WORKING PAPER

UNLOCKING PADDY FIELDS: ENABLING AQUACULTURE FOR AGRICULTURAL TRANSFORMATION

Banisha Begum Shaikh
Shobha Vasan
Sreelakshmi Harilal
D Dhanuraj

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Centre for Public Policy Research (CPPR)
First Floor, Mandoli House, New Link Road
Elamkulam, Kochi, Kerala, India-682020
www.cppr.in | E-mail: research@cppr.in

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1. Introduction

Kerala, endowed with an extensive coastline, backwaters, rivers, and wetlands, possesses one of the most resource-rich aquatic ecosystems in India. However, despite winning the Best Marine State Award in 2024 from the Union Ministry of Fisheries, Animal Husbandry, and Dairying, Kerala finds itself at a critical juncture, grappling with the deteriorating state of its fisheries sector.

According to the International Collective in Support of Fishworkers (ICSF), the state is currently able to meet only 60% of its fish demand, highlighting a widening gap between consumption and local production. Adding to the concern, projections from the Central Marine Fisheries Research Institute (CMFRI) indicate that if this trajectory continues, Kerala may be forced to source nearly half (50%) of its fish requirements from other states by 2035, which calls for immediate and sustained intervention.

To address the widening supply–demand gap, Kerala must look inward by harnessing the vast potential of inland fisheries and aquaculture, as recommended by the Kerala University of Fisheries and Ocean Studies. This shift becomes even more compelling in light of the Food and Agriculture Organisation (FAO) of the United Nations' 2019 findings, which suggest that around 34% of assessed marine fish stocks are now fished beyond biologically sustainable levels, underscoring the urgency of easing pressure on marine ecosystems. While the marine sector remains vital to building a strong blue economy, the contributions of inland fisheries and aquaculture are equally indispensable.

The Fisheries Handbook of 202-22 illustrates that Andhra Pradesh leads India’s fisheries sector primarily through its inland resources, with 87% of its total fish production (48.13 lakh tonnes) coming from inland fisheries. Kerala, by comparison, derives only 27% of its fish production from inland sources as of 2021-22. This disparity persists despite Kerala possessing 427.46 thousand hectares of inland water resources, significantly more than Andhra’s 283.6 thousand hectares, as per the Fisheries Handbook of 202-22. Yet Andhra Pradesh produced 42.19 lakh tonnes of inland fish, while Kerala managed only 2.25 lakh tonnes in 2021–2022—underscoring the vast unrealised potential.

A closer look at Kerala’s 2.25 lakh tonnes of inland fish production reveals another critical issue: only 15% comes from cultured fisheries, while a staggering 85% is derived from capture fisheries. Thus, Kerala is not optimally utilising its ponds, reservoirs, brackish waters, and even paddy fields, which are widely used by our competitive states on a large scale for export-oriented aquaculture through companies and cooperatives. Thus, Kerala has been slow to adopt such practices.

Among the list of various sources of natural resources available for expanding the inland fishing base of Kerala, paddy fields play a significant role. Paddy cultivation in Kerala faces several structural challenges, including high labour costs, declining profitability, and land fragmentation, which have collectively discouraged farmers from continuing paddy farming. These constraints are reflected in the long-term contraction of the sector over the past four decades.

Paddy production declined from 13,06,197 tonnes in 1982–83 to 5,95,860 tonnes in 2022–23, representing a reduction of about 54.4 percent, while the decline in cultivated area has been even more pronounced. The area under paddy cultivation fell from 778,490 hectares to 191,711 hectares during the same period, marking a 75.4 percent reduction, indicating a significant structural shift in Kerala's agricultural landscape. As paddy cultivation has become economically unviable for farmers, these paddy wetlands can be utilised to their full potential for expanding the aquaculture base of Kerala. Kerala's traditional integrated paddy-fish farming system, namely Pokkali and Kaipad, once demonstrated how paddy, prawns (chemmeen), and ducks could coexist naturally, maintaining ecological balance while supporting local livelihoods. For generations, farmers followed a simple 60:40 rhythm between paddy and aquaculture, which has sustained both people and the land.

Today, that balance is fading. Pokkali farmers struggle to market their unique rice and face tedious bureaucratic processes to obtain licences for filtration, even as they practice traditional catch-and-release fisheries. The involvement of multiple agencies, namely the Padasekhara Samithi, Panchayats, Krishi Bhavans, and Fisheries Departments, together with the unpredictability of the climate, has made integrated paddy-fish cultivation increasingly unviable. In this scenario, cultivating Pokkali without fish culture does not justify the toil, time, and energy farmers invest in navigating the intermediaries and regulations.

The success of major fish-producing states, such as Odisha, Andhra Pradesh, West Bengal, and Gujarat, is built on simple, enabling regulations, whereas Kerala's stringent regulatory framework often discourages fishermen and farmers from pursuing full-time aquaculture.

