Kuttanad Below Sea Level Farming System

(The only system in India that has been practicing rice cultivation below sea level since the past 2 centuries)

A Candidate System for

Globally Important Agricultural Heritage Systems (GIAHS) Programme, FAO, Rome

A proposal by

M S Swaminathan Research Foundation, India and the Government of Kerala

Kayal:- The major water scapes of the region PIC 1

SUMMARY INFORMATION

a. Country and location : INDIA, Kerala State, Kuttanad region (parts of Alappuzha, Kottayam and Pathanamthitta districts)

b. Name of the system : **Kuttanad Below Sea Level Farming System (KBSFS)**

c. Requesting agency/ organization : M S SWAMINATHAN RESEARCH FOUNDATION (MSSRF)

d. Governmental counterparts and other partners:

1. Department of Agriculture, Government of Kerala
2. Department of Water Resources, Government of Kerala
3. Farming Families of Kuttanad
4. Kottayam Nature Society, Srinilayam, Near Union Club, Kottayam, Kerala

e. Summary (max. 200 words)

Kuttanad Below Sea-level Farming System (KBSFS) is unique, as it is the only system in India that practices rice cultivation below sea level. The major land use structure of KBSFS is flat stretches of rice fields in about 50,000 ha, of mostly reclaimed delta swamps. They exist in three landscape elements: Karapadam (upland rice fields), Kayal (wetland rice fields) and Kari (land buried with black coal like materials). The rice fields are popularly known as "Puncha Vayals". Traditionally KBSFS favoured only one crop of paddy followed with inland and estuarine fish wealth, notably the endemic prawn species, pearl spot and clams. The Puncha Vayals with coconut gardens on the bunds and crisscrossed water canals offer an amazing sight. Farmers of Kuttanad developed and mastered the spectacular technique of below sea level cultivation, which has several similarities with the Dutch polder system, over 150 year ago. They made this system unique as it contributes remarkably well to the conservation of biodiversity and ecosystem services including several livelihood services. The recognition of KBSFS as a Globally Important Agriculture Heritage System will instill pride in the farm families of this area and will lead to the conservation of this unique below sea level rice-fish farming system. The conservation and refinement of KBSFS is particularly important in this era of global warming, leading to a rise in sea level. Island States like Maldives as well as countries like Bangladesh are deeply interested in replicating the Kuttanad system.

A Panoramic view of Vembanad Lake along with the Kayal Land on the rightern side PIC 2

DESCRIPTION OF THE SYSTEM

1. Characteristics of the proposed GIAHS

1 (a) Kuttanad- A Complex Mosaic of Fragmented Agricultural Landscape

Kuttanad is a delta region of about 900 sq. km situated in the west coast of Kerala between latitude of 90 8'and 90 52' and longitude of 760 19' and 760 44'. The region was formed through natural reclamation of flood deposits of four rivers -Pamba, Achancovil, Manimala and Meenachil that originating from Western Ghats-a global biodiversity hotspot-and partly by the skillful and ingenious efforts of local communities. The geographic area has a concave relief and slopes towards northwest and reaches below sea level towards west where it joins Vembanad Lake- a Ramsar site. This is an expanse lake of about 80 sq km, which opens to Arabian Sea near Cochin- a famous port city of India. It is estimated that about 500 km2 of the area with agricultural fields situated below sea level (See Map).

The landscape composition, structure, management and the regional context of Kuttanad are unique and significant. The area is a larger mosaic of fragmented landscape patches and varied ecosystems such as coastal backwaters, rivers, vast stretches of paddy fields, marshes, ponds, garden lands, edges, corridors and above are remarkably networked water ways. The system with this composition, structuring and use patterns constitutes the so-called Kuttanad Wetland Agricultural System. Agriculture and Inland Fisheries are the major land/water use practices of the system, which considered as the largest wetland use system in the west coast of Indian peninsula (MSSRF, 2007)The system is significant in terms of biodiversity conservation and ecosystem services- largely regulation of the hydrology of the region and maintenance of livelihood services to people.

1 (b) Kuttanad Below Sea-level Farming System (KBSFS)

KBSFS has three distinctively identifiable landscape structures viz:

(i) **Wetlands:** Landscape that situates usually below MSL ranging from 0.60m to 2.00m, part of which are reclaimed lands and form the traditional paddy cultivation areas called Puncha Vayals. Puncha Vayals are with abundant sediments, sand, silts and even buried remains of timber of huge trees and dead vegetation. In normal course, the buried material can go deeper and deeper and become fossils over million years, if there is no pressure from outside environment. But the history of

PIC 3-6

Clockwise from left bottom: *1) Reclamated Kayal land, 2) Karapadam with Bushes on edges, 3) Garden land housed with an ancient temple (Monkombu), 4) Fosilised timber from Karipadam,*

From left : *1) Manually harvested paddy kept on side bunds of the field- A typical scene of Kuttanad in the past, 2) Puddled Kayal land, 3) Machine harvested Paddy - the present day scene.*

PIC 7-9

Kuttanad was different, people came over here had modified the ecology, managed the hostilities and transformed the swamps to cultivable, fishable and habitable lands through hundreds of years of efforts. Puncha Vayals are classified into patches of Karapadam, Kayal and Karipadam according to the landscape structure, function and land use. Many habitations of the region are called by names suffixed with "Kari' meaning the land buried with black coal like materials or gathered with Kayal, meaning reclaimed lands from water body. Some examples of present day villages with such names are: Ramankari, Kainakari, Mampuzhakari, Manimangalam Kayal, 24000 Kayal, Rani Kayal, Chithira Kayal and so on. The Kayal Land is about 9,464 ha area at elevations 1.0 m to 2.0 m below MSL with bund levels ranging from 0.6 to 1.1 m above MSL and Karapadam of ca. 16280 ha with over 600 reclaimed stretches of rice paddies (padasekharams) in this area (MSSRF, 2007) .In the Kari Lands, the Purakkad Kari is an area of 3,500 ha with 43 padasekharams situated 1.5-2.0 m below MSL.

(ii) Garden land: These are raised lands of an area size of ca.31, 000ha and 0.50 to 2.5 m above MSL with coconut as the major crop.

(iii) Water areas: Large expanse of water comprising the rivers and lake system, in which roughly 13000 ha are actively used for fishing and other water based livelihoods.

These three landscape elements have been used in a remarkable way that show, how the wisdom and the prudent management and ingenious practices of local communities made possible the rice cultivation below the sea level and enhance the complex ecosystem services for rice, fish-shell-clam production.

Puncha Vayal Padasekharams –the Reclaimed Landscape Patches

Padasekharams are large contiguous flat patches of rice fields that range between few ha to 2500 ha in size and large portions are reclaimed during 150-200 ago. It is believed that the natural emergence of land in the region made the people to aspire for more and more land and started developing the polder system of pumping out water and changing the course and intensity of river flows and lake depth. One of the inventive practices of early days was construction of retaining walls with dry rubble packages, which called 'pulimuts' for this purpose and to protect the river strands.

