

# **KAIPAD –a unique, naturally organic, saline prone rice ecosystem of Kerala, India**

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**Abstract:** A complex and ecologically responsive rice-fish farming system has evolved in the coastal wetland regions of India over centuries. Kaipad is a unique coastal wetland rice production tract which is saline prone and naturally organic production tract of North Kerala, India which was not much known to the scientific world. The rice produce from this particular ecosystem is purely organic. Apart from integrated organic farming system in which rice cultivation and aquaculture go together, Kaipad ecosystem is featured with rich biodiversity of flora and fauna, organically rich soil, mangroves, and migratory birds. The Pokkali tract of south Kerala is said to be synonymous to Kaipad tract of North Kerala. But soils of Kaipad slightly differ from that of Pokkali. Rice farming in Kaipad is carried out in a peculiar way, purely in a natural way relying on the monsoon and the sea tides. Besides its own saline tolerant land races of rice, recently high yielding rice varieties were developed for Kaipad tract by Kerala Agricultural University utilizing the traditional land races. Even though the product from Kaipad is purely organic, nothing much has been done to explore the value of organic rice for the benefit of farmers. Besides research accomplishment, a comprehensive multi faced development approach is necessary to preserve, protect and develop this unique organic rice bowl of Kerala, governed by small and marginal farmers.

**Keywords:** Coastal Wetlands, Kaipad, Pokkali, Rice- Fish Farming, Organic Rice

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## **1. Introduction**

One fifth area of Kerala state of India is wetland. There are about 217 wetland areas in Kerala which include the unique ecosystems like marshy and water logged areas, vast paddy cultivation areas associated with backwaters, and lakes and the Myristica Swamps in the Western Ghat forests, Vembanad-Kole, Astamudi and Sasthamkotta lakes[1]. Out of 217 wetlands, 93 are “coastal wetlands” of area 93730.5 ha[2]. These wetlands provide agriculture produce, fish, fuel, fiber and fodder. Road, Railway and other infrastructural constructions fragmented and destroyed the complex coastal vegetation and ecology. Kaipad is a unique coastal wetland rice production tract which is saline prone and naturally organic production tract of North Kerala, India. The rice produce from this particular ecosystem is purely organic. Kaipad is the shortened version of ‘Kayal padam’ in Malayalam language. ‘Kayal’ and ‘padam’ are Malayalam terminologies of ‘salt water area’ and ‘rice field’ respectively.

The diversified functions of wetlands include flood con-

trol, mitigate effects of natural disasters, store water for long time, water purification, shoreline stabilization, control of erosion, control of hydrological cycle, prevent salt water ingress, enable ground water recharge, provide food and shelter for mammals and birds, act as natural filters and removes poisonous viruses, heavy metals and sewage[3]. Coastal wetlands include Estuaries /Back waters, Mangrove Forests, Kole, Kuttanad and Pokkali, Kaipad, Coastal Swamps, Mud flat, Aqua culture Pond, Islets/Thuruthu[4]. Out of total wetlands, 73.27% is coastal wetlands and only 26.73% inland wetlands. A complex and ecologically responsive rice-fish farming system has evolved in the coastal wetland regions of India over centuries. No accurate estimate of area under this cultivation exists; according to one estimate it is 0.7 million hectares[3]. There exist variations in the farming system across regions depending on the ecological, technological, institutional, and organizational arrangements conditioning the wetland resource base. Kaipad ecosystem and its multi faced roles are described in detail in this article.

## 2. Description of KAIPAD Ecosystem

### 2.1. Geographical Location

Kaipad tract is seen spread in the north Malabar districts of Kerala, India, in Kozhikode, Kannur, and Kasargod districts near to Arabian Sea. Kaipad tracts are coastal wetlands at the bank of rivers flowing through these districts and joining to Arabian Sea. The tract is located approximately 11.25°N 75.77°E / 11.25; 75.77 / 12.5°N 75.0°E. The approximate area of Kaipad tract is about 4100hectores.

### 2.2. Ecosystem

The Kaipad system of rice cultivation is an integrated organic farming system in which rice cultivation and aquaculture go together in coastal brackish water marshes which is rich in organic matter. The network of backwaters and estuaries serves as an inlet of sea water and causes salinity in the area. This ecosystem is rich in biodiversity with respect to flora and fauna. There is several species of phytoplanktons and marine fungi which play an important role in the degradation of organic matter.