While a substantial body of literature examines the structural, economic, and policy challenges facing Kerala's aquaculture sector, there remains a notable gap in the systematic identification of the specific legal provisions that constrain the efficient use of paddy land for aquaculture. Existing studies broadly recognise regulatory barriers as significant constraints on sectoral growth; however, they lack a detailed analysis of the exact statutory clauses and sub-sections within key legislation—such as the Kerala Conservation of the Paddy Land and Wetland Act, 2008; the Kerala Inland Fisheries and Aquaculture Act of 2010; and other relevant acts and amendments—that continue to limit the optimal utilisation of paddy fields for aquaculture. Against this backdrop, the present study seeks to address this gap by critically examining the applicable legal frameworks, identifying provisions that contribute to regulatory rigidity, and assessing their implications for the sustainability of aquaculture. Building on this analysis, the study proposes targeted, action-oriented legal and policy reforms to enhance land-use flexibility and enable greater freedom of crop choice. Ultimately, the study aims to support evidence-based policy interventions that promote aquaculture—particularly within paddy lands—enhance resource efficiency and unlock the broader economic and developmental potential of Kerala's aquaculture sector.

2. Overview of the Fisheries Sector

Global Scenario:

As per the Food and Agriculture Organisation of the United Nations (FAO), in 2022, China remained the major producer (36 percent) of the total production of aquatic animals, followed by India (8 percent), Indonesia (7 percent), Vietnam (5 percent) and Peru (3 percent). These five countries were responsible for about 59 percent of the world production of aquatic animals in 2022. Differences also exist in terms of the sector's contribution to economic development. In recent decades, the share of total fisheries and aquaculture production of aquatic animals harvested by non-high-income countries (as per the 2024 World Bank classification) has increased, rising from about 33 percent in the 1950s to 84 percent in 2022. Upper-middle-income countries, including China, accounted for 56 percent of total aquatic animal production in 2022, followed by lower-middle-income countries (26 percent), high-income countries (16 percent), and low-income countries (2 percent) (SOFIA, 2024).

Indian Scenario:

According to the Economic Review of Kerala, 2025, India is the second-largest fish-producing country in the world, contributing 8 percent of global fish production. The fisheries sector recorded an average annual growth rate of 6.30 percent during the last five years. The sector contributed about 1.12 percent of total national Gross Value Added and 7.26 percent of Gross Value This information was added from the agriculture sector, as reported in the Annual Report 2024-25 of the Department of Fisheries. The sector is also a major source of foreign exchange earnings, and India is among the leading seafood exporting countries.

Fish production in India in the year 2023-24 is estimated at 184.0 lakh MT, with 139.1 lakh MT from the inland sector and 44.9 lakh MT from the marine sector (Annual Report 2024-25, Department of Fisheries, Ministry of Fisheries, Animal Husbandry, and Dairying, GoI).

Kerala Scenario:

The fisheries sector plays an important role in Kerala's economy. As per the Economic Review of Kerala, 2025, fisheries accounted for 0.89 percent of total Gross State Value Added at constant prices in 2024-25 and 0.78 percent of Gross State Domestic Product. Fisheries and aquaculture contributed 11.62 percent of Gross State Value Added from agriculture and allied sectors at constant prices in 2024-25. In 2024-25, Kerala recorded fish production of 9.28 lakh MT, with 6.47 lakh MT from the marine sector and 2.81 lakh MT from the inland sector.

Kerala is the third-largest seafood-exporting state by quantity and the second-largest by export value. The export of marine products from Kerala has increased since 2015-16. In 2024-25, 1.80 lakh MT of seafood valued at Rs 6,941.29 crore was exported from Kerala. During the period, India's marine exports totalled 16.98 lakh MT, valued at Rs 62,408.45 crore.

Marine Fish Production Status:

The year 2024-25 saw an 11.36 percent increase in marine fish production, indicating a revival in the sector. As per the district-wise fish production of Kerala, the highest marine fish production was registered in Ernakulam, followed by Kollam and Kozhikode districts in 2024-25. These three districts contributed to 67.08 percent of the total marine fish production.

In-land Fish Production Status:

Declining land and water resources, along with stagnating production from capture fisheries, highlight the crucial importance of inland capture fisheries and aquaculture for achieving sustainable livelihoods. The inland water resources supporting about 2.46 lakh fisherfolk (both direct & indirect) provide not only a component of nutritious food but also contribute towards employment generation, thereby increasing the standard of living and economic development. Kerala is blessed with abundant water resources for aquaculture development. It has immense potential to develop infrastructure to increase inland fish production.

Table 1: Fish Production in Kerala & India (2018-19 to 2024-25) (lakh tonnes)

Year	Kerala			All India			Kerala's % share in India		
	Marine (Provisional)	Inland	Total	Marine	Inland	Total	Kerala's % share in India's Marine production	Kerala's % share in India's Inland fish production	Kerala's total fish production share in India's total fish production
2018-19	6.1	1.92	8.02	38.53	97.2	135.73	15.8	1.98	5.91
2019-20	4.75	2.05	6.8	37.27	104.37	141.64	12.7	1.96	4.80
2020-21	3.9	2.05	5.95	34.8	112.5	147.3	11.2	1.82	4.04
2021-22	6.01	2.25	8.26	41.27	121.21	162.48	14.6	1.86	5.08
2022-23	6.9	2.29	9.19	44.32	131.13	175.45	15.6	1.75	5.24
2023-24	5.81	2.51	8.32	44.9	139.1	184	12.9	1.80	4.52
2024-25	6.47	2.81	9.28	NA	NA	NA	NA	NA	NA

Source: Economic Review of Kerala, 2025

Kerala's inland fish production exhibits a pattern of gradual but limited growth over the period from 2018–19 to 2024–25, increasing from 1.92 lakh tonnes to 2.81 lakh tonnes. While this reflects a notable improvement in absolute terms, the sector remains relatively modest within the state's overall fisheries economy, contributing roughly 30% (2024-25) of total production, with marine fisheries retaining their dominance. More critically, when situated within the national context, Kerala's inland fisheries reveal a structural lag. At the all-India level, inland fisheries account for nearly 70–75 percent of total fish production and have expanded rapidly over the years.

