlam		Wennappuwa	Coloniya	50
Sabaragamuwa	Ratnapura	Kiriella	Kiriella	25
			Idangoda	25
Elapatha			Elapatha	25
Kegalle		Mawanella	Baminiwatta	25
Uva	Moneragala		Galgamuwa	50
			Rathugala	50
Central	Kandy	Pilimathalawa	Gangoda	50
	Nuwara Eliya	Kuwara Eliya	Shanthipura/ Kalukele	25
Matale		Ukuwela	Ukuwela	25

4. Results

This section will mainly focus on the interpretation of findings on the practice of observing biological indicators in Sri Lanka and where applicable, folk lore where applicable. The section will mainly focus on how animals and plants are used to forecast separately, providing circumstances under which they are applicable.

Biological indicators have gone far beyond predicting rain and weather patterns. It has gone as far as predicting what time is appropriate to harvest or weed paddy fields. People have even counted on biological indicators to predict good fortune or bad omens.

Use of animals in forecasting

Animals are believed to be agitated upon subtle variations in the environment. It is believed that they sense even the subtle variations of the earth's electro-magnetic fields, humidity, temperature, air pressure and inauspicious coming in way. Animals are said to be even capable of picking up ultra sound micro tremors that are not felt by humans.

Mammals

Cat is one of the domesticated animals with sharp reflexes and could predict the nature of forthcoming events. Cats generally detect the presence of animals such as snakes. When a group of cats make noise, shouting at night and fighting at night could be an indicator of death or calamity in neighborhood . There is a subtle variation in comparison to the mating calls of cats and forecasting of death that only a trained ear could detect. Similar to cats, sustained howling of dogs too is an indication of death to a family member or a neighbor. Another altered behavior that has been observed by many on dogs is it trying to dig the floor of the house and barking aggressively and trying to run out of the house before death of a house mate. However the

practice of delaying a journey if the domesticated god claps its ears (කන් පොට ගැසීම) at the beginning of the journey is still seen even in the western province.

However, in spite of forecasting doom, cat washing itself thoroughly in the front side of the house is an indication of visitors. It is also a habit of cats to wet their ears before a rain. The squirrel detects rain much earlier than the cat. It eat till late and eat unusually before a rainy day. Cows turn their back towards the direction of the wind to smell the predators coming from behind and to see the ones in front. Behavior of cows is observed by farmers in Sri Lanka as well as in other parts of the world to predict rain. However, prior to the 2004 Tsunami, people in the coastal belt of the country had observed that the cows and goats have started to run inland before the tsunami struck. However, they have not showed any recognizable behavioral change during subsequent episodes of false tsunami alarms. Fruit bats probably due to its capability of using well developed radar emitting and detecting capacity, have got alarmed of approaching disasters and fly. For example it has been observed in Matara that fruit flies have predicted the tsunami in advance. This reconfirms the findings of Weerakoon and Seneviratne 2010.

During the mini earth quakes that took place in Sri Lanka recently people have observed monkeys to have become agitated and restless during an unexpected/unusual during unusual times.

Although no one has observed, Lori (Ula Lena) is considered as a dangerous species to be seen. Its cry is believed to attract devils to the closest house whereas seeing a Lori first thing in the morning is thought to bring bad luck. Touching a Lori makes one weak and thin.

“Auvai vassai nariyage magulai” (feast for the fox during the time rainbows appear). This is believed to be a saying derived due to the rainbows that drag rabbits out of their hole dug in ground for food and subsequently falling easy prey to foxes. On the other hand, it is a good time to go hunting for rabbits when rainbows appear after rain with the guess “if it is good for a fox, why not for us”.

Birds

Avian species have an added advantage that no other class of animals has. Apart from other specific adaptations to receive broader spectrum of information from the environment, Avian species necessarily have the ability to see longer distances and also to travel relatively longer distances in quick time. Raptors who fly in higher altitude could see quite a substantial distance away and provide calls and alarms where necessary.

Vahi Lihiniya (Red rumped- *Hirundo hyperythra and* Hill country- *Hirundo hyperythra*) or Swallows appear in groups of three to four before rain. In addition, it also has the ability to find tall trees for nesting depending on the level of humidity. Therefore Lihiniyas are capable of providing with a weather forecast with substantial accuracy for a fairly long period.

Vadu kurulla is another species that is observed by farmers to predict rain and humidity levels.

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(Folk Lore)

Vadu kurulla (*Ploceus philippinus*) or the Baya Weaver generally nests around a reservoir. If the nests of the vadu kurulla are built on top pranches of trees, it is an indication of prolonged drought. Lower the nest, higher the intensity of rain. It constructs its nest to provide optimum levels of humidity required for the hatching of eggs.

Kirala (*Vanellus indicus*) - *Red-wattled Lapwing*

A species that lays eggs on ground. If a Kirala lays eggs close to the bank of a tank, it is an indicator of prolonged dry period. if it is far away from the bank where the eggs are laid, people knew that a rain is on its way. The sound that the Kirala makes is interpreted by people as “බිත්තර පෑගෙයි බිත්තර පෑගෙයි- Biththara paageyi- biththara paageyi” (Be careful, don’t step on the eggs).

