Rice farming: back to some traditional practices

in the Kapiriggama Village Tank Cascade System

IUCN programme on Restoring Traditional Cascading Tank Systems Technical Note # 7

Rice farming: back to some traditional practices

in the Kapiriggama Small Tank Cascade System

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Cover photo: A paddy tract cultivated with *kurulu thuda* (a traditional rice variety) under the Kapiriggama Cascade Project (Kumudu Herath © IUCN)

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1. Introduction

Sri Lanka's farming systems — particularly rice, other field crops and home gardening — have evolved over thousands of years to include a rich array of farming systems and cultivated crops such as rice, grains, vegetables, fruits and spices, as well as livestock. New crop varieties emerged both formally and informally. In addition, many farmers selected local landraces. The long history of cultivation, Sri Lanka's cultural diversity and a wide range of ecological landscapes have combined to result in a wide variety of farming practices in Sri Lanka.

The excavations in the citadel of Anuradhapura revealed, from cultural horizons nearly ten meters below the present ground surface, important evidence of iron technology, breeding of horses and cattle, and paddy cultivation. There is also incidental evidence (faunal, sedimentological) of water management associated with paddy cultivation. Agriculture would undoubtedly have been dominated by paddy, which can only be intensified in Sri Lanka's dry zone by the adoption of water management measures to control supplies from seasonal rainfall, streams, and perennial rivers (Deraniyagala, 2002).

In the past, the ingenious civilisation widely known as the hydraulic civilisation of Sri Lanka, was supported by indigenous agricultural practices adapted to limiting factors such as the uncertainty of rainfall, fragility of ecosystems, erosion of topsoil, damages from pests, diseases and wild animals. Communities lived in harmony with nature and were self-sufficient in food, autonomous in society and sustainable in agriculture. There are still some food materials, which are generally consumed by the peasant sector, which retains these practices.

The advent of the Green Revolution in the mid-20th century, which brought western agricultural technology (high-input required varieties, soil devastating machinery, environmental hazardous agro-chemicals and inorganic fertiliser), has posed a serious threat to the survival of the traditional agriculture system in Sri Lanka.

As once stated by Robert Chambers (1996), indigenous knowledge has different modes of experimenting and learning. Methodologies and analytical tools adopted in modern science to accept or reject should be used with some modification in investigating indigenous knowledge. Interpretation of any observation must be made carefully giving due consideration to 'time-tested facts'. However, the inability to interpret any phenomenon does not mean that it is a myth. Many practices adopted in the traditional communities are blended with religious and spiritual beliefs and cosmic influence. Similarly, Sri Lankan traditional agriculture has evolved with its unique features synchronised with socio-cultural and cosmo-spiritual dimensions into the bio-physical process found generally in western agriculture. Thus, it is wise to use a 'package effect approach' rather looking for effects of each component separately. For example, the *nawa kekulama*[1] is an improvement of the traditional *kekulama*[2] which considers the present environment and where it is to be practised.

[1] '*Nawa kekulama* is a dry rice farming system using straw mulching as a substitute for the practice of impounding water for weed management. Pest management is ensured by maintaining live bunds and biodiversity in the fields so that predators are attracted for pest and disease control. Another important aspect of *nawa kekulama* is timely cultivation following the astrological calendar. This traditional knowledge is applied in a modern setting of large-scale irrigation farming systems' (Bandara, 2007).

[2] 'Dry sowing of paddy in aswedumised fields is known as *kekulama* in Sri Lanka' (http://goviya.com/nava-kekulam.htm).

Knowledge of various practices and technologies has been built up over time. There were best practices of how grains were to be stored for consumption, as well as for seed requirements without quality deterioration. Beliefs are synthesised with disasters, worries, failures and successes experienced through generations. Communities protected forests, watersheds, medicinal species and various sacred places and materials. Simple tools and implements were developed for operations of daily life. Religious festivals were organised for different reasons, but they served to strengthen social solidity and self-motivation.

The diversity of ecosystems provided a natural setting for the adaptation of an agricultural system for producing foods sufficient to sustain a large population. It is long, time-tested knowledge, which created an environmentally-adapted, disaster-tolerant and sustainable living system. This type of agriculture had been adjusted to absorb any vagaries of the weather by shifting the time of cultivation and selecting appropriate farming practices. (Thus, they cultivated *chena* and paddy lands according to the seasonality of rains.) *Kekulama* (dry sowing), *bethma* (shared cultivation), *thaulu govithena* (tank bed cultivation) are good examples of how communities averted the impacts of drought on their farming. Traditional communities made every attempt to conserve soil, water, and natural habitat. Food security was one of the inbuilt aspects of their culture. Groundwater was never used and this assured water security. An adequate dead storage[3] was found in tanks, which could be used for all purposes during dry periods and was the only source of water for cattle and wild animals. There was a diversity in flora and fauna and the availability of water in the tank during the dry period assured their survival. Sharing resources equally and the equity of ownership were the most striking features of such a culture, which, in turn, led to a peaceful and sustainable rural society.

With the disappearance of the features discussed above, the whole system was subject to deterioration — socially, physically and economically — leaving communities vulnerable to disasters.

The Kapiriggama Village Tank Cascade System rehabilitation programme set out to:

- popularise traditional rice cultivation in the Project area;
- promote agro-chemical free farming practices;
- promote the use of traditional rice varieties as a strategy of adapting to climate variability;
- promote good management of paddy fields to enhance the soil quality and productivity; and
- improve economic and health benefits to the community.

[3] This is the phase when water level depletes to sluice sill level — the volume of water that remains in the tank.

Specifically, the project had the following objectives:

- to introduce traditional rice cultivation;
- to decrease soil and water pollution by minimising the use of agro-chemicals; and
- to generate a mechanism for seed paddy production and seed exchange within the cascade.