Though by 1870s reclamation became a trend, the system evolved its full potential by later part of 19th century (Pillai and Panicker, 1965; 16 and GOK, 1971; 5). By early 20th Century about 2226 ha and by 1930s 5261 ha of land was reclaimed in the Vembanadu (GOK, 1971; 5). These padasekharams are largely located in Pulimkunnam, Neelamperoor, Kainakari, Veliyanadu and Kavalam panchayats. The padasekharams with their reported area size are: D Block (729 ha), E Block (402 ha), H Block (783 ha), R Block (619 ha), Raja Ramapuram Kayal (539 ha), Mangalam Kayal (402 ha), Parampady Ponupakke padom (352 ha), K & L Block and Aappu Kayal (340 ha), etc. Some of the padasekharams in the Kayal Area and Lower Kuttanad are known for their huge size. One such padasekharam is about 2500 ha, and it is said that it requires more than 2 km walk to reach from one end to the other. When each of these padasekharams were owned by one or few farm families, the logistical aspects of managing cultivation in them with the help of boats were less complex. Currently, each of these padasekharams is owned by a few hundreds of

A view of Puncha Vayal

PIC 10

PIC 11-14

households with individual household ownership not exceeding 1-5 ha. For example, the Q (196 ha), S (240 ha) and T (204 ha) Kayal padasekharams have 490, 600, and 510 farm holdings, respectively, where the average size of the holding is 0.4 ha (MSSRF 2007) Some of those heroes of recent times who led reclamation of large tracts of kayals are: Eravi Kesava Panikkar of Chalayil family, Madathil Govinda Pillai, Arakkal Parameswar Kaimal and Murikkummottil Thomas Jospeh.

Landscape Management Practices

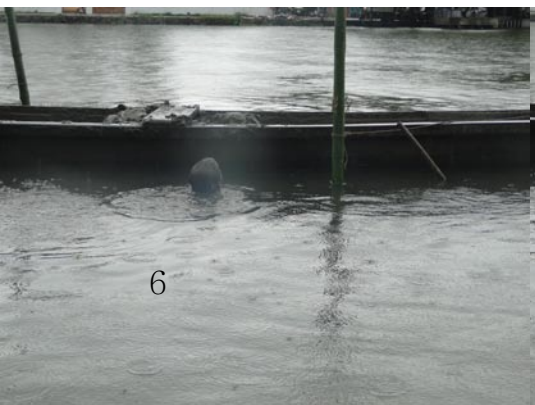
The landscape management practices varies in type, intensity and frequency based on the uses followed. Following are the major practices involved in Kayal and Karapadam Rice cultivation.

Construction of Polders and Land reclamation

The process of reclamation would start with identification of the shallow regions in the vast stretches of Vembanad Lake and once the area is identified, first step is to mark the boundaries by erecting bamboo poles, which are subsequently protected with construction of strong bunds around the boundaries. The bund construction and maintenance are the most skilful tasks, for which an array of long and stout coconut poles would be hammered deep enough into the lake bed in two rows, normally in 1.5 m to 2-5 m width enveloping the entire area and fenced with bamboo (both yellow and green ones) mats on either side. The side walls would be then protected with frames made from aracanut poles and covered with woven coconut leaf plates. The channels of the bund then would be filled to the desired height, first with sand, followed by twigs, sedges like Typha and Sheoneplectus (Kora pullu) and dead materials that brought from distant places and interspersed with high quality clay that dug from 20-25 m deep bottom lakes. Clay digging was called Katta kuth, which involves diving 20-25 m deep in to the Kayal-bed which needs enormous amount of physical strength, skill, experience and ingenuity for the persons engaged. There used to be 400 to 500 men engaged in about one year to complete the reclamation process of land about 2000 ha size.

From Top: *1) Bund on making, 2) Men engaged in bunding, 3) A partially completed bund, 4) Kora (shoenoplectus mucranatus) the common sedge used for holding soil in the bund.*
Below from left: *1) Clay digging (Katta Kuthu) steps. Clay digging a highly skillful and strenous task.*

PIC 15-17



From left: *1) A traditional water wheel, 2) Modern electrified pumping system, 3) Pumping out of water* PIC 18-20

Outer bund construction and strengthening around padasekharams is critical to prevent frequent eruption and the resultant distress from flooding related crop loss. Strengthening of these bunds in accordance with the level and force of floodwaters is important to prevent breaches and consequent serious crop losses. As the dyke's bursting pose threats to lands of every individual involved in reclamation of lands there would be coordinated effort to immediately repair such damages. The padasekhara committees are made responsible for the annual maintenance of bunds. Individual farmers of each padasekharam, on the basis of the area they own, share the cost of the maintenance work of the bunds. Similar maintenance for de-silting of adjacent canal is done collectively, once in 4 or 5 years. Normally bunds would breach during high flood and high tides. Since last 20-30 years some of the padasekharams are protected with permanent outer bunds with granite pitching, which has substantially reduced the risk of breach and crop loss.

De watering of the polder areas

Once the construction of bund is done, de-watering is the next major task. Dewatering the fields commences soon after the wet ploughing and the completion of repairs to the outer bunds.

Traditionally, huge and strong water wheels of10- 12 feet diameter with blade width of 1 to 1.5 feet were used, which pedaled by 12-14 men who work from a gallery erected for this purpose. The water wheel ranges from 4-leaved to even 18 leaved. Water is pumped out generally into the surrounded lake or the canals made outside. Normally the polder land base is 6-8 feet below the surrounding water level or to say otherwise the reclaimed land is situated that much deep, so one can guess how much quantity of water needs to pump out, a most laborious task. Protecting the bunds from bursting due to the pressure of water outside bund and stormy winds and tidal action used to be the most tedious task. When dewatering is completed, the smaller inner bunds that demark individual plots within each padasekharam are repaired. Along with this, repairs to inner irrigation canals are also done.

Modern Method of dewatering is done with special pump called petti and para, driven by oil engines or electric motors in each padasekharam mostly electric pump sets of 30-50 HP are used. The pumping out of water continues till the fields get completely drained of all excess water and the process goes on for about 15 to 20 days. Apart from the outer bund, the minimal infrastructure in a padasekaram include pumping stations (motor thara), motor sheds and water draining channels called vachals which may have no or few branches. Water inlets in the polders are closed by grass or wood. Outer bund also serves as a temporary threshing ground and storage place for threshed grain.