කිරලා මැද කළුව ළඟ බිඳු දමන කලා
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(Folk Lore)

Similarly, many species of birds lay less eggs during drought and more eggs when a rainy season is anticipated. A good example is crow, that lays one or two eggs to predict a upcoming dry season whereas laying over two eggs is an indication of an upcoming rainy season. Although crows do not generally lay more than two eggs, how come there are four eggs? The other eggs are generally laid by the sneaky Kovula bird during the absence of the crows. The higher number of eggs is an indication of the activation of North-Eastern monsoon that has brought the migratory Kovulas from the Northern hemisphere.

Similarly the migratory bird species that travel along with dry sailing winds from the northern to southern hemisphere are considered as indicator species of rains by farmers, mainly in the dry zone that provides haven for migratory birds. Halan penda is one such species. It has two different species, yellow and white. When halan pendas are sighted, farmers observe the holes that the crabs have dug (කක්කුටු බෙන - kakkutu bena) in order to precisely predict when exactly the rains are due and also the anticipated intensity of rain depending on the size and nature of the opening of the kakkutu benaya. Once a fair understanding on the oncoming rains is gathered, farmers wait till avichchiyas (Orange/blue Avichchiya and brown Avichchiya) are sighted to plant seedlings.

Other birds such as Ge kurulla (sparrow) bathes in dry mud before rain whereas sea gulls stop flying before a storm. Generally birds get quieter before rain. All birds fly low before rain. It could be due to the drop in air pressure that could lead to having discomforts in their ear drum. They are general observations of many and are generally observed a few hours prior to rain.

Unlike the birds mentioned above, long term environmental impacts can also be measured through the abundance of certain species. As an example, increased peacock presence is believed

to be an indicator of prolonged drought that could lead to desertification.

Domesticated birds such as love bird, parrot, pigeon and turkeys too have the ability to predict danger. It is mainly when a snake or an unwelcomed stranger intrudes into the comfort zone that these animals get agitated and make loud noise.

Although that is a relatively new phenomenon Sri Lanka's Vedda communities or the indigenous people are still capable of identifying distinct variations of mainly birds to predict upcoming events. They have from the past employed a symbiotic relationship with certain animals such as the jungle fowl (*Gallus lafayetii)* commonly known as the *vali kukula* (වලි කුකුළා) (இலங்கைக் காட்டுக்கோழி). Although there are instances where they kill and consume flesh of the jungle fowl, in the Vedda community it is a protected species and killing of such an animal is taboo. Due to this practice of protecting the jungle fowl for ages, they do not consider humans as an enemy or a threat, hence closely roaming around houses. The advantage of their presence for humans is that they prey on harmful species such as venomous reptiles. Furthermore, they too make loud noises when sighting poisonous reptiles. They also perform the duties of the scavenger where they feed on the kitchen leftover.

Crow is generally considered to be an intelligent species that lives close to human settlements due to its nature and habit of scavenging. People have had interactions with crows for millennia and they have observed the species for their benefit. Kapuru saasthara/කපුටු ශාස්තර (crow predictions) has evolved separately with regional variations depending on local cultures, requirements and differences. Different crow calls are said to impact the humans in different ways. As an example, crowing on top of the roof or near the house indicates visitors whereas a crow flying through the house leads to inmate of the house to leave the house. Apart from how a crow calls, droppings of crows have also been examined in the olden day and if droppings fell on a human being, predictions are given depending on where the dropping falls. There are different predictions that are given if droppings fell on the right shoulder, left shoulder, back, right side of head, left side of head, on forehead and so on.

Bird songs and bird calls have been closely studied in the olden day as they carry a lot of information. Owls (specific type of owl called ula lena) shouting (hoot) for a few days

continuously is believed to indicate death or calamity in the near future. Owl calls and the predictions given differ based on the exact time at which the call is made. Kana koka (Black crane) is considered as to be an unwelcomed guest. Calls are generally anticipated by humans with raised eyebrows while a kana koka flying over the house, with a call is believed to be an indication of something terribly bad is about to happen in the particular house. Here too, the prediction changes depending on the time of the call.

Sudden increase in Magpie robin population and them sounding from upon trees in the front of the house too indicates bad omen.

Amphibians and reptiles

A viper is generally not welcomed near human settlements. They are killed by humans upon their sighting, quite understandably so, due to its killer bite that comes without any warning. Similarly kraits too face the same fate. However, non poisonous harmless serpents such as ahara kukka misidentified are also killed. Although poisonous, the most feared and respected reptile is the king cobra. It is even venerated in some South Asian cultures. Other than as a defensive measure, cobras are generally thought to be harmless to humans. In the most rural societies, even if attacked on a kem mura day, they are avoided and never killed.

Reptiles are generally seen in abundance during prolonged dry periods when the water in paddy fields that provide them shelter too dry up and reptiles go wondering about searching for water holes. However their sightings are also increased with extreme amount of rain that displaces them from their conventional habitat. Snakes are supposed to come out of jungles during the South west monsoon.

One of the main delicacies of snakes, the frogs too is good biological indicator that could give precise alarms on rain. Anticipating rain, they prepare themselves for breeding and mating calls are heard afar loud a day before the rain. Tortoises come out of water ponds and go to high ground before extreme shower, probably to avoid from being washed away from their habitat.