2. Traditional rice farming

Rice farming has evolved facing challenges imposed by nature in form of droughts, floods, cyclones and epidemics. Thus, the skills of farming that were developed include various best practices, which can be adopted even within the present context of rice cultivation. Some of them are described briefly below[4]:

2.1. Rice varieties

According to documented history, as far back as 800 BC, there was rice cultivation in Sri Lanka (http://grainsandgreen.com/brief-history/). Since 390 BC, there was construction of irrigation structures, reservoirs, dams and diversions, many interconnected with canals (http://grainsandgreen.com/brief-history/). 'Rice cultivation was not only an economic activity but a way of life' (http://grainsandgreen.com/brief-history/). Once, Sri Lanka boasted of many more varieties of rice (there are 4,541 accessions of rice and related species collected from Sri Lanka conserved at Plant Genetic Resources Centre) (http://www.parliament.lk/uploads/documents/paperspresented/performance_report_department_of_agriculture_peradeniya_2012.pdf), and offered these as the granary of the East to the rest of the world (http://grainsandgreen.com/brief-history/). In the past, rice cultivation in Sri Lanka was sacred and well-planned: the methods of production and the sanctity associated with the process of production made it a truly sustainable process.

These traditional varieties were known to produce higher amounts of glutamic acid once consumed, higher concentrations of vitamins, were richer in fibre, had a lower glycaemic index (https://en.wikipedia.org/wiki/Traditional_Rice_of_Sri_Lanka) and contain many anti-oxidants (http://www.cmb.ac.lk/wp-content/uploads/2014/02/ANTIOXIDANT-PROPERTIES-OF-SOME-SRI-LANKAN-TRADITIONAL-RED-RICE.pdf).

What was known to have nurtured a prosperous society was lost to the nation. At present, more than 95% of the paddy field is cultivated with the so-called semi-dwarf, newly-improved rice varieties, which are harvested using chemicals, non-organic fertiliser and pesticides. However, with the current trend of global awareness of the benefits of consuming organic food and the dangers of using chemical fertiliser and pesticides — both to human health and the environment — traditional rice is gradually making a come-back.

Farmers had many rice varieties, which they developed using natural selection by observing the adaptive ability of tolerance to water scarcity, resistance to pest and disease, impact on soil fertility as well as for various social needs such as health, cultural functions and religious

[4]This document draws heavily from Dharmasena, P.B (2010a). Assessment of traditional rice farming: A case study from Moneragala District of Sri Lanka, Badulla: COMPAS Project Future in Our Hands Development Fund Badulla 2010, Indigenous Knowledge Practices Promotion Programme. 26 pp.

needs. Among them, are many varieties found for specific purposes. Table 1 provides some of the important information of traditional rice varieties followed by Table two which lists their characteristics.

Table 1. The importance of Sri Lankan traditional rice varieties
(Source: https://en.wikipedia.org/wiki/Traditional_Rice_of_Sri_Lanka)

Name of the rice variety	Importance
Suwandel	• This is an exquisitely delicious white rice with a fragrant aroma. It is believed to promote fair and glowing skin; improve the functioning of the excretory system; improve vocal clarity; and help control diabetes. It is also said to support a balanced growth of body. • Its special milky taste makes it an ideal choice for festive occasions and ceremonies. • The nutrient composition of *suwandel* consists of 90% carbohydrate; 7% crude protein; 0.7% crude fat; and 0.1% crude fibre. It is also known to contain produce higher amounts of glutamic acid and higher concentrations of vitamins than more common rice varieties.
Kalu heenati	• Its name literally means dark, fine grain. • *Kalu heenati* is a highly nutritious red rice with medicinal properties, perfect for daily consumption and is recommended traditionally for lactating mothers. It is believed to enhance physical strength and with its high fibre content, it helps regulate bowel movement. It is also said to be effective in keeping diabetes under control, as well as controlling the toxic effects of snake bites. The porridge made from *kalu heenati* rice is recommended for hepatitis patients.
Ma-wee	• *Ma-wee* is a reddish-brown rice variety with a unique texture that is low in carbohydrates, and rich in protein and fibre. It is also proven to have a 25% to 30% lower glycaemic index (GI) in comparison to other common rice varieties. • It has a nutrient makeup of 84.5% carbohydrates; 9.4% protein; 3.6% fat and 1.1% fibre. • It is believed to be effective against diabetes, tuberculosis, constipation, haemorrhoids and cardiovascular disease, and is believed to control corpulence. • *Ma-wee* rice is best when soaked prior to boiling. It is also revered for its historical importance in religious ceremonies. According to folklore *ma-wee* has been placed in caskets of sacred relics and the pinnacle (*kotha*) of *dagabas*.
Pachchaperumal	• The word '*pachchaperumal*' means the Lord Buddha's colour and this rice variety is considered a divine rice in traditional Sinhalese culture. It was often used in almsgivings.

