Indian Journal of Traditional Knowledge
Vol. 11(1), January 2012, pp 185-189

# *Kaipad* rice farming in North Kerala-An indigenous saline resistant organic farming system

KT Chandramohanan & KV Mohanan*
Genetics & Plant Breeding Division
Department of Botany, University of Calicut, Kerala- 673635, India
E-mail: drkvmohanan@rediffmail.com

*Received 09.05.11; revised 16.06.11*

Rice, the most important cereal and staple carbohydrate source of Asia is cultivated in diverse ecological conditions and many such agro-ecosystems are fragile and critically endangered. Some such systems are very special in terms of their ecological singularity and subsistence value and their conservation would invariably add to availability of food and protection of genetic diversity. The present study is an investigation in to a very unique rice farming system in Kerala state of India in which rice is cultivated in the first crop season in saline wetlands that are subjected to regular tidal action, taking advantage of the heavy South west monsoon which results in flushing out the salt content from the farmland. In Central Kerala the system is known as *pokkali* and in North Kerala as *kaipad*. *Kaipad* system of rice farming has been studied presently, based on specialities of the area, soil and water conditions and the varieties used. The study showed that soil salinity of the area in summer varied from 10.9 mmhos/cm to 19.9 mmhos/cm and water salinity in summer varied from 35.9 mmhos/cm to 49.9 mmhos/cm and in the month of July in the middle of the South west monsoon it varied from 1.6 mmhos/cm to 4.7 mmhos/cm. Soil *p*H during April ranged from 4.9 to 6.6. Water *p*H ranged between 6.71 and 7.45 in April and in July it ranged from 6.15 to 6.71. Availability of NPK in the soil ranged as follows in April: N: 1.12% to 2.0%; P: 7.2 kg/ha to 34.2 kg/ha; K: 480 kg/ha. The major rice varieties cultivated in the area are the native cultivars *Kuthiru*, *Orkazhama*, *Kuttusan*, *Orthadiyan* and *Chovverian* among which *Kuthiru* is the most popular and the best performing.

**Keywords:** *Kaipad*, Traditional and released saline tolerant rice cultivars

**IPC Int.Cl.[8]:** A01G 16/00, H01L 35/00, H01L 37/00, A23L 3/00, A23L 4/00, A47G

Rice is one of the major cereals of the world and is the staple food of the people of Asia. India stands first in rice area (44. 6 million hectares) and second in production which almost tripled from 30.4 million tones in 1966 to a record production of 93. 3 million tones in 2001-02. Though there was steady increase in production of rice in India, reverse was the trend in the state of Kerala. Since mid seventies, area under paddy cultivation is declining at the rate of 4.3% per annum in the state[1]. The net area of rice, the single most food crop of the state has been reported as 2.25 lakh hectares in 2004 which is a meagre 5.8 % of the total geographic area, 10 % of the net area sown and 16 % of the area under food crops[2]. The prosperity of the people of Kerala and in turn the economy of the state largely depends on the performance of rice. Kerala is a deficient state in rice production. While the estimated requirement of rice for the state is 30 lakh tonnes/yr, it produces only one third of its requirement. The deficit in rice production is increasing year after year due to reduction in rice area arising out of large scale conversion of paddy lands for raising other crops or for residential purposes[2]. It is estimated that half of the world's farms have been damaged by salt. About one billion hectares of the world's land are affected by salt and 60% of it is cultivated. This is not a static situation and approximately 1.5 million hectares of irrigated land are salinized each year[3].

To address these problems, the ability of crops to tolerate such conditions has become a key research issue in the world. At this context, salinity tolerant genetic resources and varieties of rice can play a major role to attain the goal of food security. Further, some degree of cultivar tolerance for salinity stress available with certain traditional land races, not exploited so far has great relevance in crop improvement. A complex and ecologically responsive rice-fish farming system has evolved in the coastal wetland regions of India over centuries. No accurate