Even though iguanas are considered as a friendly species that feeds on the molluscs and trouble

making worms etc in home gardens, their larger cousins, monitor lizards coming into the gardens are not at all promoted by many. Monitor lizards sneaking into the house and staying or resists going out of the house is considered as an indication of death to a family member.

Hoonu Sasthara

The smaller cousins of crocodile, the gecko is generally considered a housemate that feeds on flies, mosquitoes and other small insects. Similar to crows that have been studied for centuries, if not millennia, geckos too provide ground for a range of predictions, not based on the place of droppings, but the part of the body on to which a gecko falls. Gecko call at the time of leaving the house is said to predict bad fortune and upon such calling, people make an excuse and slightly delay the journey. They are called *hoonu saasthara*. Due to this widespread belief, Hoonu sasthara has been incorporated in the annual Almanac commonly known as the "*Litha*". Hoonu Sasthara is as follows according to Litha.

හූනන් වැටෙන තැන අනුව පලාපල

හිස- කළඟ පපුව- ධන ලාභ මුහුණ- බන්ධු ධර්ෂන, තනය - උතුම් ගෞරවයන්, නළල - තානාන්තර බඩ- ධන ලාභ බැම මැද - බන්දු නාසා/ නැබ - රත්න ලාභ, බැම- රජුගෙන් ගෞරව දකුණු ඇල - දියුණු වීම , වම් ඇල - මරණය ඇස - සිර භය නාසය- ව්‍යාධි පිට කොන්ද- ද්‍රව්‍ය ලාබ, උඩු තොල- වස්තු හානි, පිට- සුභ සම්පත්, මුඛය- භය, ලින්ගුව- දරිද්‍ර , යටි තොල- වස්තු ලැබීම , යෝනිය- පුරුෂයාට මරණය, නිකට- රාජ දඬුවම්- වම් අත, ඇඟිලි- මිත්‍රයන් කළඟ, දකුණු කණ- දීර්ඝායු, ගුදය- වස්තු ලාභ, වම් කණ - වෙළෙඳ ලාභ, කලාව- පියාට විපත්, හිසකෙස්- මරණය, දකුණු කෙන්ඩ- බොහෝ පාඩු, බෙල්ල- සතුරු හානි, වම් කෙන්ඩ- කළඟ, දකුණු උර- නිරෝගී, ඇස වට- සැප, වම් උර- ස්ත්‍රී සැප- දකුණු පාදය- රෝග, දකුණු වළලු කර- පීඩා, වම් පාදය- දුක්, වම් වළලු කර- කීර්ති, දකුණු පාදයේ ඇඟිලි- රාජ භය , දකුණු ඇන- භයානක මරණ, වම් පාදයේ ඇඟිලි- රුදු සහිත රෝග, වම් ඇන- ශෝක මරණ, නියපොතු- ධන හානි, දකුණු ඇන ඇඟිලි- රාජ සම්මාන- ශරීරයේ දිව්වේ නම්- දීර්ඝායුෂ

Source: Annual Almanac (ලිත)

Fish

Predictions based on sightings and behavior of fish is confined to the fisheries sector in the coastal belt. There are however, minor observations made by villagers on the fresh water fish.

Low fish density in fresh water is generally an indicator of poor water quality. Low fish species diversity is also considered to be an indication of water pollution or an introduced species that feeds on local fishes or their eggs. This scenario has been evident in tanks to which tilapia and trout have been introduced. The endemic freshwater fish are said to be lovers of shady waters whereas the introduced species prefer water to which direct sunlight is available most part of the daytime. Native species of fish such as Lula, Handaya, Ara, Kawataya can live in dried up ponds till the rainy season starts.

Due to logging of trees lie Kumbuk, that used to provide shade to tanks and reservoir edges, the number of native species of fish are believed to be declining rapidly. When Oxygen availability in water reduces, all fish come towards the surface of the water. This could even be observed in domestic fish tanks.

There are about 110 brackish water fish. e.g. grouper (*Promicarops* species), mullet (*Mugi cephalus*), milk fish (*Chanos chanos*), silvebidays / Karalla (*Leoguathus dissumeri*), pears spot (*Etroplus suratensis*), Kalanda (*Awaous grammeepus*), prawns and crabs. People have observed the increased environmental and manmade stresses on such species and declining numbers at an alarming rate. While the estuarine fish face overharvesting as a major threat, contamination of due to industrial waste and pollutants is also seen as a major concern. However, one of the major concerns could be global warming leading to rising of ocean water levels and salt water intrusion inland making the brackish fish to migrate upstream and lose their habitats.
Typical freshwater fish - Thilapia (*Oreochromis niloticus*), Malkorali (*Etroplus maculates*), Lula (*Ophiocephalus striatus*), magura (*Clarias brachysoma*), Weligouwa too that are mostly affected by overharvesting.

When it comes to marine fish, mostly smaller fish such as sprats swimming close shore is generally seen after a thunderstorm.

Arthropods

Arthropods represent the highest number of species in the animal kingdom. Diversity that the arthropods bring seconds to no other phylum. In fact most of the other species including the humans would not exist if not for their benevolent impact. A major share of the benevolence of arthropods is dictated by bees that are essential for the pollination of major staple food of human beings.