Once the dewatering is completed rice cultivation process that has the standard of practices with some variation starts. For details of the package of practices (See Annexure 4)

PIC 21-22

From Top: *1) A traditional breed of buffalo, 2) Traditional pond or water tank - drinking water source.*

Clockwise from top: *1) Calophyllum inophyllum - one of the traditional sources of oil 2) Oryza fatua (wild rice), 3) Aponogeton appendiculatus - a critically endangered aquatic species and an edible tuber widely harvested for its delicacy, 4) Kandelia candel - a rare mangrove, 5) Bacopa monneiri (Brahmi) - a widely used medicinal plant, 6) Garcinia gummi-gutta (Kodampuly) - a popular tree spice known for its fruit.*

From left: *1) Morinda citrifolia (Noni) - a commercially valuable plant species known for its fruits, 2) Pandanus fascicularis (Screwpine) - a commonly harvested species for its leaves for mat weaving.*

PIC 23-28

1(c) Agricultural Biodiversity and Associated Biodiversity

The unique ecological environment of the KBSFS and the entire Kuttanad region supports a wide variety of agro biodiversity and wild biodiversity. The major agrobiodiversity of the region and that associated with the system can be classified as follows

- **Mixed agro-ecosystems** such as backwaters, rivers, vast stretches of paddy fields, marshes, ponds, garden lands, edges, corridors and water ways-the characteristic feature of Kuttanad Wetland Agricultural Landscape.
- **Crop species and varieties,** largely of Rice. (Now only the released varieties- Jyothi and Uma. In the past puthari champavu and jeeraka champavu)
- **Livestock and fish diversity** (A traditional breed of buffalo and a cow named 'vetchur cow' were reported earlier from upper part of Kuttanad. The difficult water terrain in the system doesn't favour larger livestock. Ducks, poultry and enormous amount of fish diversity are prominent in the System)
- **Plant and animal germplasm** (of food and medicinal value like several edible wild greens and healing herbs). The delicacy like meat of turtle, frogs and different species of birds is still said to be available, though it is legally banned)
- **Insects, pests and fungi** (Enormous diversity of harmful ones available now, especially after practice is high intensive farming! most of the dragonflies are not locally seen)
- **Soil biodiversity, microbes** (not much known)

The agro biodiversity of the system is valued by the local communities largely for the production and consumption of their food, drink and for healing purpose and livelihood needs. Traditional

PIC 29-30

PIC 31-34

diet included primarily rice, fish, prawns, crabs, mussels, duck meat, coconut and cassava. Abundant availability of these resources had been ensured through sustainable management of the various landscapes, ecosystems and biodiversity in the past.

1(d) Wild Biodiversity

The wild biodiversity of the region is indeed rich as it ranges from mixed wetland ecosystems to the associated above ground and below ground flora, fauna and microbial diversity. An enumeration of species of mangroves, mangrove associates, fish and birds of Vembanad wetland is given in the Ramsar Information checklist. The aquatic species include 24 spp of green algae, 10 blue green algae, one species of yellow brown algae, 13 desmids and 19 diatoms. There are reports of 202 angiosperm species, which include 14 mangroves and 30 mangrove associates, and 8 species of pteridophytes are reported from the region (CED 2002; Bijoy and Unnithan 2004). The 11 km long stretch of mangrove vegetation still found close to Kumarakom and supports a diverse array of mangrove and mangrove associates. Pathiramanal Island of the region is reported to be a sanctuary for several species of mangroves, birds and fish species.

The region is a large repository of migratory fish species and birds. A bird count in 2009 listed out 27942 birds belonging to 56 wetland and wetland associated bird species (KNS, kottayam Nature Society)The Kayal is home to the third largest population of more than 20,000 waterfowls that visit India during winter. Endangered species of waterfowl that have been identified from the region are: spot billed pelican, oriental darter, water cock and black billed tern. The region is an ideal habitat for variety of finfish, shellfish, and several varieties of prawns, black clams, white clams and shrimps. Many fish species are reported to be depended upon the wetland for food, spawning and nursery.

From top left: *Some rare wild life of system - 1) Purple Moorhen, 2) Indian black turtle - a highly exploited species for its meat, 3) Monitor Lizard, a rare sight from the region 4) Oriental Darter.*

From left: *1) Kumarakom bird sanctuary - a haven for migratory birds, 2) Attu Wala - an endagered fish endemic to the system.*

PIC 35-36

PIC 37 *Threshing paddy harvest: A common scene which no more to be seen in kuttanad*

2. Goods and Services provide by the System

2. (a) Food and Livelihood Security

Kuttanadan Rice

As mentioned rice cultivation is the foremost land use of the region. Though in Kerala, as a whole there is an alarming decline of rice crop, which accounted for more than 60% of the fall in rice cultivation area in the last 40 years, there is no much reduction in the Kuttanad region, thanks to the region's unique geography and the environment for rice cultivation. The rice cultivation area of Kuttanad shares about 25 % of the State's total rice production area and contributes nearly 37 % of the rice production of the state. Owing to its primacy in rice area and production, Kuttanad had been long time referred as "The Rice Bowl" of Kerala.

Kuttanadan Fish wealth

Kuttanadan Agricultural Landscape, including the Puncha Rice System that surrounded with estuaries, flood plains, Kayals, ponds and canal networks known for its diverse fish wealth. Vembanad Fish Count 2009 identified 65 species of fin fish and 14 species of shell fish from the region (ATREE 2009).The wetland environment with changing salinity gradient and

Manja Koori- The Golden Catfish of Kuttanad

PIC 38-40

From top right:*1) Horabagrus brachysoma (Manja Koori) - the esteemed golden catfish of Kuttanad; now a critically endagered species, 2, 3) Common fish from Kuttanad.*

water levels because of cyclic shift in fresh water and saline water phases contributes to the richness and occurrence of fish and other aquatic diversity in the region. The fresh water environment closer to rice fields and the canals provide abundance of Pearl spots, perchlets, fresh water giant prawns (Attukonju) and freshwater catfishes during most part of the year, whereas it was reported the estuarine species dominate in Kayals that are closer to the sea.

Giant freshwater prawn (Macrobrachium rosenbergii), which grows up to the size of 40 cm and locally known as Kuttanadan konchu or Attu konchu is a highly valuable species of Vembanad lake, which provide a lucrative fishery for the region The total annual production of this species in 80's was reported as 100 tons per annum. Karimeen, the Pearl spot, another major delicacy of Kuttanad has got the status of Kerala's state fish. Kuttanad region is considered as the tharavad (family home) of this fish. Kerala now produces 2,000 tonnes of Karimeen. There are now successful attempts to increase spawning of this species reported that this new initiative may increase production up to 5,000 tonnes in a year,"(The Hindu Daily)

In normal course, the species count of migrant fisheries will be of maximum during summer from February to May with a peak observed in April, and declined with the onset of monsoons. Mullets (marine migrant species) migrate to the sea to spawn during December to April and large numbers of young ones return to the Kayal soon after monsoon breaks. The Mullets (marine migrant species) and penaeid prawns breed in the sea and return to the lake with large numbers of juveniles, mostly during the pre-monsoon and after monsoon breaks.