In contrast, Kerala's share in India's inland fish production remains persistently low, fluctuating within a narrow band of around 1.8–2.0 percent, with a marginal decline—from 1.98 percent in 2018–19 to about 1.80 percent in 2023–24. This indicates that while inland production in Kerala is increasing, it is not keeping up with the much faster growth observed nationally.

A closer period-wise analysis suggests that the initial years (2018–19 to 2020–21) were marked by relative stagnation, with inland production remaining nearly unchanged at around 2.05 lakh tonnes, accompanied by a slight decline in national share. Although a recovery phase is visible from 2021–22 onwards, with production rising steadily to 2.81 lakh tonnes by 2024–25, this growth remains incremental rather than transformative.

District-wise Inland Fish Production Status:

Table 2: District-wise fish production in Kerala 2024-25 (tonnes)

District	Marine Fish Production	Inland Fish Production	% share of marine fish production in the Total fish production of the district	% share of inland fish production in Total fish production of the district	Total Fish Production	% share of district's inland fish production in Total inland fish production of the state
Thiruvananthapuram	55925	3062	94.8	5.2	58987	1.09
Kollam	136571	37146	78.6	21.4	173717	13.26
Alappuzha	30514	80145	27.6	72.4	110659	28.60
Pathanamthitta	0	11264	0.0	100.0	11264	4.02
Kottayam	0	65110	0.0	100.0	65110	23.24
Ernakulam	185077	29106	86.4	13.6	214183	10.39
Idukki	0	3008	0.0	100.0	3008	1.07
Thrissur	30441	9086	77.0	23.0	39527	3.24
Palakkad	0	6194	0.0	100.0	6194	2.21
Malappuram	40498	2949	93.2	6.8	43447	1.05
Kozhikkode	112534	3231	97.2	2.8	115765	1.15
Wayanad	0	4341	0.0	100.0	4341	1.55
Kannur	41665	4647	90.0	10.0	46312	1.66
Kasaragode	14027	20899	40.2	59.8	34926	7.46
State (Kerala)	**647252**	**280188**	**69.8**	**30.2**	**927440**	100.00

Source: Economic Review of Kerala, 2025

The district-wise data for 2024–25 reveals a highly uneven and spatially concentrated pattern of inland fish production in Kerala. Inland fisheries contribute 30.2 percent of the state's total fish production (280,188 tonnes), with production concentrated in a few districts. In terms of Kerala's total inland fish production, Alappuzha contributes the largest share (28.60 percent; 80,145 tonnes), followed by Kottayam (23.24 percent; 65,110 tonnes), Kollam (13.26 percent; 37,146 tonnes), Ernakulam (10.39 percent; 29,106 tonnes), and Kasaragod (7.46 percent; 20,899 tonnes). Collectively, these five districts account for 82.95 percent (approximately 83 percent) of the state's inland fish production, highlighting a high degree of regional concentration.

Within the districts, however, the relative importance of inland fisheries varies considerably. Inland fisheries account for 100 percent of total fish production in the landlocked districts of Pathanamthitta, Kottayam, Idukki, Palakkad, and Wayanad, reflecting the absence of marine fisheries. Among the coastal districts, Alappuzha exhibits the highest dependence on inland fisheries, with inland fish production accounting for 72.4 percent of its total fish production, followed by Kasaragod (59.8 percent). In contrast, inland fisheries constitute a relatively smaller share of total district fish production in Thrissur (23.0 percent), Kollam (21.4 percent), Ernakulam (13.6 percent), Kannur (10.0 percent), Malappuram (6.8 percent), Thiruvananthapuram (5.2 percent), and Kozhikode (2.8 percent). These findings indicate that while inland fish production is geographically concentrated in a few districts, its relative significance within individual districts varies considerably with geographical characteristics and access to marine fisheries, suggesting scope to strengthen inland fisheries in suitable, underutilised freshwater and brackish-water ecosystems.

Livelihood and Social Security:

The inland fisherfolk population is estimated to be around 2.46 lakh. They reside in 113 inland fishing villages in Kerala. The district-wise details of fisherfolk are given in Table no 1.

Table 3 : Details of District-wise Active and Allied Fishworkers (2024-25)

Sl.No	District	Active Fisher Folk				Allied Fisher Folk (Total)	Grand Total (Active + Allied)
		Marine	Inland	Total	% share of Inland Fisher Folk in Total Active Fisher Folk		
1	Thiruvananthapuram	56190	113	56303	0.20	6264	62567
2	Kollam	18975	8110	27085	29.94	18859	45944
3	Alappuzha	26097	11128	37225	29.89	23418	60643
4	Kottayam	0	4812	4812	100.00	960	5772
5	Pathanamthitta	0	219	219	100.00	466	685
6	Idukki	0	329	329	100.00	161	490
7	Ernakulam	10879	11301	22180	50.95	10502	32682
8	Thrissur	5751	1715	7466	22.97	2790	10256
9	Palakkad	0	604	604	100.00	659	1263
10	Malappuram	30103	1407	31510	4.47	1928	33438
11	Kozhikode	19401	1302	20703	6.29	7545	28248
12	Wayanad	0	35	35	100.00	401	436
13	Kannur	4920	1547	6467	23.92	1800	8267
14	Kasaragod	10569	586	11155	5.25	1678	12833
	Grand Total	**182885**	**43208**	**226093**	**19.11**	**77431**	**303524**