Mangroves which are seen on the fringes of back waters and estuaries are characteristic feature of Kaipad tracts(fig 1). Mangroves provide breeding sites for fishes and prawn, and bind toxic chemicals and pollutants. Further, mangrove forests are valued for fish, shell fish, live stock fodder, fuel and building materials, local medicine, honey, and bees wax, chemicals or tanning leather, timber and wood. The prop roots of mangroves penetrate deep into anaerobic mud flats and activate mineral cycling and maintain productivity of Kaipad ecosystem[3]. The crown of mangroves provides resting and nesting place for birds, and flowers are good source of honey.



Fig. 1. General view of Kaipad rice tract.

Diverse species of migratory birds are another specialty of this ecosystem. As Kaipad tract is coastal to the river which merges into sea, there will be flood during monsoon and salinity during summer season. Kaipad ecosystem consists of marshes, swamps, ponds, and paddy fields which help in controlling sedimentation, flood and pollution. The tidal currents generated in the sea causes flow in of water to Kaipad fields through the river during high tide and flow out during the low tide. When water level rises in the river either due to monsoon or due to high tide, water flows in

Kaipad fields. The river water is usually saline except during monsoon.

### 2.3. Climate and Soil

Kaipad rice tract features tropical monsoon climate with high temperatures recorded from March to May. A brief spell of pre-monsoon showers hits the tract sometime during April. This is followed by the South-West monsoon which continues till the end of September. The tract also receives significant precipitation from the North-East Monsoon that sets in from the second half of October through November. The annual average rainfall is 3438 mm and more than 80% of it occurs during the period of South-West monsoon. The rainfall during July is very heavy.

The Pokkali tract of south Kerala is said to be synonymous to Kaipad tract of North Kerala. But soils of Kaipad slightly differ from that of Pokkali. Soils of Pokkali lands are deep, dark bluish black in colour, impervious and clayey in texture which form hard mass which cracks on drying and turn sticky on wetting. Soils of Orumundakan and Kaipad lands contain coarser fractions compared to Pokkali lands[3]. In Pokkali and Kaipad lands, salinity decrease rapidly up to August and was maintained till December –January. Orumundakan lands maintained high level of salinity inspite of leaching with rain water.

The soil type of Kaipad is saline hydromorphic, and soil pH throughout the depth of soil profiles is slightly acidic[5,6]. The soil of Kaipad is heterogeneous with respect to salinity. Even though Kaipad is saline, the submerged condition rectifies the ill effects. Similarly, rice-fish farming also remunerative for salinity. Due to flooding, availability of elements like N, P, K, Ca, Mg, Na, Fe, Si, and Mn were found to increase and causes decrease in availability of Zn and Cu [7]

### 2.4. Rice Cultivation in Kaipad is of Peculiar Type

Nearness to Arabian sea and the presence of large number of rivers, makes the tract saline prone adapted to specific cultivars and specific system of cultivation entirely differing from other wetland rice cultivation. Rice farming in Kaipad, which faces tidal in flow and tidal outflow twice in a day, is carried out in a peculiar way in a low to medium saline phase of production cycle during June to October. Harvesting takes place by the end of October. This is followed by traditional fishing, in the high saline phase, during November to April. Diversity of flora and fauna is rich when compared to modern rice farming system.

### 2.5. Rice Cultivars of Kaipad

‘Kuthiru’, and ‘Orkayama’ are the traditional land races widely grown in Kaipad rice tracts[8]. ‘Mundon’, ‘Kandorkutty’, ‘Orpandy’, ‘Odiyan’, ‘Orissa’, ‘Punchakayama’ and ‘Kuttadan’ are the other land races cultivated in some pockets of Kaipad. These land races are tolerant to low and medium salinity. The average rice yield of these local cultivars is about 1.0 – 1.5 t ha<sup>-1</sup>, making rice cultivation in

this region unprofitable. The traditional cultivars are susceptible to lodging, and with poor grain qualities like awn on grains, long bold, and heavy shattering of grains which make harvest a tedious and laborious process especially in the present scenario of shortage of farm labourers. However, cooked rice of local cultivars is very delicious. Realizing the demand of farmers for high yielding varieties for Kaipad tract for long time back, Kerala Agricultural University had recently developed an array of high yielding rice cultures through a challenging breeding project utilizing local land races in breeding programme[9]. Out of these cultures, two were released for commercial cultivation in 2010 in the name, 'Ezhome -1' and 'Ezhome -2'. The average yield of Ezhome -1' and 'Ezhome -2' ranges from 3.2 -3.5 t/ ha which is 60 -70% more than that of traditional land races.

