

# Pokkali rice cultivation: A Review on the indigenous rice cultivation method in Kerala

## Abstract

Kerala state's rice consumption is predicted to be between 3.5 and 4 million tons per year, but production is just a sixth of this. In order to boost the state's rice production, attention must be paid to traditional rice growing techniques. Thus, there is a need to understand the Pokkali rice cultivation method used in Kerala. The Pokkali style of rice farming in Kerala's acidic, saline soil is a distinctive way of rice cultivation. A native historic salt-tolerant type of rice called Pokkali, with a 120-day growing season, can withstand flooding by growing up to a height of 1.5 meters. Chettivirippu, Vyttila 1, Vyttila 2, Vyttila 3, Vyttila 4 and Vyttila 5 are the other rice varieties cultivated using the Pokkali rice cultivation method. With this technique, a single rice crop is harvested on mounds during the low salinity part of the production cycle (June to mid-October), with prawn aquaculture taking place during the high salinity phase (November to April). Pokkali farmers only produce 2000 kg of rice per hectare, making it slightly unprofitable. The rice plant residue after harvesting is left to rot in the water which subsequently acts as prawn feed. Prawn farming takes place from November to April. Sluice gates help in prawn culture filtering by maximizing the amount of saline water that enters the field and preventing the prawns from escaping. The two main cultivated prawns species are *Penaeus monodon* (Tiger prawn) and *Penaeus indicus* (White prawn). Prawns are typically collected in mid-April, especially two to three days before new full moon days, as tidal activity affects their movement. Prawn excreta serve as a natural fertilizer for rice cultivation; prawns feeding on rice cultivation stubbles help to minimize the occurrence of illness in rice to a minimum. It is an organic rice production approach with lower costs than commercial rice farming because chemical fertilizers and pesticides are not used.

**Keywords:** Ecosystem, Pokkali, Prawn farming, Relay cropping and Vyttila

## 1. Introduction

Kerala has both upland and low-lying locations where rice is grown (Vijayan, 2016[29]). The local climate and topography significantly influence the state's diverse rice ecology (Kumar & Kunhamu, 2021[11]). In Kerala, there are several different methods of growing rice, including intercropping it with other crops, relay planting, sequential cropping, and the Integrated Farming System (IFS) (Kerala State Biodiversity Board, 2009[7]). Moreover, the rice ecosystems in Kerala varies from below sea level, as is the case with Pokkali, Kuttanad, and Kole lands, to the rice paddies in the High Mountains of Idukki and Wayanad (800 to 1500 m above mean sea level) (Kumar & Kunhamu, 2021[11]). The state's rice consumption is predicted to be between 3.5 and 4 million tons per year, but production is just a sixth of this (Krishnankutty *et al.*, 2021[9]). A decrease in the area under rice cultivation has resulted in a growing annual shortfall in rice production. In Kerala, where rice farming has been for centuries, a severe issue has arisen due to the widespread conversion of paddy lands for other crops or residential purposes (Kumari, 2007[13]; Pervez *et al.* 2022[20]). Thus, there is an alarming need to increase the state's total rice production. But the major constraint is the shrinking area under rice cultivation and the

widespread conversion of paddy lands for other crops or for residential uses (Kumar, 2007 [10]). In order to boost the state's rice production, attention must be paid to traditional rice growing techniques, including both wild and cultivable kinds. Thus, there is a need to understand the Pokkali rice cultivation method used in Kerala. The Pokkali system of rice cultivation is a traditional technique for growing rice that systematically combines prawn farming with the saline-tolerant wild rice type known as Pokkali. In Kerala, over 25% of the entire paddy lands are submerged in water; as a result, integrated rice-shrimp/prawn farming is done here (Jayan & Sathyanathan, 2010[5]).

## **2. Geographical Location**

### **2.1 Geographical Location of Kerala**

Kerala is located in the south-west region of the Indian peninsula, in the southern portion of the Western Ghats, bordered to the east and north-east by Tamil Nadu and Karnataka, and to the west by the Arabian Sea (Krishnankutty *et al.*, 2021[9]). Kerala state is essentially categorized into 13 agroecosystems, of which eight are relevant for rice growing, based on topography, soil, abiotic variables, resource endowments and seasonality of cultivation (Kumari, 2012[12]). The Laterite Midlands, Malayorum (hill slopes), the Palakkad Plains, the Chittoor Black Soil, the Kuttanad, the Pokkali, Kole and Kaipad, the Onattukara, and the High Ranges are among of them (Kumar & Kunhamu, 2021[11]). Kerala has a variety of geographical features, including wetlands, plains, and coastland to the west, as well as foothills of the Western Ghats to the east (Krishnankutty *et al.*, 2021[9]). Wild and cultivated rice in the state have a wide variety of germplasm due to the ecological circumstances there (Sharma, 1991[24]). Kerala, Kuttanad and Palakkad are two of Kerala's principal rice-growing regions (Vijayan, 2016[29]). The overall Pokkali lands were thought to measure 25,000 acres, but vast tracts have been transformed for coconut farming and other uses (Jayan & Sathyanathan, 2010[5]).