Source: Kerala Economic Review, 2025

Note:

- Active fish workers are those fish workers who are engaged in fishing for their livelihood and are registered with the Kerala Fishermen's Welfare Fund Board (KFWFB).
- Allied workers are those engaged in allied activities related to fisheries and registered with KFWFB

The distribution of inland fisherfolk across Kerala highlights significant spatial disparities: inland fisheries account for only 19.11 percent of total active fisherfolk, underscoring the dominance of marine fisheries. While landlocked districts such as Kottayam, Idukki, and Palakkad report a 100 percent inland share, their absolute numbers remain low, indicating limited scale. In contrast, central districts like Ernakulam, Kollam, and Alappuzha show a moderate inland presence (30–51 percent), forming the core inland fisheries belt with greater potential for integrated systems such as paddy–fish farming. Meanwhile, coastal districts including Thiruvananthapuram, Malappuram, and Kozhikode remain predominantly marine-oriented, with minimal inland participation. Overall, inland fisheries in Kerala are highly localised and structurally constrained.

Key Government Initiatives:

The Economic Review of Kerala 2025 reports that aquaculture development included scientific fish farming on 4,189 ha, 'one paddy one fish' farming on 5,367 ha, and the establishment of 1,225 mussel/oyster farming units. As part of the introduction of innovative farming techniques, 673 units of biofloc fish farming, 2,641 units of fish farming in padutha ponds, 120 units of recirculatory aquaculture systems, and 1,018 cage fish-farming units have also been established. The reservoir fisheries development programme was implemented in 12 reservoirs. Despite these initiatives, Kerala's position in inland fisheries has dropped to 6th in 2021-2022 from 3rd in 1992-93.

Conservation-oriented Approach Towards Paddy Land Use:

One major reason for Kerala's limited expansion of inland fish production is structural and policy constraints, including stringent land-use regulations governing paddy cultivation and wetland conversion, and the relatively low adoption of intensive commercial aquaculture practices.

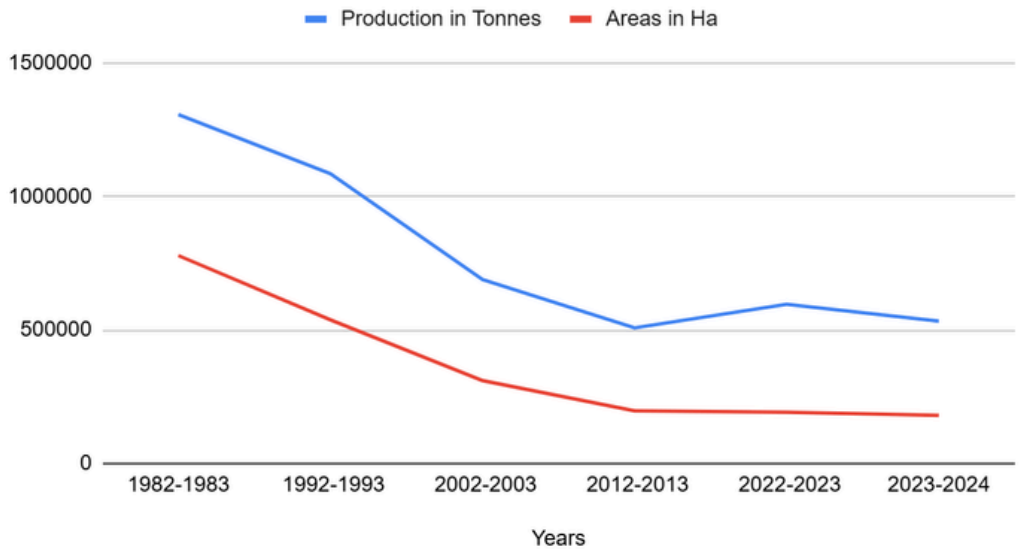
While Kerala follows a strongly conservation-oriented approach to paddy land use, the actual production trends reveal a contrasting trajectory. Paddy cultivation in Kerala faces several structural challenges, including high labour costs, declining profitability, and land fragmentation, which have collectively discouraged farmers from continuing to farm paddy. Over the past four decades, the long-term contraction of the paddy sector has reflected these constraints. Paddy production decreased from 13,06,197 tonnes in 1982–83 to 5,33,327 tonnes in 2023–24, a decline of approximately 59 percent. Over the same period, the area under paddy cultivation reduced from 7,78,490 hectares to 1,80,278 hectares, representing a decline of approximately 77 percent. The magnitude of this reduction underscores the structural transformation of Kerala's agricultural landscape

Table 4: Decadal Trend of Paddy Area and Production in Kerala

Years	Production in Tonnes	Areas in Ha
1982-1983	1306197	778490
1992-1993	1084878	537608
2002-2003	688869	310521
2012-2013	508353	197277
2022-2023	595860	191711
2023-2024	533327	180278