The cooking qualities of Kaipad rice is excellent, and the cooked rice is very tasty. There is a general say among farmers that, the gruel of Kaipad rice can be eaten as such without salt and much curries. The practice of having gruel of Kaipad rice during illness for speedy recovery indicates its medicinal value. Kaipad rice and prawn curry is the usual combination of food at this tract. Nutritive quality analysis of Kaipad cultivars revealed that, they contain good content of iron (59.8 to 303mg/kg), calcium (154 to 218 mg/kg), and potassium (8359 to 14075 mg/kg) (KAU, Unpublished).

### 3. Method of Rice Cultivation in Kaipad

Rice farming is carried out in a peculiar way in Kaipad, purely in a natural way relying on the monsoon and the sea tides. Single-crop of rice is cultivated, on mounds, in a low to medium saline phase of production cycle during June to October.

#### 3.1. Mound Preparation

As there is always water inflow in Kaipad, during rice farming season, the field has to be dried before start of land preparation activities. Agricultural operations begin by April by draining out saline water completely from the Kaipad field, and left to dry for a period of one month. After that, small mounds of diameter about 45cm and height about 60 cm are taken by skilled male labourers(fig 2). This land preparation work completes by middle of May. By early June, when South West monsoon starts and intensifies, the salinity from the top of the mound leaches away. Soils on the mounds formed for sowing seeds attain low levels of salinity on washing and leaching with rain water, while salts accumulate in the soils between the mounds. When there is enough fresh water flow in the river, the sluices are opened fully. From this time onwards there won't be any control of tidal inflow and outflow from the river till the maturity stage of rice crop.

#### 3.2. Sowing

In June, after the receipt of south west monsoon, paddy seeds of saline tolerant cultivars will be soaked in water for 24 hours. Soaked seeds will be tied in gunny bags or tied in bags of coconut fronds or covered with banana leaves for a period of 2-3 days till the seeds germinate and white radicle comes out. When rain comes, the top of the mound in the field is slightly raked by man labourers, and woman labourers sow the germinated seeds on the raked mounds, and cover with mud(fig 2). Mounds are usually taken at places where salinity is more. In places where salinity is less, sprouted seeds can be broadcasted in raked fields.



Fig. 2. nursery on mounds.

#### 3.3 Dismantling

After 45 days, the mounds with grown up seedlings will be dismantled without damage to the roots of seedlings by man labourers, and the seedlings in clefts are dispersed around the flattened mounds (fig 3). Woman labourers spread them apart uniformly. Dismantling will be over by July end. Raising nursery on wetland and transplanting in Kaipad marshy land is also practiced in some pockets. Afterwards, there is no need of any cultural operations till the harvest. Usually weed growth will be less.



Fig. 3. Kaipad field at dismantling stage.

#### 3.4. Crop Management

Neither chemical/organic fertilizers nor plant protection

chemicals are used in rice, fish, or shrimp farming. The tidal flows make the fields highly fertile through a symbiotic relationship between rice crop and prawn, shrimp, fish etc. The fingerlings of fish, shrimp, prawn etc. which swim in from the sea and the backwaters after the rice harvest, feed on the leftovers of the harvested crop. The rice crop draws nutrients from the excrement and other remnants of these sea creatures. The soil of Kaipad is always seen naturally fertile without any management. The possible reasons for the high fertility of Kaipad are ;organic matter coming along with river water which are from forest wastes of mountain and remnants of sea creatures, left over paddy stubbles in Kaipad, remnants of aqua culture and excretion of migratory birds. Another reason for fertility is high degrading capacity of marine fungi seen in Kaipad[10].

### 3.5. Weed Control

The minimal weeds seen in Kaipad are not harmful to rice crop when there is cultivation in Kaipad tracts, and normally there is no purposeful removal of weeds as practiced in modern rice farming system. When there is excess weeds hand weeding is practiced.