Name of the rice variety	Importance
	• This is a wholesome red rice variety, which, when cooked, takes on a deep rich burgundy colour. It is rich in nutrients and in proteins, and is an excellent choice for daily meals. • *Pachchaperumal* is believed to be a perfect diet for those with diabetes and cardiovascular disease.
Kuruluthuda	• This is a delectable and nutritious red rice variety, which is rich in proteins and fibre. It has a pleasant taste. • *Kuruluthuda* is said to improve bladder functioning.
Rathdel	• This is a delicious red rice that is said to provide relief to those suffering from cirrhosis. Porridge and soup made with *rathdel* is believed to help fight viral fever. It is recommended for rashes caused by mental stress and said to provide relief for ailments in the urinary system. It also believed to help flush toxic excretory matter and cool the body. Roasted and ground *rathdel* raw rice tempered with ghee is said to be an effective remedy for purging. It is also said to prevent the formation of stones in the bladder and gall bladder. Porridge made out of *rathdel* rice, *sarana* (*Boerhavia diffusa*), sugar, raisins and fresh cow's milk is recommended for those suffering from tuberculosis and lung ailments.
Madathawalu	• This is another traditional red rice variety that is highly recommended in Ayurvedic treatment to strengthen the immune system.
Hetadawee	• The duration of the rice crop is 60 days, hence the common name. • It is a red rice variety, which is said to help control diabetes and provide relief for burning sensations and to cool the body. It is believed to relieve ailments caused by biological imbalances; improve physical strength, and also said to be an effective remedy for purging, blood vomiting and bleeding disorders.

Farmers from the Hambantota District have reported that there are many traditional rice varieties tolerant to saline conditions of the soil, including *pachchaperumal*, *wanni dahanala*, *rathdel*, *dahanala*, *kuruluthuda* and *madathawalu* (Dharmasena, 2007). In general, traditional varieties grow taller and are susceptible to lodging. Farmers feel that under conditions that prevail in their fields and the management practices they could adopt, traditional varieties could produce relatively high yields compared to improved varieties. In order to get high yields from improved varieties they have to spend more money for inputs. Further, they note that taste of traditional rice varieties is better than improved varieties, and also that boiled rice of traditional varieties can be kept for a longer time without spoiling.

In the Gene Bank of the Plant Genetic Resources Centre, Peradeniya, there is more than one accession for many traditional varieties. This is because of the wide variation of characters among the accessions for the same variety. Table 2 shows the variation of plant characters of one traditional rice variety *kuruluthuda* registered with different accession numbers. Therefore,

Table 3 provides plant characters of the traditional varieties as ranges. This calls for an evaluation process of the varieties on their performance under the conditions they are cultivated.

2.2. *Bethma govithena*

The *bethma* cultivation practice is adopted during seasons of poor rainfall, when the farmers cannot cultivate the entire paddy tract using the limited water in the tank. Farmers gather together and decide to redistribute temporarily the upper portion of the paddy tract, mostly in equal size. This provides a part of their food requirement. Otherwise, there would be an abandonment of paddy cultivation for that season. Through *bethma*, the limited tank water is used efficiently without causing crop losses. *Bethma* can also be practised in combination with field rotation, and the farmers may decide to cultivate either paddy or other field crops. This decision usually depends on the water level in the tank. In some cases, the land distribution is proportional to the ownership land, but in most cases, it is divided in equal portions. Allocation of the plots is usually carried out by either the *vel-vidane* or the farmer organisation.

2.3. *Pangu kariya*

Farmers divide maintenance works — such as cleaning the tank bund, clearing canals, repairing bunds, cleaning sluices — among themselves to prepare the irrigation system for seasonal cultivation. This reduces the cost and creates a sense of responsibility, ownership and accountability. Performance is good and working together strengthens social cohesion. Regular maintenance ultimately contributes to efficient water management and system sustainability.

2.4. *Kekulam govithena*

Dry sowing of paddy seeds early in the season is referred to as *kekulam govithena*. When dry sowing is carried out in tank upstream areas, it is called *vee hena* or *goda hena*. In the traditional *kekulama* method, the dry fields are ploughed with the country plough (Sinhala: *Nagula*; Tamil: *Kalappai*) to obtain a dispersed soil and to bury the weeds. At the inception of rains, dry seeds are sown anticipating more rains. After sowing, the land is shallow and ploughed to mix-up the seeds with soil. In some instances, when the field becomes adequately wet, the same *kekulama* is practised, but sprouted seeds need to be sown instead.

In some paddy tracts and under some tanks, certain sections are sown to *kekulama* and then when the tank is full of water, other sections are cultivated with normal wetland land preparation. A study indicated that delaying cultivation without adopting the *kekeluma* method leads to a high irrigation requirement and this practice failed to use a considerable portion effective seasonal rainfall for cultivation (Dharmasena, 1989).

Table 2. Major plant characters of accessions registered as the traditional rice variety *kuruluthuda*
(Source: Plant Genetic Resources Centre, Department of Agriculture, Gannoruwa, Peradeniya)

Plant Character	*Kuruluthuda* accessions								
	1	2	3	4	5	6	7	8	9
Seedling height (cm)	35.0	37.1	41.0	39.9	37.6	47.2	31.5	28.8	28.4
Leaf blade length (cm)	57.7	63.8	66.8	63.8	48.1	73.8	71.9	54.5	63.0
Leaf blade width (mm)	14.4	14.6	14.2	10.4	6.2	11.6	1.4	14.0	15.0
Leaf blade colour	purple margins	purple margins	green	green	pale green	green	green	green	green
Culm length (cm)	123.8	125.9	121.2		83.6		120.6	102	106.6
No. of tillers	5	5	7				42	5	13
Lodging resistance	moderately strong	moderately strong	strong	strong	strong	very weak	weak	moderately strong	weak
Panicle length (cm)	27.7	26.7	23.5		26.8		24.8	22.0	30.8
Secondary branching	light	light	light	absent	absent	absent	light	heavy	absent
Panicle threshability				easy	easy	easy		easy	
100 grain weight (g)				2	3	3	1.9		
Grain length (mm)				6	6.5	6	6.4		
Grain width (mm)				3	3	3.5	3.2		
Bran colour				white	red	light brown		red	
Days to maturity	161	160	128					125	

Table 3. Major plant Characters of some traditional rice varieties
(Source: Plant Genetic Resources Centre, Department of Agriculture, Gannoruwa, Peradeniya)

