Pokkali rice cultivation: An indigenous traditional rice cultivation method in Kerala

Abstract

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 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 Pokkali rice cultivation method. With this technique, a single crop of rice 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 on average per hectare, making it slightly unprofitable. The residue of rice plant after harvesting are 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 species of cultivated prawns 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 helps to minimize the occurrence of illness in rice to a minimal. 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

Comment [H1]: Study did not state the main purpose of the study and methodology used to carry out the study. No main findings stated and implication of results are not given!

Introduction

Kerala has both upland and low-lying locations where rice is grown (Vijayan, 2016). The state's diverse rice ecology is significantly influenced by the local climate and topography (Kumar & Kunhamu, 2021). 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). 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). Saline-resistant indigenous rice cultivars helped farmers in Kerala's coastal areas create a distinctive method of farming (Gopi & Manjula, 2018). 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). 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. Considering the state's rice consumption is predicted to be between 3.5 and 4 million tonnes per year yet production is just a sixth of this (Krishnankutty *et al.*, 2021). 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 &

Venugopal, 2005). 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). Due to the shrinking area under rice cultivation and the widespread conversion of paddy lands for other crops or for residential uses, there is a severe problem with the traditional method of rice farming in many regions of Kerala (Kumar, 2007). In order to boost the state's rice production, attention must be paid to traditional rice growing techniques, including both wild and cultivable kinds. Understanding the Pokkali rice farming method used in Kerala is the goal. In areas of the wetland environment, fishing is the main industry (Maliyekkal & Thomson, 2008).

Comment [H2]: Bereaft of information, it only describes the study area and the Pokali rice production system.

-No state purpose of the study
- No gaps identified

Geographical Location

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). Kerala state is essentially categorized into 13 agroecosystems, of which eight are relevant for rice growing, based on topography, soil, abiotic variables, and resource endowments as well as the seasonality of cultivation (Kumari, 2012). 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). 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). Both wild and cultivated rice in the state have a wide variety of germplasm as a result of the ecological circumstances there (Sharma, 1991). Kerala, Kuttanad and Palakkad are two of Kerala's principal rice growing regions (Vijayan, 2016). 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).

The Kuttanad region, which produces roughly 20% of Kerala's rice, is referred to as the "Rice Bowl of Kerala" (Thomas, 2002). Located between the districts of Ernakulam and Alappuzha, Kuttanad is a lowlying 875 km^2 area with coordinates of 90171 N to 90401 N and 75019 E to 76033 E. (Padmanabhan *et al*., 2001). The majority of the Kuttanad region, which is made up of reclaimed land from Vembanad lake, is located between 0.6 and 2.1 metres below sea level (Vijayan, 2016). In Kerala's Kuttanad region, there is an ecological scenario known as the tidal wetland ecosystem coupled with deep water status (Vijayan, 2016). 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 lands known as Karappadams, and the Kayal land (land in backwaters) (Vijayan, 2016 and Padmaja *et al*., 1994). 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).

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). Saline water

incursion at high tide is also common (Balchand, 1983). 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 that form as a result of floods and tidal intrusions (Richharia and Govindaswamy, 1990). 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).

Soil

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

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). It is an integrated farming approach that doesn't interfere with the environment's normal ecological processes (Kerala State Biodiversity Board, 2009). A historic salt-tolerant type of rice called Pokkali is cultivated from June to November along Kerala's coast (Ramaiah *et al.*, 2020). In general, paddy cultivation is done during the low salinity phase, and prawn cultivation is done during the high salinity phase (Shylaraj and Sasidharan, 2005). It is an organic rice production approach with lower costs than commercial rice farming because chemical fertilizers and pesticides are not used (Vijayan, 2016). This traditional way of growing rice doesn't use artificial fertilizers or pesticides on the crop (Shylaraj & Sasidharan, 2005 and Sathiadhas, 1989). With this technique, a single crop of rice 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 utilization of labor-saving heavy machinery or manure addition (Nambiar & Raveendran, 2009). According to the custom, the variety has been given a Geographical Indicator (GI) tag (Pavithran, 2014). 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). Despite this, pokkali farmers only produce 2000 kg of rice on average per hectare, making it slightly unprofitable to grow rice here (Vijayan, 2016). 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 the acidic saline conditions with little to no external inputs.

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). Pokkali, a native rice type with a 120-day growing season, is used by farmers (Kumari, 2007). This species, which can withstand salt and flooding, can reach a height of 1.5 meters (Vijayan, 2016). Chettivirippu, Vyttila 1, Vyttila 2,

Vyttila 3, and Vyttila 4 are more types (KAU, 2002). 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 a desirable trait by customers elsewhere (Vijayan, 2016). 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).

Mound preparation

In the pokkali system of rice growing, land preparation begins in May. (Vijayan, 2016). Bunds are raised first, then mounds with a 1 m^2 foundation and 50 cm height are prepared (KAU, 2002). By restricting the flow of water into the fields, the mounds are allowed to dry up (Vijayan, 2016).

Sowing

Sprouting seeds are sown on Pokkali field's mounds (Paimpillil, 2007). The seeds are sprouted by placing them 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 and Paimpillil, 2007).

Dismantling

The mounds are levelled a month after seeding. In the field, the seedlings on the mounds are dispersed evenly (Vijayan, 2016). The rapid growth and field establishment of the seedlings 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 for the growth of Pokkali rice, resulting in the production of natural, organic rice (Jayan & Sathyanathan, 2010).

Harvesting

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). The remaining stalks are left to rot in the water where they subsequently provide prawn feed. Just 2000 kg ha^{-1} of rice is often harvested by pokkali farmers, making it slightly unprofitable to grow rice here (Shylaraj & Sasidharan, 2005). Traditional rice varieties are declining for several reasons, including their low production, very lengthy growing seasons, lack of price premiums for some types, and relatively lengthy cooking times (NICRA, 2019 and Xie, 2011). According to Jayan and Sathyanathan (2010), lodging and associated damages brought on by fish, tortoises, and rodents result in a loss of between 40 and 50 percent 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 a challenge in these circumstances (Shylaraj *et al*., 2006).

Prawn cultivation

Typically, prawn farming takes place from November to April (Vijayan, 2016). The backwaters and canals in this region become salted after the monsoon season, and a lot of young prawns

enter them (Paimpillil, 2007). 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). 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). 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 minimal (Vijayan, 2016).

Harvesting of Prawn cultivation

The two main species of cultivated prawns 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).

Prospective aspect of Pokkali rice cultivation

Prawns raised in the field give the farmers a boost in income (Vijayan, 2016). In Northern Kerala, it's usual practice to use the fertile bottom muck of the land as manure for coconut plantations (Nambiar & Raveendran, 2009). 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). According to estimates, this state needs between 3.5 and 4.0 million tonnes of rice annually. Nevertheless, Kerala only generates a quarter of this quantity (Krishnankutty *et al.*, 2021). 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 practiced for centuries, a severe issue has arisen due to the widespread conversion of paddy lands for other crops or for residential purposes (Kumari, 2007). 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). The primary reason for the decline in the adoption of Pokkali rice growing practices is the lack of farm labor, particularly for harvesting (Jayan & Sathyanathan, 2010).

Conclusion

The shrinking area under rice cultivation and the widespread conversion of paddy lands for other crops or for residential uses, there is a severe problem with meeting the demand and supply of rice within the state. In order 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 technique for growing rice that systematically combines prawn farming with the saline-tolerant wild rice type known as Pokkali. In general, paddy cultivation is done during the low salinity phase, and prawn cultivation is done during the high salinity phase. Harvesting is carried out 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 acts 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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