Source: Directorate of Economics and Statistics, GoK

Chart 1: Trend analysis of Paddy Area and Production in Kerala



Source: Directorate of Economics and Statistics, GoK

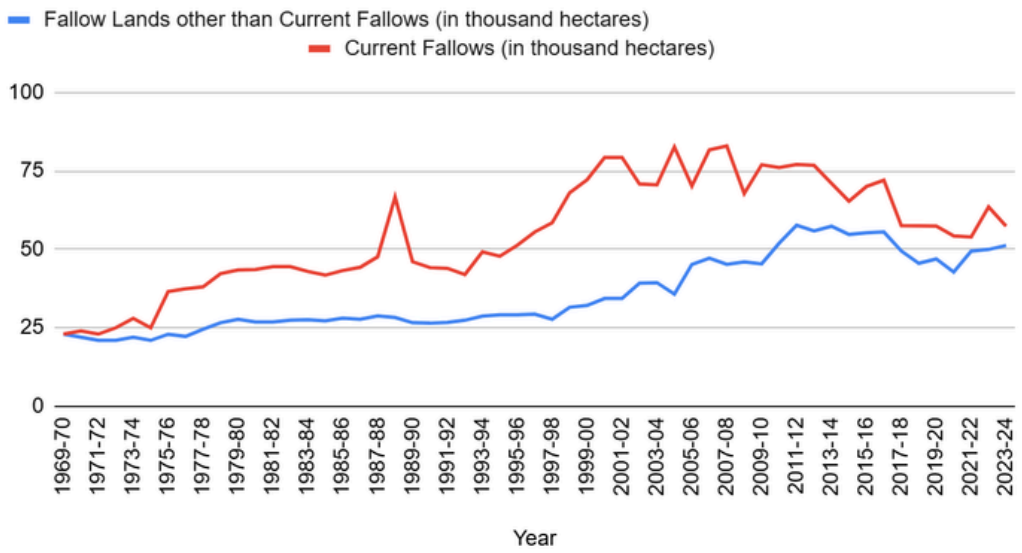
Paddy cultivation in Kerala is characterised by low profitability, particularly for traditional varieties such as Pokkali, owing to high labour costs, increasing input prices, production risks, and limited market incentives. Under such conditions, cultivating Pokkali without integrating fish culture offers limited economic returns, reducing farmers' incentives to continue cultivation. Consequently, many farmers are abandoning their fields, leaving them fallow or seeking exemption for land conversion under Section 27A of the Kerala Conservation of Paddy Land and Wetland (Amendment) Act, 2018. This trend has weakened the agrarian base and associated rural economy and is further reflected in the increasing extent of fallow lands across the state.

Fallow Land Status in Kerala:

The decadal trends indicate a steady increase in fallow lands in Kerala, reflecting a gradual decline in active agricultural cultivation. In the 1970s, fallow lands other than current fallows remained relatively low at around 21–27 thousand hectares, while current fallows ranged between 23–43 thousand hectares.

From the 1980s onwards, current fallows began increasing significantly, reaching 66.6 thousand hectares in 1988–89, indicating the growing tendency of farmers to leave land temporarily uncultivated. This trend intensified during the 1990s and 2000s, with current fallows rising to over 70–83 thousand hectares, while fallow lands other than current fallows also increased gradually to around 34–47 thousand hectares. Although some stabilisation is visible in the 2010s and early 2020s, both categories remain substantially higher than earlier decades, with current fallows consistently above 50 thousand hectares and other fallows around 45–51 thousand hectares by 2023–24.

Chart 2: Current Fallow Land v/s Fallow Land

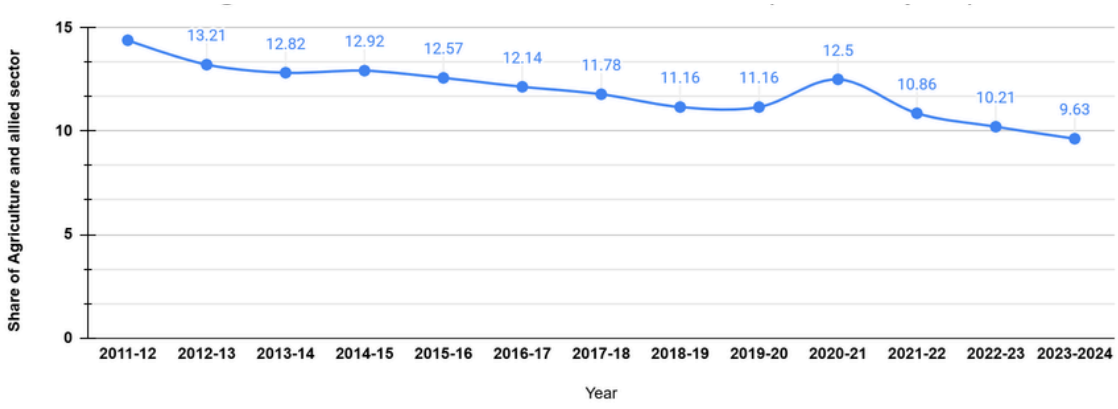


Source: Directorate of Economics and Statistics, GoK

Overall, the persistent rise in fallow lands points to increasing underutilisation of agricultural resources, largely driven by rising cultivation costs, labour shortages, and declining profitability of traditional crops such as paddy. This trend not only reflects agrarian distress but also has broader implications for the state's overall agricultural performance, as discussed below.