Apart from their obvious value of pollination and providing honey as a byproduct, they are also fairly good biological indicators. There are less bees,(mee massa), wasps (Bambara), Danduval massa sighted in an area where pesticide and insecticide is used. It is not only the harmful species of insects that are killed due to insecticide spray, but also the bees. It would also be correct to say that more bees could be sighted in areas where less chemicals are used.

Although bees do not have the luxury of a developed central nervous system, they show high levels of intelligence and organized communal behavior. Bees flying towards the hive in panic generally indicate on coming bad weather. Butterflies too are not visible before a rain.

Common species of ants display the most obvious indication of rain and drought. If ants stay on ground, it gives an indication of a prolonged dry period. Anticipating a shower, ants build elevations and extensions around ant hole entry. A line of ants heading towards the house with eggs is a clear indication of substantial rain to come in a day or two. However, a long and broad line of black ants coming into the house is considered to bring bad luck. Ants are also seen as predictors of earthquakes in other countries. It is also generally believed that termites coming into houses and building castles is a representation of bad fortune. Destroying a termite mountain to construct a house is never practiced, mainly due to the belief that termite hills are inhabited by cobras. The adult termites with wings, called as meru gives a drastically different indication. Fishermen know that their catch, mainly the close shore, is going to be good on the following day to the sighting of meru.

Abundant spider webs (Makulu dal) indicate the lack of predators and abundant insects to prey on. Spiders leave webs deserted before torrential rain and go hiding. The Maita, a microscopic Arachnid feeds mainly on immature plant tissue and can kill the whole plant. Crustaceans such

as the kakuluva (Crab, fresh water, brackish water and marine) go hiding during rainy season.

Nematodes

The only observed Nematode species by people is the earth worm. Having earthworms in soil is considered a blessing as it keeps the soil well aerated land increases soil fertility.

Hunters are equipped with traditional knowledge on observing animal trails and droppings to predict density and abundance of different species and recent visits by different species. Such observations are done through checking the mankara (trails) of different animals. There are different trails such as Koombi paara (ant trail), Iguana trail (thala goi mankada), porcupine trail (Iththa mankada), rabbit trail (Ha mankada), Badger trail (Mugati mankada), (Meemini mankada)mouse deer trail, Wild boar trail (Ooru mankada), dog trail (Balu mankada), python trail (Pimburu mankada), elk trail (Gona mankada) and Elephant trail (ali mankada). The hunters usually use gona mankada that provides ample space for the horns that leaves provision for a man to walk easily. If the hunter wants to set a trap to a wild boar, the hunter knows where exactly to install it. The size and the design of trap too differ depending on the species of the hunt.

General observation of the environment

Apart from observing animals and plants and their behavior, observing other elements of the environment such as the sky, ocean, rivers and stars too have given the humans an advantage to forecast with relative accuracy disasters, weather and good and bad omens. For example, solar calander and lunar calanders and their different interpretations too are decisive in determining certain biological indicators as some animals and plants show predictable behavioral change according to lunar movements. For example, although the month of August in the Sinhala Lunar Calander is called “Nikini Maasaya” which usually starts mid August and ends mid September. (Kandegama 2011). Some of the beliefs are as follows.

Red sky in the morning- Due to the reflection of sun upon water vapor into the high atmosphere due to heat and high pressure. rain warning

Red sky in the afternoon/ evening- Due to the reflection of sun upon dust particles carried by high pressure and high temperature in the high atmosphere- Generally no rain

Still winds- No rain during the next few days (Contradicts lul before the storm)

Fog in the morning- water in atmosphere (Humidity) and the temperature is sufficient to condense water vapor than to condense

During a fine day, clouds are whiter and higher and less turbulent.

Rain carrying clouds are darker and low and turbulent.

Circle around the moon- rain soon (This could also fall into atmosphere)

On full moon days lunatics could become aggressive

On full moon days wild animals become violent Lunar eclipse- Bad omen

Certain practices that go along with the lunar calendar are also described as follows in "අමෘත කලාව / විෂ කලාව" (art of immortality and art of poison)

According to the art of immortality, පුර පැලවිය පටන් පසළොස්වක දක්වා පුරුෂයින් දකුණින් ද ස්ත්‍රීන් වමින් ද නැගගෙන ගොස් අව පැලවිය පටන් අමාවක දක්වා පුරුෂයින් වමින් හා ස්ත්‍රීන් දකුණින් බසී.

According to the art of poison
අව නවවක අටවක දක්වා පුරුෂයින්ගේ දකුණින් හා ස්ත්‍රීන්ගේ වම් පසින් ද නැගගෙන ගොස් පුර නවවක දක්වා පුරුෂයින්ගේ වමින් ද ස්ත්‍රීන්ගේ දකුණින් ද බසී.

According to the positioning and sighting of extra terrestrial matter

Solar eclipse- Worse omen

Sighting a comet- depending on the comet, it could bring good or bad episodes

Beliefs

Kem-Mura Davas (sacred days connected with gods and deities. These days are generally reserved for special poojas and prerequisite cusoms and rituals)- Tuesday, Friday and Saturday

Thursdays are the most auspicious

If a milk man, a woman with a full pot of water, flowers could be considered as good luck.

If a person sees someone taking a pile of firewood (sticks), empty pot (Chatti), red attire, shaven head, uncombed loose hair at the beginning of a journey, it is considered as bad luck.