It has been reported that over the last thirty years, the fish diversity has reduced from 150 spp. to 36 spp. and many are reported as critically endangered or even extinct in the region (Padmakumar et al.1988). Some of the endangered fish species of the region are: the endemic carp of Central Travancore, Labeo dussumieri (Tooli/Pullan), the esteemed golden catfish of Kuttanad, Horobagrus brachysoma (Manjakoori), the riverine coldwater fish, Gonoproktopterus curmuca (Kooral), Wallago attu (Attuvaala), the glass perch, Parambassis dayi (Nandan), Macropodus cupanus, and Nandus nandus (Andikalli). The highly threatened endemic species in the fresh water reaches include Channa micropeltes (Manal waaha), C. leucopunctatus (Puliwaaha) Pristolepis malabaricus (Pannakarimeen), Ompok bimaculatus and Clarias dussumie (Mushi).

PIC 41

Karimeen (pearl spot) KWAS is the tharavadu (native home) of this state fish of Kerala,

42) Kuttanadan konchu or Attu konchu - a highly valuable species of Vembanad lake, 43) A fisherman with his harvest, 44) some prominent Commecial fish spp.

PIC 42-44

PIC 45-47

Kuttanadan Clam and live shell fisheries:

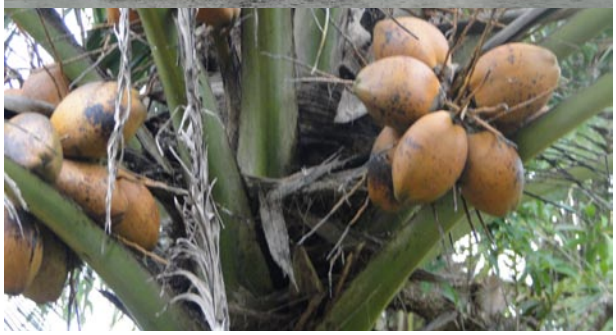
Four species of Clams (Villoritta cyprinoids, Meretrix casta, Paphia malabarica and Sunetta scripta) are reported from the region, in which Black clam (Villoritta cyprinoids) is found in all sides of the lake and its harvesting for meat is still an important livelihood option for the poor families of the region. Its production was estimated about 31430 ton in 2000. The abundance of the clam used to be more in the intertidal zones where it was reported in dense forms.

Large quantity of lime shell deposits (white clam) is a characteristic feature of the Vembanad Lake and the inner Kayal regions. These shells are commercially dredged for Cement industries and also harvested as a means of livelihood of the people. Ravindran et al (2006) reported annual production of 30,000-40,000 t of black clam and more than 7000 t of fish, shellfish from the region. They calculated approximately 20,000 fishermen are directly or indirectly involved in the exploitation of the aquatic resources and annual revenue of Rs.100 million.

Kuttanadan Rice-fish Rotation farming

Rice –fish rotation is an emerging practice of the system, as double cropping of rice turned to be less lucrative and more damaging to environment (Padmakumar et al.1988). The second crop (March to October) is now taken for rearing of fish (various carps) and prawns and reported good yield, particularly in those fields cultivated less intensively with chemical fertilizers and pesticides. The rotation also helps in not only getting high yield for the rice, but less disease and pest problems for the crop.

45) Black clam harvesting 46) Lady with black clam harvest, 47) Fishing in a harvested paddy field



Kuttanadan Duck Farming

The ideal condition of the system allows Duck farming in a promising way. Immediately after harvesting the rice, ducks are brought in even from distant places to the fields. It mutually benefits the duck rearer and rice farmers. Famous local breeds of Kuttanadan duck are: Chara and Chempalli. The introduced breeds are Kuttanadan White, White Pecking and White Muscovi. There is now recommendation for evolving a new Kuttanadan Broiler variety by a 3-way crossing between Kuttanadan White, White Pecking and White Muscovi. The new breed is expected to have high body weight and increased portion of lean meat (Hali et al., 2009).

Kuttanadan Coconut Gardens

The narrow strips of bunds of reclaimed lands are planted with long stretches of coconut palms (Kera) coconut is the second most important crop of the system. In garden lands coconut based agroforestry is followed where the palm is grown integrated with fruit trees like mango, jack and roots and tubers like yams and taros. The palm is also used for tapping toddy, which is another attraction of the region. Toddy gives flavor to the traditional Food basket of people of Kuttanad included four major items- Kizhangue (tuber, mainly cassava), Karimeen (pearl spot), Konju (Giant freshwater prawn), Kakka (clams), and Kallu (toddy). Apart from the immense economic importance of this crop, its presence everywhere from small and marginal farm holdings add profound scenic beauty to the region.

Kuttanadan Clay and bushes

Clay of Kuttanad is a key resource for the people, not only for building land for them or making bricks for their housing or rice production, but also as a healing material for their wounds and cuts. They had the habit of using deep mined clay for healing their small wounds and cuts. Herbal medicine known for poisonous bites is still popular in the region. The plant and animal diversity present in the bushes in isolated patches and water are employed in various ways for their food and agricultural needs. Abundantly grown screw pines and a sedge Typha in the region offer enough raw material for Mat weaving – a livelihood option for the women in earlier days. It is a fast fading tradition now along with many other natural and bio-resource dependant heritage practices.

Top to bottom: *48) a duckery unit, 49) waterways a major transport route in the region, 50) Coconut palm for toddy taping, 51, 52) Toddy taping process, 53) Kuttanadan clay, 54, 55) Srewpine leaves for mat weaving*

PIC 48-55

2 (b) Environmental services

The geographic feature and complexity of the area and position of agricultural landscapes below mean sea level makes its environmental services exclusive. The major ecosystem services of the system, apart from agriculture and inland fisheries are water supply, health and sanitation, transportation, recreation and conservation of biodiversity and the crucial regulating service its plays in the control of the hydrology of the entire region. The hydrological relationship between the various matrices of the system landscape and its sources of surface and ground water plays a significant role in controlling flood during monsoon and drought in summer season. The importance of interconnectedness of the hydrological cycle and its positive impacts, unfortunately not being taken into consideration while implementing the various development packages in the region.

55) Vallams: Large storage areas of fresh water,
56) Seagulls and Pelicans on a fish hunt in puncha vayal

PIC 56-57

3. Threats and Challenges

Kuttanad – A 'Water Desert'

As described, the life of people of Kuttanad is water based. Though "water, water everywhere, there is no drop of water to drink" is the situation, particularly the 'Kayal' area. Fresh water supply is hugely defective due to pollution, urban encroachment, land reclamation for agriculture and tourism, fragmentation by transportation routes, untreated human sewage from dense settlements, and intensive agricultural run-offs including fertilizers and pesticides. Almost all areas in Kuttanad are reeling under severe shortage of potable water. The people of this water logged area virtually starve for quality potable water.