Plant Character	***Rathdel***	***Pachcha perumal***	***Dahanala***	***Suduru***	***Kuruluthuda***	***Kuru wee***	***Madael***	***Wanni dhanala***
Variety group	indica	indica	indica	indica		indica	indica	indica
Seedling height (cm)	19 – 45	19 – 36	25 – 28	26 – 45	29 – 47	42	26 – 48	41
Leaf blade length (cm)	23 – 82	30 – 78	32 – 64	44 – 60	48 – 74	47	38 – 71	52
Leaf blade width (mm)	9 – 15	9 – 10	8 – 13	9 – 10	6 – 15	10	9 – 14	8
Leaf blade colour	pale green to dark green	pale green to dark green	pale green to dark green	pale green to dark green	pale green to dark green	green	green	green
Days to heading	72 – 131	81 – 92	68 – 79	61 – 89	82 – 131	112	44 – 135	80
Culm length (cm)	70 – 142	76 – 87	73 – 95	77 – 127	84 – 126	110	72 – 124	81
No. of tillers	5 – 30	7 – 25	12 – 18	7 – 32	5 – 42	7	5 – 8	5
Culm angle	Erect < 30^0	45^0 - 60^0	30^0 - 60^0	45^0	30^0 - 60^0		variable	45^0
Lodging resistance	strong to mod. strong	strong to interm.	strong to mod. strong	mod. strong to interm.	variable		weak to very weak	mod. strong
Panicle length (cm)	12 – 30	19 – 26	18 – 26	21 – 27	22 – 31	23	22 – 48	24

Plant Character	***Rathdel***	***Pachcha perumal***	***Dahanala***	***Suduru***	***Kuruluthuda***	***Kuru wee***	***Madael***	***Wanni dhanala***
Panicle type	Interm.	Compact to interm.	Compact to interm.	Interm. to open	Compact to interm.		Compact to interm.	
Secondary branching	variable	absent	absent to light	absent to light	absent to heavy	light	light to heavy	light
Panicle shattering	very low	very low	low	very low to low	very low to moderate		very low to low	
Panicle threshability	easy	easy	easy	Interm. to easy	easy		Difficult to interm.	
Awning after full heading	absent to short and partly awned	absent	absent	absent	absent	absent	absent to short and partly awned	absent
100 grain weight (g)	1.2 – 1.6	2.4 – 2.9	2.0 – 4.0	1.5 – 5.0	1.9 – 3.0		2.4 – 3.0	
Grain length (mm)	6.2 – 9.0	7.9 – 8.2	6.7 – 8.5	6.2 – 8.0	6.0 – 6.5		6.1 – 8.4	
Grain width (mm)	2.2 – 3.5	2.9 – 3.4	2.4 – 3.0	2.8 – 3.0	3.0 – 3.5		2.3 – 3.1	
Bran colour	white to light brown		light brown	red	light brown to red		light brown	
Scent	non-scented				non-scented			
Days to maturity	136 – 191	122	131	124	128 – 161	142	120 – 165	110

2.5. Crop protection

In Sri Lanka, there were many traditional practices designed to protect crops from the damage caused by wild animals. During the last century, land use changed considerably. In the wet zone forests, large scale tea and rubber plantations expanded. In the dry zone, extensive irrigation projects promoted paddy farming and colonisation, through the removal of forests. In this process, farmers have been driven into marginal lands and today, these areas are often close to wildlife reserves.

According to traditional practice, agricultural cultivation was a community activity. Cultivation started with a vow to the gods to ensure the success of cultivation. Then cultivation was initiated by the village leader in one area, at an auspicious time. These activities were followed by several agricultural practices: minimal tillage of the land; mixed cropping and seeding wherever possible; fencing activities at auspicious moments; crop protection like the cultivation of a small portion of land (*kurulu paluwa*) to attract birds for pest management in paddy; performing *kems* — a ritual or a religious rite; and if necessary, the supplementation of these actions with use of plants or plant extracts (bio-pesticides); harvesting and heaping in the field for some weeks or months; threshing and separating a small portion for the *mangalya* or other festival.

There are three categories of traditional practices to protect crops from wild animal damage. The first group is based on astrology, the second on the powers of the spirits and Gods, and the third involves the chanting of verses and the use of specific symbols. Often these different practices are combined (Upawansa, 2000).

2.5.1. Astrological practices

Some astrologers are generalists, while others are specialised in health, agriculture and helping travellers.

Astrology plays a dominant role in agriculture, especially in the cultivation of rice. Farmers believe that certain days are good for beginning cultivation. They also avoid certain days, which they consider inauspicious or unlucky. Usually, a Sunday is chosen to initiate work relating to paddy cultivation. The work is begun on an auspicious day and at an auspicious time. Most farmers follow the astrological calendar or *pancha suddiya* to ensure success and avoid bad luck (http://goviya.com/activating-powers.htm).

2.5.2. Spirits and Gods

If the people realise that issues cannot be addressed by their own strategies, then they expect the support of Gods and spirits. One such example is that all farmers visit a temple and make offerings before they start cultivating their crop. Each season, almost every farmer performs an offering and hangs a coconut in the field before cultivation begins. They also participate in the communal rituals held at the temple. After the harvest, farmers perform a ritual in the field before use. They believe that such practice would please unseen forces. These activities still take place in some rural villages.

Since ancient times, rituals have been used in Sri Lankan agriculture to support crop growth and animal husbandry, and to chase away wild animals or pests that damage the crops. The combination of spiritual practices, astrology and eco-friendly technologies have become customs. Despite the impact of the green revolution, many of these spiritual practices still exist, but in some instances, their full meaning is not fully understood by younger farmers (Dharmasena, 2010a).