Overall performance of the agriculture sector:

Chart 3: Contribution of Agriculture and allied sectors to state's GSVA (at current price)



Source: Directorate of Economics and Statistics, Government of Kerala

The weakening agricultural base is also evident in the declining contribution of agriculture and allied sectors to Kerala's Gross State Value Added (GSVA). The data indicates a consistent decline in the contribution of agriculture and allied sectors to Kerala's GSVA over the past decade, reflecting the sector's diminishing role in the state's economic structure. The share of agriculture and allied activities fell from 14.39 percent in 2011–12 to 9.63 percent in 2023–24, representing a decline of about 4.76 percentage points, or roughly 33 percent over the period. This downward trend has been gradual but persistent, with the sector's share falling below 12 percent after 2016–17 and continuing to decline thereafter. Although there was a temporary rise to 12.5 percent in 2020–21, this increase was likely driven by the contraction of other sectors during the COVID-19 pandemic. The continued decline to 10.21 percent in 2022–23 and further to 9.63 percent in 2023–24 underscores the increasing marginalisation of agriculture in Kerala's economy.

Thus, the effective utilisation of paddy lands—particularly fallow and underutilised areas—can crucially revitalise Kerala's agrarian economy by promoting inland fish cultivation. Integrating aquaculture with paddy farming systems offers a viable pathway to enhance farmers' incomes by providing an additional, more stable source of revenue, especially amid declining profitability of traditional cultivation. Such an approach not only improves land productivity but also enables better resource utilisation. Moreover, the expansion of integrated paddy–fish systems can strengthen the overall performance of the agricultural sector by increasing output, generating rural employment, and promoting diversification. In this context, inland fisheries can emerge as a strategic intervention to address agrarian distress in the state.

3. The Historical Evolution of Aquaculture in Kerala

The integrated farming practice of cultivating rice with fish in Kerala is a centuries-old approach that combines brackish/rainfed rice fields with aquaculture. Traditionally practised in the low-lying coastal saline soils of Ernakulam, Thrissur, and Alappuzha districts (known as Pokkali tracts) and Kannur district (known as Kaipad tracts), this integrated rice-fish/shrimp co-culture is a testament to indigenous ecological engineering (Jose et al., 2023). The system evolved primarily as an adaptive response to the region's unique topography and monsoon climate, where lands are periodically submerged by river floodwaters and tidal influxes from the sea.

Historically, subsistence needs drove this system, enabling local farmers to maximise the utility of their land throughout the year. Because these wetland soils are highly acidic and prone to severe salinity during the summer months, conventional agriculture was impossible (Jose et al., 2023). Traditional farmers bypassed this limitation by alternating a specialised, salt-tolerant rice variety with seasonal prawn filtration, creating an ecologically symbiotic cycle that required minimal artificial inputs (FAO, 1968).

Traditional Mechanics: The Symbiosis of Rice and Prawns

The traditional method of rice-aquaculture in Kerala is fundamentally rotational, determined by the salinity of the estuarine waters. The cycle begins with land preparation in May, which involves constructing mounds to allow monsoon rains to wash away accumulated soil salinity. The native, salt-tolerant, and flood-resistant rice varieties, such as Pokkali (which can grow to 1.5-2 metres to survive flooding), Chettivirippu, and various Vyttila strains, are sown (Jose et al., 2023). This single rice crop is cultivated during the low-salinity monsoon phase from June to mid-October.

Following the paddy harvest, the high-salinity phase from November to April marks the beginning of the aquaculture cycle, locally known as Chemeen Kettu (prawn filtration). Instead of stocking hatchery-reared seeds, traditional farmers relied on the natural tides. Wooden sluice gates were erected at the boundaries connecting the paddy fields to the backwaters (ibid). During high tides, especially at night, estuarine water carrying wild seeds of penaeid prawns, predominantly Metapenaeus dobsoni, M. monoceros, and Penaeus indicus was allowed into the fields (FAO, 1968). A lamp was often hung near the sluice to attract the juvenile prawns.

The brilliance of this historical system lay in its closed-loop nutrient recycling. The prawns fed on the decaying stubble of the harvested rice plants and natural benthic algae. In turn, prawn excreta served as a highly effective organic fertiliser, enriching the soil for the subsequent rice crop (Jose et al., 2023). Chemical fertilisers and pesticides were strictly avoided, as their use would break the delicate ecological balance and kill the aquatic life. Harvesting occurred at night during the spring tide periods (associated with the full and new moons), using conical nets at the sluice gates to trap the mature prawns as the water flowed out (FAO, 1968).

Socio-Economic Evolution and Commercialisation

For centuries, prawn filtration was a secondary activity, with rice being the primary crop for food security. Fish and prawns provided supplemental nutrition and a minor source of income. However, a significant shift occurred in the mid-to-late 20th century. With the global "Blue Revolution" and the sudden surge in international demand for shrimp exports in the 1970s, the system's economic hierarchy inverted (FAO, n.d.). Prawns transitioned from a byproduct of rice farming to a highly lucrative cash crop.

This commercialisation altered traditional leasing structures. Landowners began leasing their harvested paddy fields to specialised prawn filtration contractors during the summer months (Sathiadhas et al., 1989). According to historical studies by the Central Marine Fisheries Research Institute (CMFRI) and the Food and Agriculture Organisation, this period saw efforts to maximise shrimp yields (FAO, 1968).