Kuttanad: A threatened Landscape

Almost the entire area is flood prone, where the south-west monsoon every year makes havoc by flooding the low lying region. But, the situation in recent years is very different from the past. Normal level of flooding is a boon to farming as it brings large quantity of sediments. The increased flash floods are routine in Kuttanad, which can lead increase in production variability and considerable effect on microbes, pathogens, and insects associated with agriculture. It is also predicted that the increase in sea and river water temperatures likely to affect breeding, migration, and harvests of fish.

Some of the other major challenges for sustainable management of the system are:

Sediment/silt deposition in Rivers and Canals: Heavy deposition of silt and sediments is reported and it causes shallowness of canals and rivers. Disturbing growth of invasive alien and native weedy species: Over transporting and stagnation of nutrients from the fertilizer stimulated extensive growth and permanent occurrence of major aquatic weeds like Eichornia and Salvinia. The former species is the most aggressive invader of the region.

PIC 58-61

58) Thanner mukkam barrage: a historic structure that changed the function and dynamism of KWAS, 59) Water hayacinth - the noxious weed of the entire water scapes of the region), 60) Thrown away plastic bottles another menace in the water bodies, 58) Flotting grass (Ischeamum travancorense) an endemic species which forms small floting island wherever water is blocked. An important fodder too, 61) Dying diversity: shells of killed turtles for meat.

PIC 62-64 *61) Cabomba sp.: A threatening new alien invasive of the system, 62) The growing backwater tourism possing serious threats to the fragile environment, 63) Water transport - a common feature in Kuttanad*

Depletion of aquatic and above and below ground biodiversity: The original vegetation of largely mangroves and other riparian flora and fauna have severely been depleted and so the case of aquatic biodiversity because of the change in the natural ecological characters and construction of rock embankment along the rivers. This has replaced completely the natural riparian vegetation and thus altered the natural bio-dynamics.

Depletion of land productivity: Largely due to alternate land use for both agricultural and non-agricultural uses in the form of conversion of wetlands, paddy fields and flood plains.

A Study Report of MSSRF identified six major contributing issues that challenge the livelihood options of majority of farmers, fishermen and the landless labourers and the long-term future of KBSFS. These are (i) declining surface area of waterways including the Vembanad Lake, (ii) flood management, (iii) Control and regulation of saline water intrusion, (iv) choked waterways and the consequent problems in water availability and drainage to agriculture, and to human health, sanitation and clean drinking water, (v) pollution of water body due to many factors including alien invasive species, and (vi) degrading ecosystem services and goods like water recharge, pollution control, fishery and loss of biodiversity.

It can be seen that almost all these issues are related to the current water management practices.

4. Policy and Development Relevance

A major possible lesson from the KBSFS would be the understanding of the system in a holistic perspective from the level of landscape structure and relationship to land use management and practices. Such plane of understanding is crucial for making any wetland agricultural production system more resilient and sustainable. The study and interventions can show the best possible integration of scientific and local community knowledge and practices. This can futher help in production of meaningful results for bio resource management and climate risk adaptation as well as long term benefits to the society. The system and the local community management practices offer by examples how best the ecology and biodiversity of a region can be efficiently used for achieving food, nutrition and livelihood security.

Considering the importance and value of the System, M.S. Swaminathan Research Foundation, three years ago recommended promotion of the region as a Special Agricultural Zone for strengthening location specific research and extension system for the prosperity of Kuttanad. Prof. M. S. Swaminathan also advocates the need for an institute of world class standard for the best management of the system by undertaking research and training in below sea level farming. This would be of benefit not just to KBSFS, but many other coastal regions and places such as Lakshadweep and Maldives, the Sunder bans and a number of SAARC countries. We think getting Globally Important Agriculture Heritage Status for this unique system would help to revitalize the heritage of KWAS and that can lead in telling example for addressing the concerns of sustainable food security, poverty alleviation and ecosystem services management.

5. Global Importance

Kuttanad Wetland Agriculture System is unique, as it is the only system in India that favours rice cultivation below sea level in the land created by draining delta swamps in brackish waters. Rice is the major staple of the region and its production is by harnessing the local advantages, mainly the water availability, which in fact contributes in instead of promoting 'virtual waters' from more drier parts of the country. Promotion of Kuttanad Agricultural Heritage Villages will help increase in rice and fish production and enhanced conservation, cultivation, consumption and commercialization of the local resources. In view of the seawater level rising steadily across the world due to climate change, there is need to strengthen and develop local level food production system. The system of below sea-level farming is an approach to cope with the imminent climate impacts in coastal areas and evolve efficient methods to deal with soil and pest-related issues in agriculture as well as inland fisheries apart from learning to manage flood and salinity threats.

The region as described is also exclusive by way of provisioning many ecosystem services like formation of delta soil, regulation of floods and droughts, favourable habitat for the rice-fish (prawn) rotation practice and diverse biodiversity. Further, the panoramic rice fields and vast expanse of water bodies attract tourists from worldwide. Thus, protection of this fragile and unique system from any external pressure is important and urgent for humanity as it is essential for maintaining and enhancing so much endemic biodiversity and several vital ecosystem services for human well-being worldwide.

6. Outline of Activities

Activities necessary for dynamic conservation of the system

1. Scientific and participatory mode of research on Agricultural Landscape Ecology of the region, in particular, biodiversity and ecosystem services related to below sea level farming and integrated fisheries with a goal of revitalizing the heritage of KBSFS;

2. Specially focused research on Climate Change scenario analysis in relation to the hydrology of the system, as well as water and agricultural landscape management, methane emissions of rain fed and deep water rice cultivation;

3. Gender friendly and user friendly training to adults and youth members of Farming and Fisher communities and their representative institutions like PRIs, NGOs and CBOs on the field level application of findings from the above two research areas.

4. Organizing communication, education and public awareness through lectures, exhibitions, national and international symposia and workshops in sustainable agro ecosystem management and food security.

5. Capacity building of farmers and fishermen in designing and sustaining improved interventions in agriculture, water and land management practices and community managed initiatives like seed-grain banks, fodder banks, aqua banks and water banks through village knowledge centres and Heritage-village initiatives;

6. An international meeting on climate change adaptation for the practitioners and researchers of wetland agriculture, particularly below sea level farming focusing Asian countries;

How these activities will respond to the threats as described under 3 ?

The Problems were listed out in three broad categories-water management, livelihood management and ecosystem management. The above mentioned six activities can help directly and indirectly to address the issues and challenges of these three problem areas. Our experience shows for an effective developmental intervention there is a need for integration of research, policy and people focused actions. The activities that have chalked out here are keeping this rationale in mind.

How these activities can be used to leverage funding or attract internal and external donors?

High quality action research in the area of sustainable wetland agricultural management that focused on socio- ecological production is inadequate in this part of India, and it is expected that the project will result in producing technical and popular printed and multi-media publications, apart from the emergence of 'Agrobiodiversity Heritage Villages' in the area. These instruments will leverage partnering of other critical institutions and individuals and help in shaping expert opinion, public awareness and policy advocacy. The increased visibility of the project interventions would speak for itself and thereby the activity approach will gain high credibility and in turn funding support from different quarters.