2.5.3. *Pirith*

Pirith is the Lord Buddha's teaching for laymen and involves chanting specific verses in a group. Each verse deals with some aspect of good living. Some of these prescriptions are used for crop protection. The verses are used to charm sand and water. These are then sprinkled thinly over the field. Chanting specific verses extracted from Buddhist teachings is carried out in a group. In some areas, symbols are painted on an *ola* leaf and hung in the corners of the field. However, the performer must live a pious life and must refrain from robbery, sexual misbehaviour, eating animal protein or drinking alcohol (Dharmasena, 2010a).

2.5.4. *Manthra*

Manthra chants with specific sounds, repeating the same version specific number of times. This causes a vibration in the environment. This is said to influence the spirits to bring about a desired effect. In the *mantra,* Gods or religious leaders, like Lord Buddha or the Prophet Mohammed, can also be called upon and their great achievements are recalled.

Each *mantra* is different and depends on which animal is being addressed. When elephants are threatening the crops, the *mantra* must be accompanied by placing a charmed coconut flower in the middle of the plot. If the animal concerned is a wild boar, a glowing fire stick is charmed and dipped in the paddy field.

To prevent rat attack, sand and pebbles are taken from the field and these are then charmed. The sand is then sprinkled over the field, while pebbles are buried in each of the corners. Charmed pebbles are also buried in each corner of the field to ward off monkeys. Birds are kept away by burying charmed mustard seeds and sand in the centre of the field (Dharmasena, 2010a).

2.5.5. *Yanthra*

A symbolic drawing preferred by a particular spirit is hung or kept in a specific place to receive blessings of an unseen power, so that daily activities may be carried out without threat. Drawing a *yantra* involves following certain laws. If these laws are not carefully followed, it is believed that not only will the *yantra* have no effect, but that evil things may happen. For the spirit to occupy the *yantra* it has to be enlivened with specific verses, or *mantras*.

In agriculture, the use of *yantra* is widespread. Generally a *yantra* is placed in the centre of the rice threshing floor. An abstract geometrical drawing is used: three concentric circles and eight radial lines with different drawings on the outside. The *yantra* is placed or drawn on the threshing floor, certain items such as an oyster shell, a coconut, a piece of iron are placed on it, together with a few bundles of paddy (http://www.bibalex.org/Search4Dev/files/416886/362468.pdf).

2.5.6. *Kem krama*

The practice of *kems* is very widespread in rural Sri Lanka. A *kem* is a kind of practice, technique or custom that is followed in order to obtain some favourable effect such as relief from a specific illness. For example, washing in a pool of water immediately after a crow washes in that pool is believed to bring relief to people suffering from certain infirmities. A requirement in this *kem* is that the patient should wash without speaking or making much noise.

Some *kem* combine the use of astrology and the use of certain plants or herbs. Other *kem* depend on the use of specific plants and *mantras*. These traditional practices have survived because they must be effective. If these had no real effect, they would have disappeared long ago.

There are also *kem* that do not involve any belief in spiritual beings or gods. These *kem* are based on a careful observation of nature and natural phenomena. Some *kem* are mechanical methods, like the lighting of fire torches. These torches are made using a piece of saffron robe for the wick and sticks of trees *Calatropis gigantea* (Sinhala: Wara; *Tamil*: *Erukkalai*), *Pagiantha dichotoma* (Sinhala: *Divi-kaduru*; Tamil: *Nanthia-vattai*) or *Leea indica* (Sinhala: *Gurula*; Tamil: *Nyckki*) for the handle. There are various conditions that have to be met to make the *kem* successful. With some *kem*, women are prohibited from entering the field altogether, while other *kem* must be performed only by women or even by pregnant women only. The effectiveness of a *kem* can be nullified if the person is exposed to a *killa* or impurity caused by eating certain food (especially meat) (http://goviya.com/activating-powers.htm).

3. Strategic approach

The paddy sector is extremely vulnerable to the impacts of climate change. Over the years, on many occasions, farm lands have been damaged heavily by floods or droughts. Traditional agriculture practices that use local paddy varieties have proven to be more successful in withstanding such impacts.

Today, there are only a handful of traditional paddy varieties in existence in Sri Lanka. These are: *suwandel, rathdel, kaluheenati, ma-wee, kuruluthuda, pachchaperumal, madathawalu, hetadha wee, hondarawalu, girisa*, and *heenati*. Compared to the newer varieties used in chemically intensive paddy cultivation, these traditional paddy varieties have unique characteristics that help them survive the impacts of climate change such as droughts, heavy rains, and floods.

The Government has clearly identified the problem of farmers and the country's agriculture. Rehabilitation of irrigation schemes at all scales and the development of new schemes all over the country are the focus of a plan to improve the agriculture in the country. In this context, paddy cultivation will be still encouraged to face the challenge of achieving the national annual production requirement of 3.5 million metric tons of rice by the year 2025. Thus, the IUCN-HSBC programme is on par with the identified national goals in agriculture. Today, one of the major problems in paddy farming is the deterioration of resource base that causes a gradual decline in the productivity and profitability of paddy farming sector.

During the Project, the following strategies were adopted to address the problems stated above:

- ways of reducing the cost of production, especially by addressing the problems of weeds, pest and diseases;
- adoption of low cost practices to enhance soil fertility — such as use of straw, green manure, cow dung, poultry manure, liquid fertiliser; and .
- methods to increase profitability of rice farming by lowering the cost of input use and offering high market price for traditional rice varieties.

4. Adaptable practices

As mentioned at the beginning of this document, traditional rice farming consists of many practices during the cropping period. However, it may be difficult to introduce all at once, as these practices are now new to many farmers. Considering this fact, the following four main components are recommended to bring back the practice of traditional rice farming.