Bathing on Sunday- makes ones' appearance deteriorate and on, Mondays- makes ones' appearance improve, Tuesdays- induces disease, Wednesday- Become rich, Thursday- Leads to unrest and arguments, Friday- Someone close will die, Saturday- It brings good luck, fortune and happiness.

Meals should be taken facing east or west, No monetary transactions are auspicious on poya days. Sundays Tuesdays and Thursdays are not good days to visit someone. July is considered the most inauspicious month for weddings. The newly wedded bride always goes in frount of the groom. A blind man is never bitten by a snake.

Right nostril itches and follows it up with a sneeze- Someone speaks good about you. Left nostril itches and follows it up with a sneeze- Someone speaks bad about you.

Unknown and unexplainable smell of burnt flesh (Minee ganda/ vahathu ganda, peretha ganda)- Presence of mala perethayo (spirits). If one death takes place after some time, it is expected that six more deaths would take place subsequently

Use of Plants in forecasting

Just like the animals that are abundantly being considered to provide information on forthcoming situations, plans too provide such information. Observation of growth patterns are the main means of indications that are considered valuable to the humans. There are three phases of plant growth that are taken into consideration in terms of forecasting.

1. Growth phase 2. Reproductive phase 3. Dormant (sleep) phase

Niyangala (Gloriosa superba)

Niyangala is one of the plants that produces a yam which is poisonous. The plant is generally categorized along with Thevetia peruviana, Kaneru, Goda Kaduru, Diya kaduru, Endaru, Weta Endaru, Datura, Kalu Aththana and Hondala due to its poisonous values.

NIyangala's Scientific name is *Gloriosa superba* and the Tamil name is Karththigaikkilangu. The English common names include flame lily, glory lily and tiger claw. Plant habitat is generally confined to the tropical band and can be seen in countries like tropical Africa, India, and Malaysia. In Sri Lanka, it is found in low country and traditionally it is used as a remedy to treat bruises and sprains. Even though the entire plant is considered as poisonous, especially the tubers are considered to be extremely poisonous.

This plant Niyangala (Niyanga + Ala) is considered as one of the best predictors of rain and drought. even with the availability of modern day technology, farmers continue to rely on the Niyangala plant. Observing each step of its life cycle it is possible to understand when exactly the rains will be available, when the dry season could start and so on. The life cycle is approximately six months in length. The farmers prefer to use the lunar calendar over solar calendar for farming practices. Niyangala plant's general life cycle includes the following annual steps. However, it has the ability to stay dormant till the conditions are ideal for it to grow.

Table 9: Growth chart of Niyangala

Solar Calendar month	Lunar Calendar month	Growth phase
Yala kannaya		
February	Navam	Yam (ala)
March	Medin	Root (mula)

April	Bak	Creeper (vala)
May	Wesak	Flower (mala)
June	Poson	Capsule (karala)
July	Esala	Seed (ata)
Maha Kannaya		
August	Nikini	Yam (ala)
September	Binara	Root (mula)
October	Vap	Creeper (vala)
November	Il	Flower (mala)
December	Unduvap	Capsule (karala)
January	Duruthu	Seed (ata)

Other plants that show clear responses to forthcoming environmental changes

Trees generally love to expose their leaves to rain

Dandelion- Closes the flower before rain

Wood swelling when air moisture is high. During rainy times

Wilting of plants during dry weather

Dandelion flowers after last rain predicting a dry period

Oxalis (Bim Thamburu) leaves are angled during high intensity sun light to avoid photo inhibition

Plants indicative of the soil quality

Availability of legume trees indicates soil rich in nitrogen

Where Bandura (*Nepenthis*) grows, soil is deficient in nitrogen

Soil bearing many citrus trees indicates an acidic soil

Stunting of trees- Nutrient quality/ water or sun light a limiting factor

Fern availability- soil water is available

Fungi and lichens on trees and rocks- bio diversity available Plants having yellowish leaves indicates lack of Magnesium

Wilting of plants could be mostly due to the lack of ground water. It could also be due to high intensity of solar irradiation or parasitic attacks.

Kadupul flower: Kadupul flower blossoms at night and spreads a unique scent. Kadupul flowers during the Sri Paada season (November- march period)

Apart from fauna, some trees are also believed to be predictors of good fortune or bad omen. An example is the belief in Sri Lanka that doom is close if a flower of the Thala (a palm) is blossoming, which is a rare occurrence.

Auspicious and inauspicious trees

It is believed that trees, especially the larger trees are inhabited by gods. It is not an accepted practice to cut down trees without a valid reason. Even if a tree had to be cut down, poojas and alms were offered to gods inhabiting trees.

It is believed that trees grown around the house bring good and bad fortune. North- Palol trees

(Kasaya) good	Aththikka bad
East- Nuga good	Bo bad
South- Aththikka/ Divul good	Palol bad
West- Bo good	Nuga bad

If inauspicious trees are grown in home garden, mainly the head of household will experience financial problems, problems to children.

In order to reduce the impact of inauspicious trees, trees such as Domba, Ho palu, Kohomba, moonamal, Jack, Sal. However, there are specific directions in which the above trees should be ideally installed.