### **2.2 Geographical Location of Kuttanad**

The Kuttanad region, which produces roughly 20 per cent of Kerala's rice, is referred to as the "Rice Bowl of Kerala" (Thomas, 2002[28]). Located between the districts of Ernakulam and Alappuzha, Kuttanad is a low lying 875 km<sup>2</sup> area with coordinates of 90171 N to 90401 N and 75019 E to 76033 E (Padmanabhan *et al.*, 2001[17]). Most of the Kuttanad region, which is made up of reclaimed land from Vembanad lake, is located between 0.6 and 2.1 meters below sea level (Vijayan, 2016[29]). Kerala's Kuttanad region has an ecological scenario known as the tidal wet land ecosystem coupled with deep water status (Vijayan, 2016[29]). The entire wetland is split into three parts: the Kari lands (a marshy area with black peat soil that is highly acidic), the shallow reclaimed land known as Karappadams, and the Kayal land (land in backwaters) (Vijayan, 2016[29] and Padmaja *et al.*, 1994[16]). The Kuttanad region's paddy field is organized into contiguous blocks known as "Padasekharams," which are delimited by canals and natural partitions and range in size from 1 to 1000 ha (Thomas, 2002[28]).

### **2.3 Climate**

Due to the presence of four rivers, primarily Manimala, Meenachil, Achencovil, and Pampa, the cultivable region of Kuttanad endures numerous natural calamities, such as heavy flooding during the South West monsoon period from July to August (Vijayan, 2016[29]). Saline water incursion at high tide is also **typical** (Balchand, 1983[2]). Floods transport alluvial materials from the Western Ghats that are rich in nutrients and deposit them along rivers in low-lying areas. Rice agriculture, especially deep water rice, is very suitable in the **tidal wetlands resulting from floods and tidal intrusions** (Richharia and Govindaswamy, 1990[22]). Growing rice in locations where there is 50 cm of flooding for more than a month during the growing season is known as deep water rice or floating rice (Catling, 1992[3]).

## **2.4 Soil**

Throughout the soil of Kerala's Kuttanad region, sand and clay are mixed in various amounts (Vijayan, 2016[29]). The extremely fertile pokkali fields are also periodically submerged in water (Jayan & Sathyanathan, 2010[5]). **The pokkali fields are exceptionally fruitful due to the daily tidal inflows and outflows and the intense microbiological activity brought on by the abundance of organic matter** (decomposed aquatic weed mass and paddy stubbles) (Shylaraj & Sasidharan, 2005[25]).

## **3. Pokkali rice cultivation: Peculiarities**

The Pokkali style of rice farming in Kerala's acidic, saline soil is a distinctive way to grow rice (Vijayan, 2016[29]). It is an integrated farming approach that doesn't interfere with the environment's normal ecological processes (Kerala State Biodiversity Board, 2009[7]). A historic salt-tolerant type of rice called Pokkali is cultivated from June to November along Kerala's coast (Ramaiah *et al.*, 2020[21]). **Paddy cultivation is generally done during the low salinity phase, while prawn cultivation is done during the high salinity phase** (Shylaraj and Sasidharan, 2005[25]). It is an organic rice production approach with lower costs than commercial rice farming because chemical fertilizers and pesticides are not used (Vijayan, 2016[29]). This traditional way of growing rice doesn't use artificial fertilizers or pesticides on the crop (Shylaraj and Sasidharan, 2005[25]; Sathiadhas, 1989[23]). With this technique, **rice crop is harvested** on mounds during the low salinity part of the production cycle (June to mid-October), with prawn aquaculture taking place during the high salinity phase (November to April). The soggy, waterlogged fields don't require **the labour-saving** heavy machinery or manure addition (Nambiar & Raveendran, 2009[15]). According to the custom, the variety has been given a Geographical Indicator (GI) tag (Pavithran, 2014[19]). Pokkali rice production is an environmentally benign method of growing rice because it doesn't result in biodiversity loss, overuse of natural resources, or coastline deterioration (Paimpillil, 2007[18]). Despite this, pokkali farmers only produce **2000 kg of rice per hectare**, making it slightly unprofitable to grow rice here (Vijayan, 2016[29]; Suchitra, 2005[27]). Consequently, to maintain rice farming in the pokkali areas of Kerala, it is crucial to develop suitable varieties with high yield potential and the capacity to operate well **under acidic saline** conditions with little to no external inputs.