### 3.6. Plant Protection

The peculiarity of Kaipad ecosystem is that, there is no pest and disease incidence in the natural field condition. The reason for this phenomenon may be due to high potassium content of Kaipad soil or may be abiotic stress induced biotic stress tolerance, yet to be researched. As there is no pest and disease incidence in Kaipad rice tracts, no chemical plant protection is followed. Farmers are following the unique natural way of cultivation practices, as the tract is suited for natural organic rice production. This clearly indicates that Kaipad rice and related products are free from hazardous chemicals.

### 3.7. Harvest and Yield

The crop will be ready for harvest by the end of September to mid of October. During harvest, panicles along with small portion of the culm are harvested leaving larger part of the stubbles in the field. The harvest produce from interior of Kaipad are brought to the bank of Kaipad in yachts or country boats(fig 4). Yield of traditional Kaipad cultivars ranges from 1.0 – 1.5 t ha<sup>-1</sup> and that of high yielding varieties ranges from 3.2 – 3.5 t/ha. As the production tract is naturally organic, the rice from Kaipad is purely organic.



Fig. 4. Kaipad tract at harvest stages.

### 3.8 Processing

Parboiled rice of Kaipad cultivars is consumed by farmers and sold in the local market. Rice flake is an important product produced at this tract. As rice flake contains bran of rice also unlike milled rice, the nutritive value of rice flake from Kaipad rice tract which is naturally an organic tract is imperative. This is evident from the local practice of giving Kaipad rice flake to the people outside Kaipad rice tract by the people of Kaipad rice tract, when they visit their house for the first time. Rice flakes from Kaipad rice tracts fetches 40% more price than flakes from ordinary wetland field in the local market. As the farmers of this tract are small and marginal farmers, they could not do large scale processing and marketing of rice and its products by their own.

## 4. Aqua Culture in Kaipad

After the harvest of paddy, the Kaipad field is left for aqua culture, especially for shrimp culture. Aqua culture in Kaipad is of traditional capture based. Immediately after the cessation of North East monsoon in November, the bunds around the fields will be strengthened using sticky mud and weeds, and wooden sluice gate (Mancha) will be fixed. Along with the tidal current, fingerlings of prawn, crab and other fishes enter into the field.

This unique ecosystem which has a great potential to contribute to food security, nutritional security, livelihood security, water security, bio-diversity and environmental protection faces various kinds of menaces. As the recent focus of world agriculture is small holder agriculture in the developing world, Kaipad rice tract which is naturally an organic production tract and governed by small and marginal farmers have a great role to play. Due to the unique and complex combination of agro-climatic conditions prevailing in the region of Kaipad rice tracts, rice produced in this region are having distinctive and naturally occurring characteristics, which have won the patronage and recognition of both low income consumers and high income consumers. The tract which is specific with heterogeneous soil structure and properties, vulnerable to vagaries of climate change and abiotic stresses, rich in bio-diversity, is a vast avenue for researchers of various fields of live science. The only thing the researchers should keep in mind is that, the unique naturally blessed ecosystem of Kaipad should not be disturbed at any cost, using external out puts. Research should be of supportive type to the farmers, researchers, and students revealing the wonderful network system of the nature. In Kerala, wetlands are getting reduced in a fast rate compared to any other state, because of very high population density. This threat is comparatively less to coastal Kaipad tracts because of soil salinity.

## 5. Conclusion

As land and water are diminishing resources because of

urban expansion, we should all make maximum utilization of the available agricultural lands. And if it is a land not useful for urbanization like Kaipad, it has great relevance. Hence, development of Kaipad, which is a sea coastal unique tract affected by vagaries of climate, not much use for urban expansion, and governed by small and marginal farmers, preserving its ecosystem, is need of the hour. Further, in the current scenario of food crisis, solving location specific problems has great significance. In the present era of organic agriculture gaining societal, political and scientific recognition for its contribution to sustainable agriculture, enhancing rice production from a naturally organic production system like Kaipad rice tract, which is an abiotic stress prone area, is imperative to achieve ever green revolution in rice. As Dr.M.S.Swaminathan rightly pointed out in the 97th Indian Science congress, “A revolution in small farm management is essential to revitalize the country’s agriculture sector” for which we need a re-orientation to streamlined lab to land movement understanding the socio-economic background of the farmer. Besides, as wetlands of Kerala are under the threat of real estate mafia, there is every chance of intrusion of this social miscreant to this bestowed ecosystem also for which Government should take very strong action to restrain.

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