Household head lives in fear when a tree with thorns is grown by the house. Trees with milk (resin) grown by the house leads to financial losses. If a tree by the house bears unbearable amounts of fruits its believed that it indicates bad omen and that a death is inevitable. Timber of such trees is not taken for uluvahu (door hosts) of the houses. Trees in cemeteries/ grave yards, trees to which lightning has struck, wasted trees with bena (holes), trees on which a person has not hung to death are never considered to supply timber to construct houses. There was a belief in the olden days that the place in which houses would be constructed will be decided after observing the direction to which the trees are fallen. Trees fallen to the Eastern and Northern direction are considered good. Trees that are broken or dried, trees grown in devaala, trees inhabited by abundant birds are not considered as a good timber. Bulu, Kohomba, Mee trees grown around the houses are never considered as timber. Trees such as coconut and plantain grown in home garden getting infected by dormancy (vanda peedeema) is considered as bad omen.

However the nature of the impact of trees is dependent on the birth sign of the person that grows the plant. Birth nakatha and kendra of the person that grows the particular tree. There are 28 nakath and 28 corresponding trees. For example for Denata nakatha- Samadara, for Asvida nakatha - Goda Kaduru.

Trees that are considered as good to be grown in the frount yard include delum, grapes, sudu idda, flowers, de vadaara, Puwak, Pol bolidda, Saman mahanel, Sadikka, Orange (citrus), vetakiya. By growing such trees, good health and pleasure is gained by the occupants of the house. However, Musa (kesel) and king coconut (thambili) are not good for the frount yard. However, thambili (king coconut) is considered good for front yards of kings and ministers.

Trees that are good to be grown in the front garden, but a bit distant to the house include Ho Palu, Domba, Sapu, Palol, Moonamal, Nelli, Sinu amba, Kohomba.

For longevity and happiness eethana is recommended. To safeguard livestock, grow kalanduru, To get over impacts of devils Demata, Andara, Suriya, Katakaala are good. Murunga and kathuru Murunga although grown in home gardens are not allowed to grow above the hight of the roof. Beli tree is said to be a good tree to be planted in frount of the house. Ruk mal are a good thing to be grown in paddy fields

Certain trees such as siyambala are not allowed to grow in the home garden as it is believed that these plants attract evil spirits. Trees that should never grown in a garden are erabadu, vathusudda, kapu, kaju, kinihiri, kathuru murunga, na, king coconut, Beli, divul, erandu, vara, thla, Spu, aralu. Araliya is a tree that is planted in cemeteries and not in home gardens. Water is generally cooler in wells that have kumbuk (*Terminalia arjuna*) trees in close proximity of the well.

Folk Lore associated with plants as indicators

Folk lore and myths associated with biological indicators of nature are mostly in the oral tradition rather than in literature, which makes the collecting of such practices that much more important. It is from the infanthood where folk lore is generally made to be embraced. Traditions and customs are such most of the popular lullabies educate to sustain with nature from an immature age.

ඔන්න බබෝ ඇතින්නියා
ගල් අරඹේ සිටින්නියා
ගලින් ගලට පනින්නියා
බබුට බයේ දුවන්නියා
(Folk Lore)

This is an expression of human elephant conflict that has been there ever since the human settlements began. This basically says how humans have led to elephant's freedom to become limited and an advise is given not to scare the elephants off.

මේ ගසේ බොහෝ පැණි දොඩම් තිබේ
පැහිල ඉදිලා බිමට නැමිලා බැර වෙලා අතු
නංගිටයි මටයි ගෙඩි දෙකක් ඇතියි
වැඩියේ කඩන නරක ළමයි හෙම නොවෙයි අපියි
(Folk Lore)

Some of the most popular lullabies sung throughout Sri Lanka, naturally close to nature contain biological indicators.

නුඹේ අම්මා කිරට ගියා
කිරි එරවා එන්ට ගියා
කිරි මුට්ටිය ගඟේ ගියා
ගහට උඩින් කොක්කු ගියා
(Folk Lore)

It describes the fate of the mother that went to fetch milk in a subtle way. Cranes depict Kana koka, which is believed to be an indicator of death.

puraana maimathaya (Gebim shasthraya)

පුරාන මයිමතය (ගෙබිම් ශාස්ත්‍රය)

තණකොළ කඩාගෙන
අරිටු තෙපොලෙන් බැනගෙන
දුටොත් පෙරමඟ යන
අරිටු ලකුණයි එගෙය නොමතන

මුලින් දවාලූ ගස
ගෑනු ගස්සයි ඉසි බස
මැදින් දලටු ගස
නපුන්සක වේය ඒ ගස

මුලසිට අග දක්
එකලෙස මහතා විගසක්
දුටු මේ ලෙස ගසක්

පිරිමි ගස යයි අනුව නොම සක්

අගින් දළුවී නම්
එගසා වනසා රැඳුනා නම්
යකිනියක් වී නම්
කපා නොගනින් එගසා එහෙනම්

බෙර කඳක් විලසට
වට වී ගසක් දුටු විට
කපා ඒ ගස ගෙට
මඟුල් කැපයට රැගෙන නොකිළිට

ඇතුලට බෙණ සැදී
ගස බැඳ ගෙයක් සැදී
සෝදුක් බිය ව සැදී
අවදවී ගෙට නොයෙකු දේ සැදී

අගින් පටුවී නම් ඒ ගස
වනසා රන්දු නම්
යකිනුඉයක වී නම් කපා
නොගැනීම් ඒ ගස ගෙට නම්

ඉතාමත් සකි සඳ
අරගෙන ගෙයක් කල සඳ
එගසා වනසා ලද
නිතර ඉන්හට කරනි ඉඳ

(Folk Lore)