- Cultivation of traditional rice varieties;
- Land preparation and water management taking cognizance from traditional farming;
- Applications of fertilisers of organic origin (such as straw, green manure, cow dung, poultry manure, liquid fertiliser);
- Management of weeds through hand weeding, mechanical weeding and water management; and
- Management of pest and diseases by practising *kem krama* (rituals), maintaining biodiversity and using bio-pesticides.

4.1. Traditional rice varieties

After a programme that created awareness about traditional varieties, farmers in the project area showed a particular interest to undertake the practice of using traditional varieties. Current health problems ensuing from the use of agro-chemicals and inorganic fertiliser is leading them to believe that traditional rice farming is only the possible alternative solution. It is recommended that they use various rice varieties available around them — such as *kuruluthuda, pachchaperumal, suwandel, rathkanda*, and *kalu heenati*.

4.2. Land preparation

If the *nagula* and buffalo practice is not possible, it is recommended that farmers use a two-wheel tractor with a rotary to plough fields. Partially burnt paddy husk and *Gliricidia* leaves should be spread over the field two weeks after the first ploughing. Bunds are repaired before levelling the field.

4.3. Planting method

Broadcast sowing is preferable. A seed rate of 45–50 kg/acre with traditional varieties is sufficient. (For improved varieties, a rate of 60–70 kg/acre is used.)

4.4. Water management

In a month's time, land preparation and sowing must be completed with irrigation water. Subsequently, irrigation water is supplied once in four days.

4.5. Addition of organic matter

Farmers should apply partially burnt paddy husk, cow dung, liquid fertiliser, *Gliricidia*, *Thespesia populnea* (Sinhala: *Gansooriya*; Tamil: *Puvarachu/Kavarachu*) *Justicia adhatoda* (Sinhala: *Adathoda*; Tamil: *Pavettai*) and rice straw.

4.6. Pest management

Spreading ash over the field, walking across the field, *kem krama*, placing crushed *Derris* spp. (Sinhala: *Kalawel*) packed in bags, astrological methods, bio-pesticides are good methods of pest management.

Farmers believe that use of inorganic fertiliser does not increase yield much in saline soils, but that a satisfactory yield can be obtained with organic fertiliser with low or no cost. They do not observe a difference in the quantity of weeds in fields cultivated with traditional varieties and those with improved varieties. Crop growth at the beginning is observed to be slow in traditional varieties, but shows a rapid growth rate at development stage. Yields could be obtained as 90–100 bushels per acre irrespective of the variety (Dharmasena, 2007).

5. Performance evaluation

It was found very difficult to evaluate the overall performance of the farmers and farming practices because of the wide variability in inputs, practices, effects and impacts. Further, the challenge in evaluating some aspects — such as social cohesion, mental satisfaction — remains unsolved in economic evaluations. Therefore, the author has developed a performance index embedded with quantitative, as well as qualitative, aspects of the evaluation process (Dharmasena, 2010a).

Table 4 shows the format to assess the overall performance of the cultivation. Values in each row should total up to 100 for each performance. This is based on the assumption that the proposed set of practices will bring full benefit of all aspects considered in the matrix. It means that 100 % of performance on any benefit is expected from the practices applied.

The matrix has been prepared with practices (use of traditional rice varieties, organic manure, medicinal liquids, herbal seed treatments, astrology or *nekath, manthra, yanthra, rituals* and *kem*,

non-use of artificial fertiliser, insecticides, and weedicides and adoption of appropriate spacing) against their performance in relation to economic benefits, low labour use, low production cost, improved family health/ nutrition conditions, environmental benefits, increased yield, mental satisfaction and social cohesion.

Practices / Performance (Pi)	Use of traditional varieties	*Use of Organic manures*	Use of medicinal liquids	Systematic planting	Non use of inorganic fertilizer	Non use of Insecticides	Non use of weedicides	Seed treatment (Herbal)	Astrological practices	Use of manthra	Use of rituals	Use of Kems	
P_1 Economic benefits													100
P_2 Low Labor use													100
P_3 Low cost of production													100
P_4 Family health/Nutrition													100
P_5 Environment													100
P_6 Yield													100
P_7 Mental satisfaction													100
P8 Social cohesion													100
Performance reduction due to absence of activity (%)													

Table 4.Format developed for Overall Performance Index (OPI) on traditional rice farming
(Source: Dharmasena, 2010a)

Overall Performance Index (OPI) % = $(P_1+P_2+P_3+P_4+P_5+P_6+P_7+P_8) \times 100/8$

6. A comparison between traditional and current rice farming

An assessment was made in Moneragala District to compare the traditional rice farming and modern high input based rice cultivation through a comprehensive field study conducted by Future In Our Hands (FIOH) Development Fund in 2007/08 *maha* season and 2008 *yala* season. The study included soil analysis, crop growth measurements and field surveys for crop economics and pest and diseases incidence. Findings are reported in Dharmasena, 2010. A summary is given below.