*Corresponding author

estimate of the area under this cultivation exists. According to one estimate[4], it is about 0.7 million hectares. Rice culture in these lands takes place either under deep water or floating conditions. The rice varieties cultivated are traditional types with an average yield of about 1.5 to 2 tonnes per hectare[4]. An important characteristic of this farming system is that to facilitate the cultivation of rice during the wet season of the year, the land has to be dewatered for sowing and subsequently protected from saline water intrusion to ensure crop growth; rest of the year it remains under fresh or saline water depending on the ecological setting. For the organisation of this farming, different types of water control, both for the cultivation of rice and for the culture of fish are required. There exist variations in these farming systems across regions depending on the ecological, technological, institutional, and organisational arrangements and systems of exploitation of the wetland resources base[4]. Forty years ago, about 2500 ha of *kaipad* rice fields existed in Kannur district of Kerala, but now it has been restricted to about 600 ha. Most of the *kaipad* fields either lie barren or produce low yields. At present, traditional cultivars namely *Kuthiru*, *Orkayama*, *Mundon*, *Kandorkutty*, *Orpandy*, *Odiyan* and *Orissa* tolerant to low and medium salinity are cultivated in various *kaipad* fields of Kerala[3].

The present effort is significant since in recent decades, the wetlands under rice-fish farming have been facing severe threats due to a variety of factors including shift from the ecologically fragile rice-fish farming to the semi-intensive fish farming. The study has been carried out at a time when the world fritters time and money on researching new varieties of paddy that are flood and saline tolerant while the indigenous varieties adaptive to organic farming in coastal Northern Kerala that thrive on salinity and water are finding survival a tough proposition. *Kaipad* system of rice farming in the Ezhome and Keezhara regions of Kannur district of Kerala state of India has been studied presently, based on agro-ecology, farming practices and the varieties used.

## Materials and methods

Hydromorphic saline soils are common in Kerala and are found near the coastal tracts of the state in the districts of Ernakulam, Alappuzha, Thrissur and Kannur. The network of backwaters and estuaries serve as inlets for tidal waters to flow inland in to these areas causing salinity[5]. The area of present study also is subjected to tidal action and hence the soil is saline and out skirted by mangrove plants which provide a special habitat for rice cultivation.

The study area is located at Ezhome region of Ezhome village panchayat and Keezhara region of Kannapuram village panchayat of Kannur district of Kerala. Fifty farming units in the Ezhome and Keezhara regions, each with an area of about 0.1 ha to 0.3 ha were used for the study (Table 1). The units were frequently visited and the observations recorded and analysed in the first cropping season of 2009-10. Details of the commonly used cultivars and varieties were collected and the frequency of their cultivation observed. Water and soil samples were collected from 10 representative units during April and July and analysed for parameters like *p*H, salinity, Nitrogen content in terms of organic C and available P and K content. The farming units were observed from land preparation to harvest and observations were made on the agronomic characters of the crop cultivars used based on systematic sampling selecting 30 plants per farming unit.

## Results and discussion

*Kaipad* wetland ecosystems consist of marshes, swamps, ponds and paddy fields. These swampy and water logged areas experience flood during monsoon and salinity during summer owing to their proximity to estuaries. Tidal currents enter the fields during high tide and flow out during low tide. Saline water from the sea enters the estuaries during summer when the flow is low and it spreads in the low lying *kaipad* wetlands and this water keeps the area moist even in summer months. *Kaipad* farms are made by making bunds around the wetlands and these are protected by the mangrove plants growing along their outer boundaries. The *kaipad* system of agricultural practice is traditionally empowered with local knowledge and it is interwoven with traditional lifestyle.

### The farming system

Agricultural operations are started with the drying of the low lying *kaipad* fields in the month of April.

Table 1—The rice cultivars used and the frequency of their cultivation by the farmers

| Cultivar | Number of farming units out of the 50 units visited | Percentage |
|---|---|---|
| 1.*Kuthiru* | 28 | 56 |
| 2.*Orkazhama* | 10 | 20 |
| 3.*Kuttusan* | 10 | 20 |
| 4.*Chovverian* | 1 | 2 |
| 5.*Orthadian* | 1 | 2 |
| Total | 50 | 100 |

The tidal flows are controlled by constructing bunds with about 2-3 m breadth and 2.5-3 m height at the outer boundaries adjacent to estuaries using sticky mud and wild grasses which are available in the river banks. Locally the bunds are known as *chira* or *kandy*. The flow of water is regulated by sluice wooden gates, locally known as *mancha*.