### **3.1 Rice varieties in Pokkali system**

Both wild and cultivated rice in the state have a wide variety of germplasm as a result of the ecological circumstances there (Sharma, 1991[24]). Pokkali, a native rice type with a 120-day growing season, is used by farmers (Kumar, 2007[10]). This species, which can withstand salt and flooding, can reach a height of 1.5 meters (Vijayan, 2016[29]). Chettivirippu, Vyttila 1, Vyttila 2, Vyttila 3, and Vyttila 4 are more types (Kerala Agricultural University, 2002[6]). However, the export potential of the four pokkali rice cultivars (VTL 1 to VTL 4) that were made available by the Vyttila Rice Research Station is minimal. In particular, the red bold grain type, preferred by the local consumers, is not considered desirable by customers elsewhere (Vijayan, 2016[29]). A potential "Mahsuri" mutant named VTL 5 has numerous abiotic stress tolerances, including salt, acidity, and submersion. It is a tall, medium-duration, high yielding kind of rice with white kernels that is also excellent for cooking (Vijayan, 2016[29]).

### **3.2 Present status of Pokkali rice cultivation in Kerala**

The overall area under Pokkali has decreased from 25,000 ha a few decades ago to about 8,500 ha today, of which only 5,500 ha are really used for rice cultivation. The remainder is either kept fallow or is primarily used for prawn farming (Suchithra, 2005[27]). Just 967 acres of paddy is periodically grown using the Pokkali method when the climate is suitable, with the area under Pokkali agriculture decreasing yearly (Jayan & Sathyanathan, 2010[5]). In areas of the wetland environment, fishing is the main industry (Maliyekkal & Thomson, 2008[14]). The primary reason for the decline in the adoption of Pokkali rice growing practices is the lack of farm labour, particularly for harvesting (Jayan & Sathyanathan, 2010[5]).

## **4. Package of practices**

### **4.1 Package of practices of Pokkali rice cultivation**

#### **4.1.1 Mound preparation**

In the pokkali system of rice growing, land preparation begins in May. (Vijayan, 2016[29]). Bunds are raised first, then mounds with a 1 m<sup>2</sup> foundation and 50 cm height are prepared (Kerala Agricultural University, 2002[6]). By restricting the water flow into the fields, the mounds are allowed to dry up (Vijayan, 2016[29]).

#### **4.1.2 Sowing**

Sprouting seeds are sown on Pokkali field's mounds (Paimpillil, 2007[18]). The seeds are sprouted in fresh water for 12 to 15 hours while being securely wrapped in coconut leaves with a layer of banana or teak leaves inside (Thomas, 2002 [28]; Paimpillil, 2007[18]).

#### **4.1.3 Dismantling**

The mounds are levelled a month after seeding. In the field, the mound seedlings are dispersed evenly (Vijayan, 2016[29]). The seedlings' rapid growth and field establishment makes them more resilient to the ensuing floods. Because the prevalence of pests and diseases is below the

threshold level, manuring and plant protection practices are not required to grow Pokkali rice, resulting in the production of natural, organic rice (Jayan & Sathyanathan, 2010[5]).

#### **4.1.4 Harvesting of Pokkali rice cultivated paddy**

Except for the erect panicles, which are harvested, the 1.5 to 2 m tall rice plant bends and collapses when it reaches maturity (Nambiar & Raveendran, 2009[15]). The remaining stalks are left to rot in the water where they subsequently provide prawn feed. Just 2000 kg ha<sup>-1</sup> of rice is often harvested by pokkali farmers, making it slightly unprofitable to grow rice here (Shylaraj & Sasidharan, 2005[25]). Traditional rice varieties are declining for several reasons, including their low production, very long growing seasons, lack of price premiums for some types, and relatively lengthy cooking times (Anonymous, 2019[1] and Xie, 2011[30]). According to Jayan and Sathyanathan (2010) [5], lodging and associated damages brought on by fish, tortoises, and rodents result in a loss of between 40 and 50 per cent of the potential yield. In addition to these losses and the challenges associated with harvesting paddy, clearing fields for the subsequent selective stocking of prawns is challenging these circumstances (Shylaraj *et al.*, 2006[26]).