A baseline description of activities, policies and experiences, which are already ongoing in the area and that the project could build upon.

A special package is in implementation in the region that meant for the holistic development of Kuttanad region. However, it is purely a developmental package, in which there is only limited scope for this kind of an action research that meant for revitalization of agricultural heritage. It is planned to present this proposal before a high power committee of the state government that connected with this package to invite their ideas and suggestions for integrating this kind of a project in the laser level interventions. Fortunately, there are policy guidelines and implementation mechanisms under the 3-tier biodiversity institutions or India (National Biodiversity Authority, State Biodiversity Board and Biodiversity Management Committee) to establish Heritage Villages, particularly in the Biodiversity Hotspot areas of the country. This advantage will be leveraged for taking on this project. But, above all, mobilization of local communities through a C4 (Conservation, Cultivation, Consumption and Commercialisation) framework will be adopted as a core approach of the project to help in achieving the Heritage Village concept in a replicable manner.

Institutional involvement and embeddedness (support and involvement of institutions that carry responsibility or are otherwise involved in the project area, both local, regional and national)

There are NGOs and various departments of state government operating in the area with a goal of sustainable development of Kuttanad. The notable

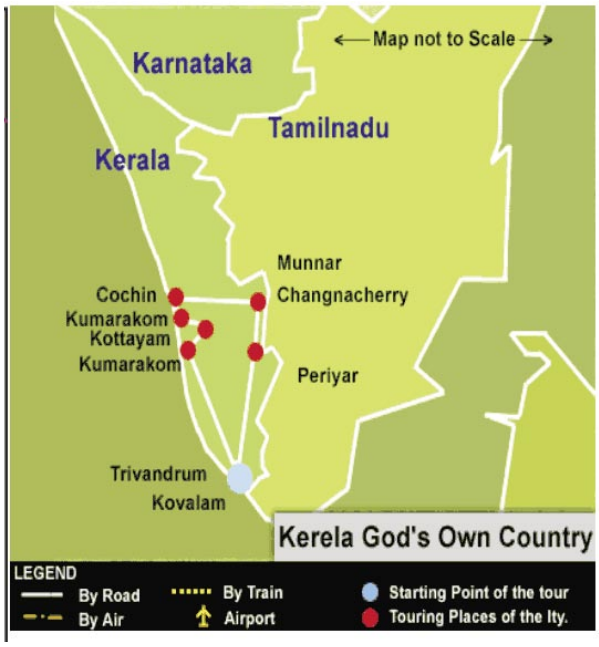
NGOs working here in the area of Ecology and Biodiversity are ATREE, Kottayam Nature Society and ERRC. The government agencies like Center for Water Resources Development and Management (CWRDM) and departments of Agriculture, Water, and Fisheries are also active in the area. But, so far there is no agency working here with an aim of developing practical strategies and methods by linking science and traditional wisdom for revitalizing the agricultural and conservation heritage of the region. This project will be of help to people of Kuttanad for taking up such kind of an intervention and offer sustainable development methods and options for such ecologically fragile regions.

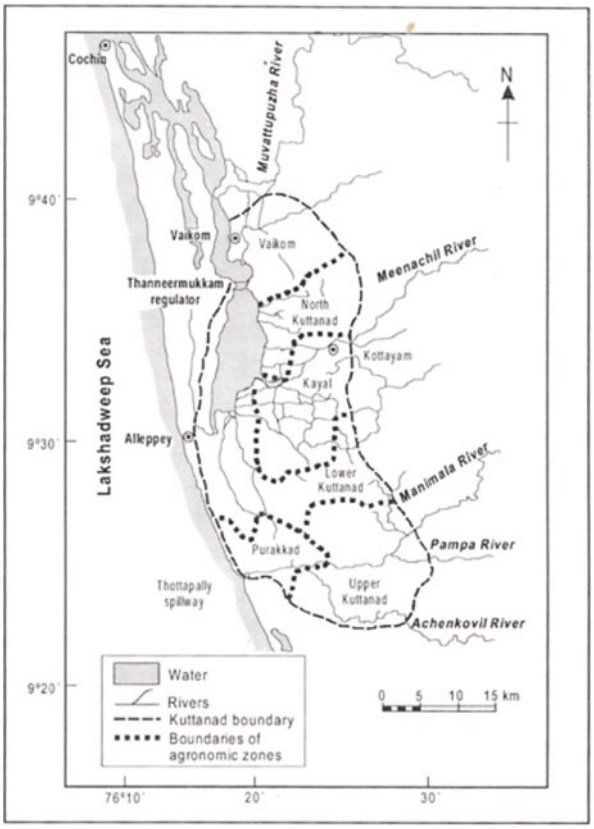
Participatory approach and community centred and driven:

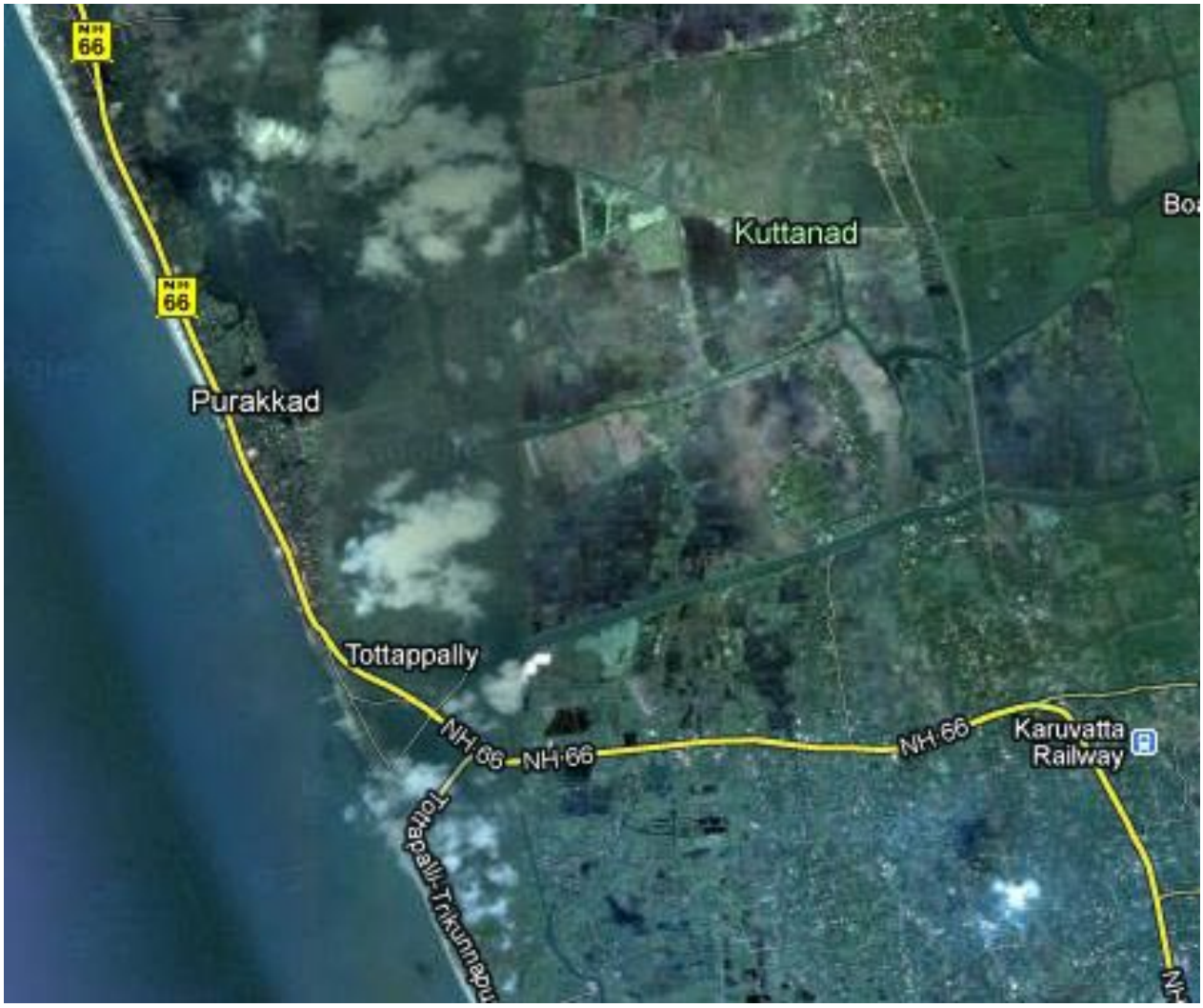
The KBSFS was developed by farming families, who will continue to cherish and conserve their farming heritage. Recognition under GIAHS will give Kuttanad farming families a sense of pride in their past achievements and will encourage them to continue to adopt farming and fishing technologies which are in harmony with Nature. The Kuttanad GIAHS will thus become the flagship of the global movement for anticipatory action to adapt to the consequences of sea-level rise.