Good trees

සන්ගාරමද දෙවොලාදියටත්
සිංහාසන මන්දිර වලටත්
ගන්න මඟුල් කප්ප ඕගහ යහපත්
දන්නා මේ වග අය වදුකම සලසත්

සැදින මඟුල් කැප වටකර අලුව ගෙන

කපන මඩුල් කැප බිම්හුණු දෙස අඳින
යෙදෙන ශුභ අශුභ දැනගෙන මින් පෙනෙන
තනන නෙතනන දෙස දනු වඩු විසන

නැගෙනහිරට වැටුනොත් ඒ කැපු තණ
ගෙයි හිමි සඳ ණුවනින්අගතැන් වන
දකුණු දෙසට වැටුනොත් යු දෙන
බටහිරට වැටුනොත් සිතුවිලි කරන

උතුරු කොනට වැටුනොත් ඒ කපපු ගස
සිකුරු ගෙය සැහවී උන්නත් එළිබැස
රුදුරු මාරු ඇවිත් පැමිණි ගෙයට බස
ඉතුරු නොකර මනළ ගෙනයයි නොසල

(Folk Lore)

Good and bad trees

මෙකී බිම්වල ගේ තැනුමට
පළමුව බිම් තිබී ලියරුක් පහ කොටට
මතු කියවෙන ලියරුක් තොර සිත
එබීමෙන් පිටලනු වදදෙයි කදිමට

කිණිහිරි සිම්බල කොසඹ කොලොන් ගස්
හදාවක බුරුනද කිහිරිද බූ තස්
අන්දර නෑ ගස් නිලෝල් ඒ බෝ ගස්
මෙකී මෙරුක් මුල් සිඳ හාරාලා පස්

අන් තැනකින් පස් කපා ගෙනල්ල
ගස් කැපු වලවල් සම කරපල්ලා
වහලා අවුරුද්දක් ගිය දෙල්ලා
ඉන්පසු ඒ බිම ගේ බැඳපල්ලා

කරඳද බෙලි මිදී මාරි පලොල් ගස්
කුඹුක් දිඹුල් කිරි වලහුන ගස්
අරළුද සාරන ඇට්ටේරිය ගස්
පිසා කෙලින් දත් පෙනේළ මෙකී ගස්

මෙකී ටුක්ලිය තිබී බිම ගේකට
පටන් ගඳ පළමුව උදුරා වට
දමා එපස් හැර අන් පස් ලා හිත
සමාසයක් ඇරලා සඳගේ තුට

ඊතණපලවෙයි දැන් මාරු සමඟ
බුරුත ගොදිවූ උඳුපියලියත් සමඟ
එක ඉඩමක පලවී තිබු ඒ රඟ
ඒ බිම ගේ තැනුවොත් සිරෙ මේවග

බෝ සැවැන්දරා මාර ගස් ඇති
එබීම ගෙයක් කල ආයු වඩා ලති
කොස් නාරං එල බොහෝ කොටම ඇති
ඒ බිම ගේ තැනුවොත් දඹරසක් ඇති
(Folk Lore)

Pruning of trees

When a tree is to be pruned the dormant or the sleeping phase should be correctly identified. Dormant phase is species specific and is also dependent on the environmental variables.

Nutrient Deficiencies of plants

1. Green colour is reduced and plants appear yellowish in Nitrogen deficiency
Results in lack of nitrogen in soil, growth of paasi (bryophyta) too is an indicator of nitrogen deficiency

2. Trace elements- Leaves have color mosaic, spots, sprinkled spots. Unexplained growth retardation is also assign of micro nutrient deficiency

3. Phosphorous- Stems of new buds and young leaves are shorter than usual

4. Humidity deficiency- Leaves appear rough. This is also a sign of prolonged drought

5. Stress of trees- due to high temperature/ lack of water/ problems with drainage (too much water), high nutrient concentration

5. Conclusions

It is clear that the contemporary Sri Lankans, mainly in the peripheries still use, to a certain extent biological indicators in combination with astrology and ecological indicators for forecasting weather.

It is compulsory that the use of biological indications for forecasting needs discussion on the basis of agri-culture that has been replaced by agribusiness which has led to vast leaching out of cultural values, traditions irreversibly. It is seen that such practices are left only with the older people and also confined mostly to males. However, mainly the elderly people engaged in farming know the art of prediction of rain through the assessment of animal and plant behavior. There are a few who could recollect what was used by their previous generations.

Although there is folk lore on biological indicators, most of it is brought in an oral tradition rather than through a literary lineage, which is another reason for important information to be lost from generation amidst rapid modernization. Most of such practices are confined to the agricultural sector, however, such practices are becoming disused even in the peripheries. The younger generation is mostly employed somewhere and are engaged in farming on a part time basis. Using animals for asvaddumisation is replaced by the use of tractors, combined harvesters and other sophisticated equipment. Similarly, traditional methods of insect control and fertilization is not practiced even by the older generation and is replaced by heavy use of agrochemicals mostly as advised by the agents of conglomerates investing in agriculture.