Modern Challenges and the Decline of Traditional Extents

Despite its ecological brilliance, the traditional Pokkali and integrated farming systems began facing severe existential threats by the late 20th and early 21st centuries. Studies by the Centre for Development Studies (CDS) and various agricultural agencies highlighted a drastic decline in the cultivable area (Padmanabhan et al., 1998). Where tens of thousands of hectares were once cultivated, recent estimates indicate that the actively farmed Pokkali area has shrunk to a few thousand hectares (Jose et al., 2023).

The decline has been multi-factorial:

- **Economic Unviability of Rice:** The yield of Pokkali rice is relatively low, averaging about 2000 kg/ha (Jose et al., 2023). Combined with the exponential rise in agricultural wages and severe labour shortages in Kerala, the rice phase of the cycle became increasingly unprofitable, prompting many farmers to leave their fields fallow during the monsoon (Jose et al., 2023; Padmanabhan et al., 1998).
- **Ecological and Climate Pressures:** Erratic monsoons, altered tidal patterns, and increased pollution in the Vembanad estuarine system have disrupted the natural availability of wild shrimp seeds (Padmanabhan et al., 1998).
- **Systemic Degradation:** With fields left uncultivated during the paddy season, the natural decomposition of rice stubble, which forms the base of the food web for the prawns, ceased, reducing the productivity of the subsequent aquaculture phase (Jose et al., 2023).

Historical Evolution of Laws Governing Paddy Lands in Kerala

The traditional land tenure system of Kerala, rooted in the feudal Janmi system, was characterised by complex hierarchical relationships in which janmis (landlords) held superior

rights over land, while actual tillers worked as Kanakkars or Verumpattakkars (tenants) under various forms of tenancy arrangements (Narayanan, 1991; Kurup, 1988). However, the advent of the British fundamentally transformed Kerala's land tenure system. For instance, in Malabar, the British recognised the Janmi as the absolute proprietor, giving landlords legal backing to evict tenants arbitrarily and creating a class of Verumpattakarans (tenants-at-will) who faced a constant threat of eviction (Raj and Tharakan, 1983). But with the enactment of further legislative responses, such as the Malabar Tenancy Act of 1929, which introduced fixity of tenure and fair-rent provisions for paddy cultivators, and parallel developments such as the Pattom Proclamation of 1865 in Travancore, early peasant proprietorship was fostered (ibid.).

With the formation of the state of Kerala in 1956 through the amalgamation of Travancore, Cochin, and Malabar, there was a need for unified legislation. Despite its annulment, the Kerala Agrarian Relations Bill (KARB, 1957) laid the ideological foundation for land redistribution. However, the subsequent enactment of the Kerala Land Reforms Act, 1963, and its 1969 amendment abolished landlordism, imposed a land ceiling, and transferred ownership rights to cultivating tenants, thereby significantly restructuring agrarian relations in the state (Sudheesh, 2025; Radhakrishnan, 1989).

From the late 1960s onwards, the policy focus shifted toward conservation amid a rapid decline in paddy cultivation due to changes in land-use patterns, especially toward the cultivation of other food crops, non-food crops, and non-agricultural practices (Abraham, 2020). The Kerala Land Utilisation Order, 1967, sought to prevent the conversion of agricultural land and to maintain food-crop production by mandating prior approval for land-use changes (ibid.). However, despite such measures, the paddy area declined sharply over the decades. For instance, between 1970 and 2015, Kerala witnessed a drastic 81.5% decline in the land area under paddy cultivation in India (IRRI, 2020). The increasing costs of cultivation and wages, combined with lower yields and prices, further exacerbated the replacement of paddy with other crops or the keeping of land fallow (George & Mukherjee, 1986; Cheeran & Saji, 2015). In Kerala, following the conversion of paddy land, banana was the most preferred crop (Jose & Padmanabhan, 2016). However, it resulted in several negative impacts, including the use of pesticides, which poses higher health and environmental risks (Henrique et al., 1997). Taking cognisance of the severity of the issue, the Government of Kerala enacted the Kerala Conservation of Paddy Land and Wetland Act, 2008, and its subsequent amendments in 2018 & 2023 (Rasheed et al., 2022), which introduced stringent restrictions on the conversion and use of paddy lands and wetlands, thereby indirectly constraining aquaculture expansion (Government of Kerala, 2008).

The evolution of aquaculture-related legal frameworks in Kerala reflects a gradual shift from fragmented, protection-oriented regulation to a more structured yet increasingly restrictive governance regime. Prior to 2010, aquaculture was not governed by dedicated state legislation and was instead regulated indirectly through union government laws such as the Indian Fisheries Act, 1897, and environmental statutes including the Environment (Protection) Act, 1986, and the

Coastal Aquaculture Authority Act, 2005, which primarily focused on conservation and pollution control rather than sectoral development (Government of India, 1897; Government of India, 1986; Government of India, 2005). The establishment of a sector-specific legal framework through the Kerala Inland Fisheries and Aquaculture Act, 2010, marked an important institutional shift, aiming to regulate, develop, and manage inland fisheries while recognising traditional practices and introducing licensing mechanisms (Government of Kerala, 2010). However, the subsequent Kerala Inland Fisheries and Aquaculture (Amendment) Act, 2021, signalled a move towards tighter regulatory control, expanding licensing requirements and strengthening restrictions on aquaculture in paddy fields (Government of Kerala, 2021). While these developments were grounded in concerns of environmental protection and sustainable resource management, they have also contributed to a compliance-heavy regulatory environment that limits adaptive land-use decisions and the scalability of integrated aquaculture systems. Overall, the trajectory demonstrates a transition from regulatory absence to increasing stringency, highlighting the need for a more enabling and outcome-oriented legal framework.