Normally only one crop of rice is raised in the area. Cultivation starts in April and ends by October. Before the starting of agricultural operations, the saline water is drained out completely and the fields are left to dry for about one month. Germinated rice seeds are sown on mounds known as *potta* in the low to medium saline phase of the ecosystem. The soil mounds with a spacing of about 50 cm are prepared by the end of April. Two kinds of mounds are common: hemispherical mounds with 30-45cm height and 50-60cm diameter and long strips with 30cm width. The mounds help to leach away the high salinity by the heavy rains during early June. The bunds are opened as soon as the river is filled with fresh water. The fresh river water tides wash away the salinity.

The seeds are soaked in fresh water in jute sacks for one day and the wet seeds are kept for 3 days for germination by the beginning of June. Local salinity tolerant rice varieties are used for the purpose. After the onset of southwest monsoon, 4 day old germinated seedlings are sown on the flattened tops of the mounds. After 45 days of vegetative growth, the mounds are dismantled and the seedlings in clefts are dispersed around the flattened mounds using spades. There are no other cultural operations till the harvest except removal of weeds. No fertilizer is also added. Harvesting is done by the end of October. While harvesting, only the panicles are cut and the rest of the stalks are left to decay in the water, which in time become feed for the prawns that are grown subsequently.

The strengthening of the bunds needs about 20 man power days, preparation of the soil mounds needs 40 man power days, dismantling of mounds needs 20 man power days, weed removal requires 10 man power days and harvesting needs 20 man power days, totally coming to a cost of about Rs. 22000/- per ha.

Traditional fish rearing is carried out in *kaipad* farms during the high saline phase from November to April. Mud-bunds and sluices are made around the fields to regulate the entry of tidal water. Prawn filtration in the fields begins after the monsoon. The sluices are kept open to allow tidal water and prawns and fish to enter the farm. Fish is caught during low tide when water is released through the sluices. A net is fixed to the sluices to catch fish. Neither chemical fertilizers nor plant protection chemicals are used in rice, fish or shrimp farming. The daily tidal inflows and outflows, besides the tremendous microbial activity owing to the presence of large quantities of organic matter (decomposed aquatic weed mass and paddy stubbles) make the *kaipad* fields fertile.

The 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. Further, diversity of flora and fauna in this area is rich when compared to modern rice-farming system. In addition, fertility of the field is increased due to left-over rice stubbles and post harvest vegetation. This ecofriendly farming method has been practiced for many years with no change even to this day.

**Soil and water parameters**

An analysis of the soil parameters of the study area in the month of April showed that soil organic C content varied from 0.7% to 2% (available). Available Phosphorus varied from 7.2kg/ha to 34.2kg/ha and available Potassium content was of the order 480kg/ha. Observation on soil analyses shows that K is high in all cases, N is varying from medium to high and in general P is medium. This shows that the major nutrient requirements of the crop are well supplied by the system even without the application of any fertilizer. Soil *p*H of the study area during April showed a range of 4.9- 6.6 which is acidic (Table 2). The *p*H of water during the month of April ranged from 6.7 to 7.5 and it was in between 6.2 to 6.7 in July. It shows that the *p*H of water of this area changed from alkaline of pre-monsoon stage to slightly acidic due to dilution by heavy rain in the monsoon. Salinity also got decreased due to this dilution effect of heavy rainfall. The minimum salinity of water during April was found to be 40.6 mmhos/cm and maximum 49.9 mmhos/cm and it got reduced in the monsoon to 1.6-6.2 mmhos/cm (Table 3).