6.1. Soil Status

- In any soil if EC value[5] is larger than 2, then the field is considered to be salt affected. If the value exceeds 5 then the soil is considered not suitable even for paddy cultivation. A few varieties such as At 354, At 401, Bw 400 — and traditional varieties — such as *pokkali, nonabokra, muppangam* are tolerable to a salinity level (EC) up to 5 milli-mhos/cm. After three months of traditional cultivation practices, the salinity level could be brought down to a level lower than 5 milli-mhos/cm.
- There is no significant difference observed between soil pH values of rice fields cultivated with modern and traditional practices. However, a slight increase in pH of traditional rice fields and slight decrease in pH of conventional rice fields was observed after three months of cultivation.
- Soils are low in available phosphorous (P). Available soil P were higher in traditional fields than that in modern farming fields at the beginning, but an increase of available P in soils after three months of cultivation was observed as 19 % and 10 % in traditional and modern cultivation fields respectively.
- Exchangeable potassium (K) in traditional farming sites was relatively high even at the beginning. However, K had not been a problem for rice cultivation. The soil K increased by 52% and 33% in traditional and modern farming fields respectively after three months of cultivation.
- Soil organic matter content in all rice fields studied was adequate to keep the soil condition favourable for rice cultivation. However, in traditional farming sites an average increase of 8% could be observed during a three-month cultivation period, while an average drop of 10% was reported from modern farming sites.
- Although rice plants can grow in heavy soils, they also need some form of soil aeration, which facilitates the root respiration process. In the absence of a structure, soil is more compacted and should be improved with addition of organic matter so that it becomes physically fertile for paddy farming. Results indicate that soils with traditional farming were 46% less compacted compared to that with modern farming (Dharmasena, 2010a).

[5] Electrical conductivity

6.2. Growth Performance of Rice Crop

- Basic plant characteristics — such as plant height, leaf length and width — do not differ much due to variety and location.
- Tiller density was high in modern farming fields, probably because of a high number of plants established per hill. The average number of seeds found in a tiller was about 80. A clear reduction in tiller density was observed in the *yala* season compared to previous *maha* season irrespective of varieties and locations because of water shortage (Dharmasena, 2010a).
- Tiller productivity of rice plant had seriously dropped in the *yala* season as a consequence of the shortage of water. It decreased from the average value of 80 observed in the *maha* 2007/08 season to 32 in the 2008 *yala* season.
- Grain weight of traditional varieties is 11% higher than that of improved varieties. However, 1,000 grain weight decreased from 25 g observed in the *maha* season to 17g in the *yala* season.
- Both traditional and improved rice varieties performed equal grain filling percentage (80%) in the rice fields studied.
- The average leaf area was relatively low in traditional varieties when compared to improved varieties. This is a disadvantage of traditional varieties in photosynthesis (Dharmasena, 2010a).

6.3. Crop Economics

- The yield variation within a geographical area can be attributed to a range of reasons — such as the use of different amounts of inorganic fertiliser, response to pest and disease incidence through use of various agro-chemicals, inheritance of soil properties and irrigation water management. Analysis shows that the relationship between input cost and the yield is linear and shown by the following equation.

  Yield (kg/ha) = 0.034.
  Input cost (Rs./ha) – 95, $r^2 = 0.62$*

- Cost of production and the return to investment do not vary much according to the input levels.
- Farmers should be encouraged to move towards an optimum input level for achieving a satisfactory income from paddy farming.
- There is a need to find ways and means to reduce the present input cost.
- The marketing network should be established to enable farmers to sell their produce at a higher price.

- Machinery cost for traditional farming was relatively low. Modern farmers spent 15% more on tractors. Of the total investment made during the *maha* 2007/08 season, farmers spent 42% and 28% for machinery use in traditional and modern farming respectively.
- Material cost includes cost of fertiliser, agro-chemicals, seeds and others. In traditional farming, the cost for application of organic fertiliser sources and bio-pesticides was included in the material cost. Material cost can be reduced by 55% with the adoption of traditional farming.
- Total labour use for cultivation was in the range of 60,000 – 80,000 rupees/ha, and it was in the range of 60-75% of the total input cost. Use of family labour in traditional farming was found relatively high compared to that in modern farming. As a result, expenses incurred for hiring labour in traditional cultivation can be reduced by 57%.
- The average total investment made to produce one kg of paddy from traditional farming was only about 12 rupees, while it was about 17 rupees from modern farming (Dharmasena, 2010a).

6.4. Resource Productivity

- Due to low yields obtained from traditional farming, average land productivity was rupees. 39,800/ha, while it was rupees 47,700/ha from modern farming. Thus, land productivity was 17% lower in traditional farming.
- Farmers expect a seed productivity of 50 under normal condition. However, the observed average seed productivities were below this value and in the range of 30-40.
- Labour productivity in traditional farming was 32% higher than that of modern farming. Further, in traditional farming, farmers can earn more than rupees 1,000 per day, which is a reasonable rate under present circumstances.
- Capital productivity in traditional farming is 33% higher, when compared to improved farming. Family labour can be used more effectively in traditional farming.
- When family labour was not considered in the calculation, it was found that in traditional farming, production of one kg of paddy could make a net return of Rupees 20.50, while the net return from modern farming was only Rupees15.70 (Dharmasena, 2010a).

6.5. Plant Protection

- Average pest:predator ratio in modern farming fields was 0.83 and below the required level of 2.0 for natural protection. The value with traditional farming was 2.4 indicating that the crops are well managed by natural processes.
- Weed biomass remaining after harvest will be an important organic matter source for the next season. An average amount of 11 mt/ha (fresh weight) remained on land after removal of paddy grains with straw during harvesting. This amount does not depend on

the two farming practices. Variation observed may attribute to soil fertility level, water supply and the farmers' management practices.

- Increased biodiversity is a factor behind successful protection of rice crops. In addition to rice plants about 50 plant species were identified in traditional farming fields, while there were only 27 found in modern rice farming fields.
- The number of broad-leaved species found in traditional farming field was 23, while only 10 species were found in modern rice fields. This is a consequence of applying weedicides, which destroyed all weeds including broad-leaved plants, which are desirable in contributing to the growth of rice plant (Dharmasena, 2010a).