### **4.2 Package of practices of Pokkali prawn cultivation**

#### **4.2.1 Prawn culture filtering**

Typically, prawn farming occurs from November to April (Vijayan, 2016[29]). The backwaters and canals in this region become salted after the monsoon season, and a lot of young prawns enter them (Paimpillil, 2007[18]). Sluice gates, or water canals with a head at their gate, are used to direct young prawns into pokkali fields. They are unable to leave due to these gates. In Pokkali field, this is known as prawn culture filtering (Thomas, 2002[28]). In order to maintain the entry and outflow of water during the farming season, sluice gates are crucial in the prawn farming industry. They are kept up in a way that maximizes the amount of saline water that enters the field and prevents prawns from escaping (Vijayan, 2016[29]). Prawn culture uses the leftover residue from rice cultivation as natural feed. While prawn excreta serve as a natural fertilizer for rice cultivation, prawns feeding on rice cultivation stubbles helps to minimize the occurrence of illness in rice to a minimum (Vijayan, 2016[29]).

#### **4.2.2 Harvesting of Prawn cultivation**

The two main cultivated prawn species are *Penaeus monodon* (Tiger prawn) and *Penaeus indicus* (White prawn). Prawns are typically collected in mid-April, especially two to three days before new full moon days, as tidal activity affects their movement (Vijayan, 2016[29]).

### **5. The prospective aspect of Pokkali rice cultivation**

Prawns raised in the field boost the farmers' income (Vijayan, 2016[29]). In Northern Kerala, it's usual practice to use the fertile bottom muck of the land as manure for coconut plantations (Nambiar & Raveendran, 2009[15]). In addition, saline-resistant cultivars and methods can help

farmers prepare for the effects of climate change. Climate change is expected to result in sea level rise, which can increase sea water intrusion in more coastal locations and cause agricultural setbacks that can be avoided by using these types (Gopi & Manjula, 2018[4]). Saline-resistant indigenous rice cultivars helped farmers in Kerala's coastal areas create a distinctive farming method (Gopi & Manjula, 2018[4]). According to estimates, this state needs between 3.5 and 4.0 million tons of rice annually.

Nevertheless, Kerala only generates a quarter of this quantity (Krishnankutty *et al.*, 2021[9]). A decrease in the area under rice cultivation has resulted in a growing annual shortfall in rice production. In Kerala, where rice farming has been for centuries, a severe issue has arisen due to the widespread conversion of paddy lands for other crops or residential purposes (Kumari, 2007[13]; Pervez *et al.* 2022[20]). By erecting barriers to the entry of brackish water from the lakes and oceans and directing the flow of fresh water from the river system to these fields, the reclamation schemes were primarily designed to increase the amount of area under the rice crop and increase the output of the current fields (Korakandy, 2005[8]). The primary reason for the decline in the adoption of Pokkali rice growing practices is the lack of farm labour, particularly for harvesting (Jayan & Sathyanathan, 2010).

## 6. Conclusion

The shrinking area under rice cultivation and the widespread conversion of paddy lands for other crops or for residential uses has a severe problem with meeting the demand and supply of rice within the state. To boost the state's rice production, attention must be paid to traditional rice growing techniques, including both wild and cultivable kinds. The Pokkali system of rice cultivation is a traditional rice-growing technique that systematically combines prawn farming with the saline-tolerant wild rice type known as Pokkali. Paddy cultivation is generally done during the low salinity phase, while prawn cultivation is done during the high salinity phase. Harvesting occurs when the rice crop reaches to a height of 1.5 to 2 m with the help of boats. The remaining stalks are left to rot in the water where they subsequently act as prawn feed whereas prawn excreta as a natural fertilizer for rice cultivation. Pokkali rice production is an environmentally benign method of growing rice because it doesn't result in biodiversity loss, overuse of natural resources, or coastline deterioration. Despite this, the primary reason for the decline in the adoption of Pokkali rice growing practices is the lack of farm labor, particularly for harvesting.

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### Author's Contribution

First Author defined the problem, proposed the solution and wrote the first draft of the manuscript. Second and third authors collected the brief literature of review. Fourth and fifth authors managed the references section of the study. All authors read and approved the final manuscript.

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