Annexure I: Location Map

Map of Kuttanad region







Annexure 2: List of agriculture biodiversity and associated biodiversity

AGROBIODIVERSITY

Plant Diversity

Oryza sativa

Cocos nucifera

Areca catechu

Mangifera indica

Artocarpus hirsuitus

Vigna unguiculata

Sesamum orientale

Musa paradisiaca

Vegetables tuber crops

Endangered Endemics fishes

Labeo dussumieri (Tooli/Pullan), the esteemed golden catfish of Kuttanad,

Horobagrus brachysoma (Manjakoori), the riverine coldwater fish

Gonoproktopterus curmuca (Kooral)

Wallago attu (Attuvaala), the glass perch

Parambassis dayi (Nandan)

Macropodus cupanus, and

Nandus nandus (Andikalli)

Channa micropeltes (Manal waaha)

C. leucopunctatus (Puliwaaha)

Pristolepis malabaricus (Pannakarimeen)

Ompok bimaculatus and

Clarias dussumie (Mushi)

Clams

Villoritta cyprinoids

Meretrix casta

Paphia malabarica

Sunetta scripta

Mangrove and associated species

Acanthus ilicifolius

Ardisia littoralis

Pandanus fascicularis

Pongamia pinnata

Acrostichum aureum

Avicennia officinalis

Premna serratifolia

Barringtonia racemosa

Bruguiera gymnorrhiza

Cerbera odollam

Clerodendrum inerme

Derris trifoliata

Dolichondrone spathacea

Excoecaria agallocha

E. indica

Flagellaria indica

Heritiera littoralis

Hibiscus tiliaceus

Kandelia candel

Viscum orientale

Morinda citrifolia

Rhizophora apiculata

Sonneratia caseolaris

Stenochlaena palus

Terminalia catappa

Thespesia populnea.

Dendrophthoe falcata

Viscum orientale

Stenochlaena palustris

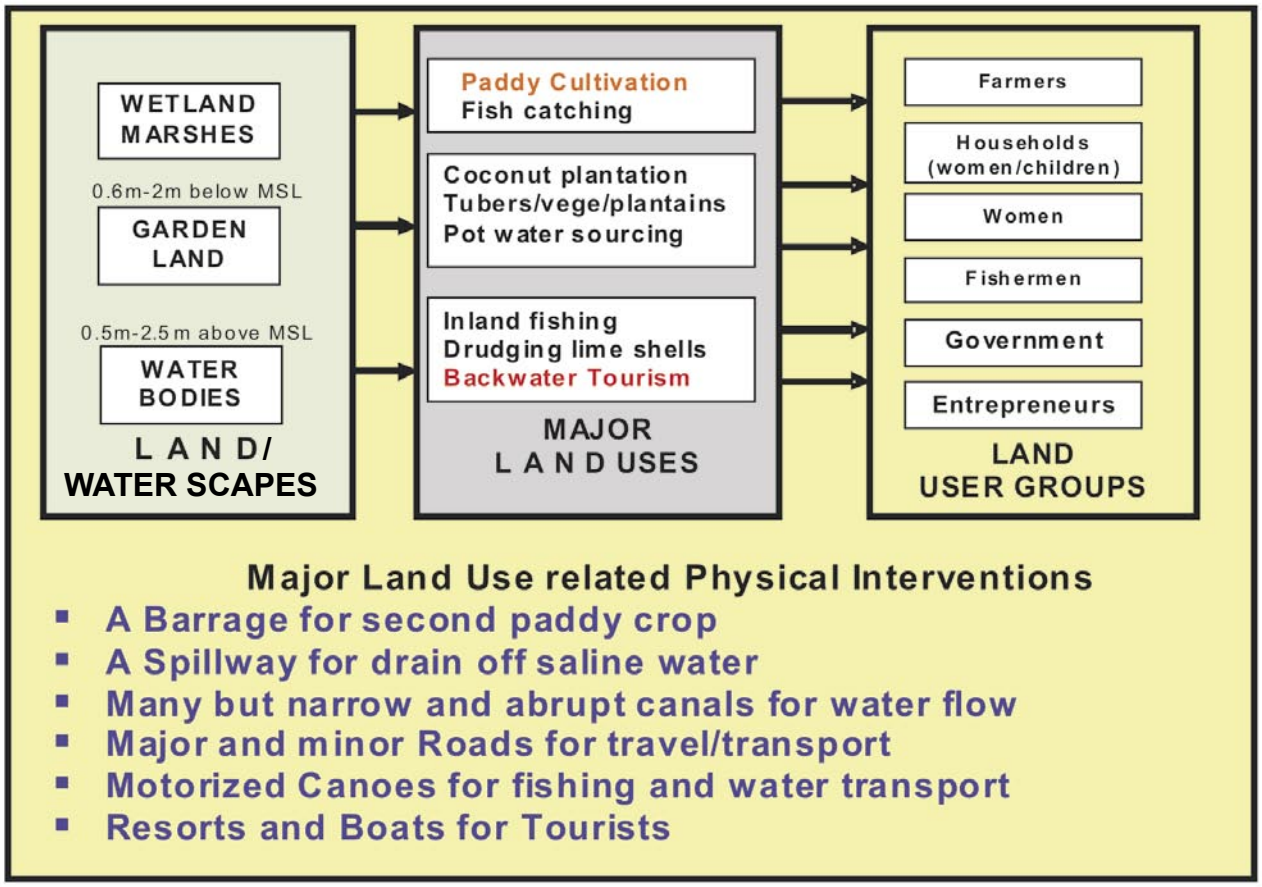
Terminalia catappa

Thespesia populnea

Dendrophthoe falcata

Annexure 3:

A schematic cross section/catena of the landscape indicating the biophysical elements/ process/flows and User groups.