6.6. Overall Performance Index (OPI)

- The OPI was developed to assess the performance of practices on various types of benefits anticipated by the farmer related to, *inter alia*, economy, environment, family health, mental satisfaction.
- The advantages of the OPI are that
    - it can assess the adoption level of different farmers;
    - it determinesthe effectiveness of different practices;
    - it shows relative performance by farmers;
    - it can be used to monitor the progress of farmers;
    - it can be used for evaluating performance before the Project terminates; and
    - farmers can be guided to improve their practices.
- The OPI matrix includes a set of practices (such as traditional varieties, organic manure, liquid fertiliser, non-adoption of chemical inputs and practice of *yanthra*, *manthra*, *kem*, *puja*) and their expected performance (economic, labour use, cost of production, family health/ nutrition, environment, yield, mental satisfaction and social cohesion).
- The OPI matrix indicates following facts in traditional farming:
    - The most effective practices in traditional farming are: use of traditional varieties; refraining from using inorganic fertiliser; and use of organic manures. Other important cultural practices include planting on the right time (finding the auspicious time based on astrology), non-use of weedicides and use of *kem krama*.
    - People gain mental satisfaction mostly from the use of traditional varieties, use of rituals and refraining from the use of inorganic fertiliser, insecticides and weedicides.
    - Benefits to the environment mostly come from practices such as refraining from the use of insecticides and inorganic fertiliser, and the use of organic manures.
    - Family health of traditional farm families can be assured with the use of traditional rice varieties, use of organic manures and liquid fertiliser and refraining from the use of insecticides and weedicides.
    - When plants are established at the right time with traditional cultural practices (including astrological practices, *yanthra* and rituals), labour use will become minimal for the application insecticides and inorganic fertilisers.

- The cost of cultivation can be reduced by a considerable amount if organic manure is used instead of inorganic fertiliser; traditional *kem krama* and astrological practices are used instead of using insecticides; and systematic planting practices are adopted for managing pests.
- Social relationships in the community will be improved if the farmers use traditional rice varieties, follow astrological practices, adopt *kem karma* and adhere to systematic planting.
- Economic benefits would mostly be gained from the use of traditional varieties and organic manures and non-use of inorganic fertiliser, insecticides and weedicides (Dharmasena, 2010a).

7. Project interventions

- Two awareness raising programmes were conducted for 104 farmers on the importance, advantages, and methodology for traditional rice cultivation. The seed paddy supplier, the Department of Agriculture, the Agriculture Instructor (AI) of the area, and IUCN Technical staff engaged in activities related to the programme, such as awareness raising, selection of suitable seed paddy, and distribution of seeds. Farmers were guided to select the suitable varieties depending on their requirement, interest, and the respective land characteristics.

Figure 1. Awareness raising programme on traditional rice farming
(S. M. M. Senavirathna © IUCN)

- Awareness raising programmes included the introduction of methodology for preparing organic fertilisers and bio-pesticides that can be used in the paddy lands.

Figure 2. Training farmers on preparation of bio-fertilisers
(Kumudu Herath © IUCN)

- It was arranged that 45 farmers and five officers from the Rambewa Divisional Secretariat visited two sites of traditional farming (Dambulla and Matale) to gather knowledge on chemical-free agriculture, traditional rice farming and the preparation of bio-fertilisers.
- Four hundred and fifty kilogrammes of traditional seed paddy belonging to four varieties (*pachchaperumal*, *kalu heenati*, *rath kanda*, and *kurulu thuda*) were distributed among the farmers in the cascade area for cultivation during the 2013 *maha* season. The seeds were purchased from a certified traditional seed paddy supplier, who is also a traditional rice farmer, from Rambewa. The seeds were purchased with project funds.

Figure 3. Selecting traditional seed paddy for the project
(Kumudu Herath © IUCN)

- Two hundred and thirty kilogrammes from the above varieties of traditional rice paddy seeds were distributed among 104 individual farmers who cultivate in the command areas of Konakumbukwewa, Galkadawala, Puliyankulama, Maha Kadiyawa, Mailagammana, and Massalawa tanks. Nearly two kilogrammes of seed paddy were given to each farmer under the condition that they return the same quantity of seed paddy, from their yield, free of charge, to another farmer in the project area for expanding the programme.
- The remaining 220 kg of traditional seed paddy (*rath kanda* and *kurulu thuda*) was given to a group of framers in Konakumbukwewa for cultivating in a common field. This approach was taken because there was a limitation to the land that could be cultivated in the 2013 *maha* as a consequence of the limitation of water. As above, farmers are expected to return the amount of seed paddy they receive to another group of farmers in the next season.

Figure 4. A tract of paddy cultivated with the traditional rice variety *kurulu thuda* (Kumudu Herath © IUCN)

Figure 5. Several tracts of paddy cultivated with the traditional rice variety *rath kanda* (Kumudu Herath © IUCN)

Figure 6. Traditional paddy variety *kurulu thuda*
(Kumudu Herath © IUCN)

8. Recommendations for the future

- The programme should be continued in the cascade. Technical assistance should be provided continually, through the AI. Farmer to farmer technology transfer should be strengthened.
- The seed paddy obtained from the regular paddy fields has a tendency to be mixed with other paddy varieties. Therefore, a continuous reliable supply of traditional seed paddy has to be arranged. This can be achieved either through Department of Agriculture seasonally or by providing the farmer the necessary resources for generating his own high quality seed paddy using standard procedures.
- Market opportunities have to be created for farmers to sell their produce at a reasonable price. Measures have to be taken to prevent adulteration of the produce along the supply chain from the farm gate to the customer.
- A quality assurance procedure should be introduced to certify good quality traditional rice produced without using agrochemicals. In this way, both the farmer and the consumer benefit: the farmer obtains the highest price for his produce, while the customer receives a good quality product for the price he/she pays.

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