**Crop cultivars/varieties used**

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

Table 2—Data on the analysis of soil samples collected from the fields before the crop season in April

| Sample No. | Place of collection | Organic carbon % | Available P (kg/ha) | Available K (kg/ha) | *p*H | ECe (mmhos/cm) |
|---|---|---|---|---|---|---|
| 1 | Keezhara (1) | 1.40 | 10.8 | 480 | 6.6 | 15.7 |
| 2 | Keezhara (2) | 1.72 | 23.4 | 480 | 5.2 | 15.3 |
| 3 | Keezhara (3) | 1.88 | 7.2 | 480 | 6.2 | 19.9 |
| 4 | Ezhome (1) | 1.40 | 21.6 | 480 | 5.3 | 14.8 |
| 5 | Ezhome (2) | 1.24 | 14.4 | 480 | 5.8 | 12.2 |
| 6 | Ezhome (3) | 1.12 | 27.0 | 480 | 6.1 | 12.4 |
| 7 | Ezhome (4) | 0.72 | 34.2 | 480 | 5.6 | 12.2 |
| 8 | Ezhome (5) | 2.00 | 27.0 | 480 | 5.6 | 10.9 |
| 9 | Ezhome (6) | 1.80 | 18.0 | 480 | 5.0 | 17.2 |
| 10 | Ezhome (7) | 1.48 | 14.4 | 480 | 4.9 | 13.7 |

Table 3—Analysis of water samples collected from the fields in April and July

| Sample No. | Place of collection | Salinity | | *p*H | |
|---|---|---|---|---|---|
| | | April (mmhos/cm) | July (mmhos/cm) | April | July |
| 1 | Keezhara (1) | 46.8 | 4.7 | 7.35 | 6.33 |
| 2 | Keezhara (2) | 37.4 | 1.6 | 6.83 | 6.15 |
| 3 | Keezhara (3) | 35.9 | 1.6 | 6.71 | 6.17 |
| 4 | Ezhome (1) | 46.8 | 6.2 | 7.2 | 6.46 |
| 5 | Ezhome (2) | 40.6 | 1.6 | 7.3 | 6.29 |
| 6 | Ezhome (3) | 46.8 | 1.6 | 7.4 | 6.42 |
| 7 | Ezhome (4) | 48.4 | 1.6 | 7.05 | 6.71 |
| 8 | Ezhome (5) | 49.9 | 3.1 | 7.42 | 6.19 |
| 9 | Ezhome (6) | 43.7 | 3.1 | 7.41 | 6.22 |
| 10 | Ezhome (7) | 39.0 | 1.6 | 7.45 | 6.51 |

matter. (Figs. 1-4) Five local salinity tolerant rice cultivers, namely *Chovverian* (Fig.5), *Kuthiru* (Fig.6), *Kuttusan* (Fig.7), *Orkazhama* (Fig.8), and *Orthadian* (Fig.9) are cultivated in this area (Table 1). However, the cultivar *Kuthiru* is used more commonly, followed by *Orkazhama* and *Kuttusan*. The remaining two cultivars are only very rarely cultivated.

Observations on the yield attributing traits of these land races are presented in Table 4. All the five rice varieties are tall and plant height is relatively higher in *Chovverian* with an average of 150.4cm. The highest number of tillers at harvest among the varieties was 9.8 shown by *Kuthiru* and the lowest was 6.93 shown by *Orthadian.* Ear bearing tillers are relatively more in *Kuthiru* rice cultivar with an average of 8.4. Panicles of these cultivars are long but less in number of grains, and grains are bold type with red kernel. Hundred grain weight is higher in *Orthadian* and lesser in *Kuttusan*. Yield per plant is higher in *Kuthiru* and lower in *Orthadian*. The varieties differ in their morphological and physicochemical characteristics and cooking qualities. Duration of *Kuthiru* and *Orthadian* is 110-120 days, that of *Orkazhama* and *Kuttusan* is 135 -140 days and that of *Chovverian* is 125-130 days. These saline tolerant traditional land races are low yielders and are susceptible to lodging, because of the poor culm strength and excessive culm length, with poor grain qualities like awn on grains and heavy shattering of grains. However, these cultivars are resistant to pests and diseases in natural field conditions of *kaipad* and the cooked rice is delicious.