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Annexure 4:

Kuttanadan Rice Cultivation and Crop Management Practices (including soil and water management practices)

Once the dewatering process is completed the field will be made ready by first a gentle harrowing, a process called 'pallikkadi', which helps the weed removal soft puddling of soil. The mostly cultivated rice in the past was Champavu- a variety with red slender and long grain for the traditional cultivation, which maturing in 100 days and offering nearly 1 ton /ha. Jyothi and Uma the improved varieties that yield up to 6 ton/ha are now widely in cultivation. Cultivation starts with a minimum of two rounds of ploughing, one length-wise and the other cross-wise along with the application of powdered burnt lime to neutralize the acidity of the soil. The acidity of soils is more, particularly in the Kari lands, which controlled through regular liming. Wet ploughing is the second round of ploughing that is done in waist deep water to help to stir up the soil and allow fresh water to percolate into the soil. Flooding of the fields is then done where water is allowed to remain in the field for 3-4 days and pump out completely to dry for 6 to 8 days till the soil dries. This is done except in kari lands. This practice suppresses the capillary rise of salt from below the soil.

Germination of seed is done by soaking gunny bag full of seeds for about 8 to 12 hours and draining off excess water induces sprouting in 2 to 3 days. Germinated seeds are directly broadcasted in the wet field. Traditional Puncha sowing time is the mid-October or until mid of November. Weeds of various kinds-sedges, grasses, and other broad leaved angiosperms- are difficult to control, which mostly done through application of chemical weedicide, popularly, 2-4 D sodium salt at a dose of 1.2 kg/ha after 17-20 days of sowing.

Manuring of Punja lands in earlier days was not even known, because the land was always rich in Ekkal and Vandal (humus and debris of many aquatic plants, ferns algae, fish etc). The organic matter for the soil also contributed the left behind straw of harvest. Application of chemical fertilizers (usually in 3 split does) becomes very common, ever since the improved varieties were introduced.

Water management is done primarily for washing out the salts and regulating soil pH to the optimum

65-71) Puncha / Kayal rice cultivation operations: visuals of the past methods

for better crop growth. This is done by letting in and draining out water by operating the sluices in the outer bunds, and being continuous throughout the cropping season. The usual water management schedule is as follows: (a) Draining the field before preparation of land and stale seedbed, (b) Letting in water for killing weeds, (c) Maintaining 2 - 5 cm deep water during sowing, (d) Draining out 2 days after sowing, (e) Letting water in 5 days after and maintaining 2 - 5 cm water until first fertilizer application, (f) Draining water for first fertilizer application and letting water in, (g) Draining out water at peak tillering stage for second top dress and letting in water, (h) Maintaining 5 cm of water after maximum tillering stage, (i) Draining out for giving third top dress and letting in till heading stage, (j) Draining out 15 days prior to harvest. However, farmers' practices use more than the required water quantity.

Pest and Disease Management is also a high alerted activity because of regular incidences of pests and diseases to the rice cultivation. The common pest and diseases reported are BPH, gall midge, sheath blight and blast, especially in case of the present day varieties. Incidences of are becoming more frequent, most serious and damaging to the extent of 30 to 90 % yield loss. Spraying and dusting with different kinds of pesticides are usually done two or three times during the crop season.

Harvesting was purely manual till 10 years back. Presently combine harvesters are introduced, although there is opposition from farm labourers to mechanization. Harvesting is largely done at one-third top part of the stalk, leaving much of the straw in the field. The harvest is kept in small heaps in the field and another batch of labourers tie the harvest into sheaves and takes to the threshing grounds. Threshers on the bunds and roadsides are now increasingly doing threshing. The threshed grain is packed in gunny bags and transported by another group of labourers. Country crafts take the threshed paddy along the waterways for sale or storage. In many areas workers, inputs and produce are transported along waterways.

Annexure 5: Historical Description

There is no recorded history on the origin of this land. But the oral history among local people, transferred from generation to generation is a blend of myths and legends. There is reference to Kuttanad in the epic Mahabharata of ancient India. During their exile, the five Pandava princes are said to have traveled through this land. In those days, Kuttanad was part of a dense forest, later destroyed by a forest fire which is also mentioned in the epic. Thus came the place name Chuttanad or the burnt place. In course of time Chuttanad became Kuttanad. One can still see kari or coal if we dig deep into the soil of Kuttanad, pointing to the fact that the place was once a forest, destroyed by wild fire. While digging for well etc. people usually gets burnt woods which are called as 'kaandaa maram'. There are a paddy fields known as 'kari nilangal' (charcoal lands). In Kuttanad most of the place names end in kari. Some familiar place names are Ramankary, Puthukkary, Oorukkary, Mitrakkary, Mampuzhakkary, Kainakari, Chathurthiakary and Chennamkari.

According to the widely agreed hypothesis, millions of years ago these lands were forest and during a geological event, the Arabian Sea advanced up to the foot of Western Ghats in many places, submerging these areas. Years later there were upheavals and recession of sea, during which the trees of the entire forest that was under submergence got uprooted and buried 'in situ' under varying levels of silt to give rise to the low-lying marshy saline lands of Kuttanad. Soils of these areas have vast organic deposits, fossils of timber and shellfish in varying depths.

The golden era of Kuttanad Paddy cultivation started with the construction of a harbor at Alapuzha by Sri "Raja Kesava Das" the Divan of then Travancore "Empire Ramavarma". It was through these water ways of Kuttanad that spices, condiments and other exportable commodities from the Western Ghats reached Alapuzha harbor. Till that time "Nanchinaad" (now in Kanyakumari district of Tamil Nadu) was known as the rice bowl of Kerala. The rulers of Travancore realized the necessity of another rice bowl to meet the increasing demand for food grains which transformed Kuttanad into the rice bowl of Kerala.

Source: synthesised from various readings

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Maharaja SREE CHITHIRA THIRUNAL BALA RAMA VARMA the last ruler of Travancore Rajas who influenced in a greater way the rice productivity of Kuttanad.

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Photo Credit

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