Modernization is seen to have replaced the whole landscape of traditional agricultural societies in Sri Lanka. Even the fisheries sector is now dominated by multiday trawler boats replacing the small scale fisher folk who have merely become labourers, hence reducing chances of recovering traditional practices and customs that could even be life saving.

Amidst rapid urbanization and modernization, Sri Lankans are still using biological indicators for forecasting to a certain extent. It is mostly the elderly who still believe that these indicators are valid out of which only a fraction could be considered as true practitioners of In the urban centres, use of biological indicators has been replaced by technology. For example even satellite

imaging and forecasting is abundantly being used by youth in Colombo. In general people do not seem to bother about the need to preserve traditional practices and do not value the traditional way of life nor the traditional forms of forecasting.

The state on the other hand seem to have left room for corporations to continue to replace the remnants of traditional agriculture and associated culture which is seen detrimental from every aspect.

The other side of the issue is the lack of existing information and literature on biological indicators and practices of traditional knowledge. It is mainly due to the oral traditions that was in place rather than an accumulation of literature relevant.

This process well place the existing practices of using biological indicators for forecasting becoming extinct altogether.

It is in fact a daunting task to protect the remaining at lease the last gasps of traditional knowledge and the part of the diminishing culture.

6. Recommendations

Recommendations are based on findings and the existence of knowledge among the public on the use of biological indicators for prediction and forecasting.

Recommendations to protect the remaining areas of traditional knowledge concerning biological indicators used for forecasting should have three clearly distinguishable areas.

1. to have accumulation of literature on biological indicators, under a broader thematic area of traditional knowledge.

2. to have a mechanism to enhance the knowledge of present generations on applied biological indicators for forecasting within the broader thematic area on traditional knowledge.

3. to have a sustainable process of biological indicators education

There is a severe lack of knowledge on traditional forecasting methods among the general public in general and even among farmers and fisher folk. Therefore, a plan should be employed to accumulate information pertaining to traditional knowledge under which a separation component could be on biological indicators.

Knowledge enhancement on traditional knowledge and traditional forecasting using biological indicators and beyond, ecological indicators could be done through influencing the state to include chapters on biological indicators, under a major unit in school text books and curriculums on traditional knowledge.

Through giving the state the responsibility of protecting and promoting traditional knowledge in general and particular information on use of applied biological indicators, a process and a programme could sustain. Any other realistic approaches to inducing knowledge on traditional knowledge at a national scale are not seen by the practitioners of traditional knowledge.

Therefore, the state is proposed to be represented by the Ministry of Cultural Affairs and the Ministry of Education and their line ministries. The SAARC Cultural Centre is recommended to

perform a catalytic role that coordinates the respective Ministries with potential resource persons that could further enhance and sustain a programme.

Considering the fact that the context and the extent of modernization is similar than dissimilar in the region, the SAARC Cultural Centre as the pivotal and authorized body is also recommended to carry out a relevant research project at the regional level. Such a project with broader scope and coverage could look into quantification of the practice and knowledge on biological indicators under the umbrella of traditional knowledge.

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Annex 1. Interview Guide

The study on how biological indicators are used by contemporary Sri Lankans

Introduction: I am doing a research on ***"biological/ecological indicators of nature and how they are associated with folk lore and myths"***. I want to interview mature people who possess traditional knowledge so that I can acquire knowledge and preserve for the generations to come instead of letting such knowledge to become extinct. Could you kindly grant me permission to interview you and to take down notes?

1. Name of interviewer: 2. Date/ Time:

3. Name of respondent:

4. District: 5. D S Division:

6. G N Division:

7. Address of respondent:

8. Gender: 9. Race: 10. Religion: 11. Age:

12. Level of Education: 13. Occupation:

14. Give some common examples for biological and ecology indicators under each of the following categories to probe and note down along with possible explanations.

a. Frog's noise, ant movements- predicting rain

b. Dog’s irritating bark (udu bireema)- predicting a death in neighborhood

c. Gecko falling on head, shoulder, arm, leg etc- different prediction depending on the anatomical part

d. Yellow colour of leaves of trees/ wilting of leaves/ shedding leaves- soil nutrients/ dehydration/ season…

e. Different formations of the moon, stars, commets

f. Different formations of clouds/ mist/ lightening/ temperature/ humidity

g. Sound/ direction of winds/ flow of water in rivers and streams/ currents in ocean

h. Sound of animals (e.g. crow/pigeon/ owl/ peacock/sea gull/robin/magpie/crane)

i. Behavior of animals (e.g. cow/dog/cat)

j. Sighting of a particular animal. (e.g. cobra/ pol kichcha/ black cat/ monitor lizard)

k. Ant hills/ merus/ fish/type of fish caught:

l. Mushroom/ flowering plants/ non flowering plants (eg. Palmyra flower)

14. Have you observed an increase or decrease of the number of any particular species recently? Provide possible reasons.

15. Are there any trees that you do not grow in a home garden? (e.g. Araliya/ siyambala)

16. Are there any trees that are auspicious to grow on home garden/ near wells? (e.g.Beli/ kumbuk)

17. Are there any trees that are considered

18. Other indicators and observations