Two new rice varieties, *Ezhome*-1 and *Ezhome*-2 have been developed recently by Kerala Agricultural University with the participation of farmers of Ezhome panchayat. These varieties are high yielding and non-lodging red rice varieties with awn less, non-shattering grains and favourable cooking qualities better than local cultivars. The average yield of *Ezhome* -1 and *Ezhome*–2 is 3.5 tones/ ha and 3.2 tones/ha, respectively under close planting and zero management conditions of *kaipad*. This yield is 70 % and 60% more than that of local cultivars. These varieties differ in duration, and are having distinct morphological qualitative traits and different mode of salinity tolerance mechanism imparting varietal diversity to the unique ecosystem of *kaipad*[6].

This system exists as a world acclaimed farming model complementing the natural system, utilising indigenous knowledge and ensuring efficient utilisation of local resources. The proximity to sea and subsequent periodical seawater inundation ensure the uniqueness of the rice varieties cultivated and contribute to the high degree of specialisation in the cultural practices followed in the region. The less remunerative rice cultivation compliments a highly profitable prawn culture, making it a unique agro-ecological continuum. The farming system is traditionally organic, as farmers desist from use of agrochemicals in rice farming which hampers the productivity of the succeeding crop, i.e. the prawn culture. But lately, monoculture of prawn has caught up, which though provides higher net return over rice-prawn culture in short

Figs. (1-4), *Kaipad* habitat, (5-9), *Kaipad* varieties; 5-*Chovverian*, 6-*Kuthiru*, 7-*Kuttusan*, 8-*Orkazhama*, 9-*Orthadian*

Table 4—Yield attributing characters of five local rice cultivars

| Rice cultivar | Plant height at harvest (cm) | No. of tillers/plant at harvest | EBT % | Panicle length (cm) | Spikelet number per panicle | Seed number per panicle | Hundred grain weight (g) | Yield per plant (g) |
|---|---|---|---|---|---|---|---|---|
| *Kuthiru* | 143.00 | 9.80 | 95.19 | 26.45 | 129.35 | 97.60 | 3.32 | 26.22 |
| *Orkazhama* | 142.15 | 9.14 | 94.75 | 25.82 | 124.67 | 89.69 | 2.91 | 22.72 |
| *Kuttusan* | 140.09 | 8.19 | 94.87 | 24.08 | 142.65 | 110.07 | 2.34 | 20.04 |
| *Chovverian* | 150.40 | 7.73 | 87.58 | 24.60 | 99.73 | 88.40 | 3.41 | 20.38 |
| *Orthadian* | 140.57 | 6.93 | 92.78 | 22.73 | 80.23 | 65.67 | 3.53 | 14.90 |

run, is found to be unsustainable both from ecological and social contexts. *Kaipad* rice is distinguishable in taste, quality and utility from the conventional rices.

## References


1 Gayatri RN & Raveendran K, Exploration of untapped potentiality of coastal paddy fields of Kerala (India)-A Case Study, *Middle-East J Sci Res*, 4(1) (2009) 4-47.

2 Leenakumary S, Genetic improvement of rice varieties in Kerala, In*: Genetic Improvement of Rice Varieties in India Part-II*, edited by Sharma SD and Prasad Rao U, (Today and Tomorrow's Printers and Publishers, 4435-36/7, Ansari Road, Daryaganj, New Delhi), 2004, 689-741.

3 Vanaja T, Neema VP, Mammootty KP, Rajeshkumar R, Balakrishnan PC, Jayaprakashnaik & Raji P, Development of first non-lodging and high-yielding rice cultures for saline kaipad paddy tracts of Kerala, India, *Curr Sci,* 96 (8) (2009) 1024-1028.

4 Nair KN, Vineetha M & Mahesh R, The lure of prawn culture and the waning culture of rice-fish farming: A case study from north Kerala wetlands, Discussion Paper 43, Kerala Research Programme on Local Level Development, Centre for Development Studies, Thiruvananthapuram, 2002.

5 Swarajyalakshmi G, Gurumurthy P & Subbaiah, Soil salinity in south India: problems and solutions, *J Crop Prod*, 7 (2003) 247-275.

6 Anonymous, Ezhome-1, Ezhome-2- First saline resistant, high yielding, non-lodging rice varieties of *kaipatu*, Kerala Agricultural University, Thrissur, 2010, 1-2.