4. Aquaculture Practices across Major Countries and States

Table 5: Decadal analysis of major fish-producing states in India

2021-2022 (Lakh Tonnes)				2011-2012 (Lakh Tonnes)				1992-1993 (Lakh Tonnes)			
States	Inland	Marine	Total	States	Inland	Marine	Total	States	Inland	Marine	Total
Andhra	42.19	5.94	48.13	Andhra	11.69	4.33	16.02	West bengal	6.12	1.45	7.57
West Bengal	16.52	1.91	18.43	West Bengal	12.9	1.82	14.72	Gujarat	0.49	5.89	6.38
Karnataka	4.85	5.89	10.74	Gujarat	0.91	6.92	7.83	Kerala	0.38	4.96	5.34
Odisha	7.89	2.01	9.9	Kerala	1.4	5.53	6.93	Karnataka	0.65	2.34	2.99
Gujarat	1.86	6.88	8.74	Karnataka	1.2	3.43	4.63	Andhra	1.51	1.13	2.64
Kerala	2.25	6.01	8.26	Odisha	2.67	1.14	3.81	Odisha	0.93	1.19	2.12

Source: Handbook of fisheries 2022 Source: Handbook of fisheries 2014 Source: Handbook of fisheries 2008

The comparative analysis of the last three decades of fisheries data illustrates that Kerala's fish production has grown at a much slower pace than that of other major fish-producing states in India. Kerala's total fish production increased from 5.34 lakh tonnes in 1992–93 to 8.26 lakh tonnes in 2021–22, representing a 54.7 percent increase over three decades. In contrast, states that aggressively expanded aquaculture recorded much higher growth. For instance, Andhra Pradesh's production increased from 2.64 to 48.13 lakh tonnes, a growth of about 1723 percent, transforming it into India's leading fish-producing state. Similarly, Odisha grew by 367 percent, Karnataka by 259 percent, and West Bengal by 143 percent, all significantly outperforming Kerala.

A key structural issue in Kerala's fisheries sector is its continued dependence on marine capture fisheries, which limits long-term growth. Marine fish production increased only from 4.96 lakh tonnes in 1992–93 to 6.01 lakh tonnes in 2021–22, representing a modest 21 percent growth. Since marine fisheries are largely resource-limited and subject to ecological constraints, this sector offers limited scope for expansion. In contrast, states that have expanded inland aquaculture have seen rapid growth in fish production.

Kerala's inland fisheries production has grown from 0.38 lakh tonnes in 1992–93 to 2.25 lakh tonnes in 2021–22, which represents a 492 percent increase. However, the absolute scale of inland production remains small compared with that of leading aquaculture states. Inland fisheries currently account for only about 27 percent of Kerala's total fish production, while marine fisheries contribute roughly 73 percent, highlighting the limited expansion of aquaculture relative to the state's potential.

In terms of inland fish production, Andhra Pradesh recorded the most remarkable increase, from 1.51 lakh tonnes in 1992–93 to 42.19 lakh tonnes in 2021–22—an exceptional ~2694% increase, reflecting large-scale intensification of aquaculture. During the same period, Odisha also demonstrates strong expansion, with inland production growing from 0.93 to 7.89 lakh tonnes (~748% increase). Karnataka's inland fisheries recorded a rise from 0.65 to 4.85 lakh tonnes (~646 percent increase). So, in this way, other major fish-producing states have leveraged their inland fishing potential to increase their overall domestic fishing production.

The comparative analysis suggests that Kerala missed the aquaculture-driven growth experienced by other states over the past three decades. While states like Andhra Pradesh, Odisha, and West Bengal transformed their fisheries sectors through large-scale inland aquaculture, Kerala's fisheries economy remained largely dependent on traditional marine fishing.

Best Practices from Other States:

- **Andhra Pradesh:**

In Andhra Pradesh, a progressively evolving land-use policy framework that combines regulation with facilitation has supported the expansion of inland fisheries. The Andhra Pradesh Agricultural Land (Conversion for Non-Agricultural Purposes) Act, 2006, created a formal mechanism for converting agricultural land, including paddy fields, into aquaculture, subject to permissions and conversion charges. This provided legal clarity and enabled farmers—particularly in low-lying and waterlogged delta regions—to shift toward more remunerative aquaculture practices. The framework was further strengthened through sector-specific regulations and guidelines, which ensured that conversion was selective and largely limited to less productive or unsuitable paddy lands, thereby balancing agricultural protection with fisheries development. Institutional oversight by aquaculture authorities helped streamline approvals while addressing environmental and land-use concerns.

Over time, the policy regime underwent amendments and eventual repeal aimed at simplifying land conversion processes and reducing procedural delays. In 2025, the state moved to repeal the 2006 Act, replacing it with a more streamlined system integrated with broader land governance mechanisms, designed to improve the ease of doing business. This transition marked a shift from a permission-intensive regime to a simpler, more facilitative approach, while retaining regulatory oversight through other laws and institutions. Taken together, Andhra Pradesh's phased policy evolution—from regulated conversion to procedural simplification—played a crucial role in enabling the rapid expansion of inland aquaculture, demonstrating how adaptive land-use policies can support fisheries growth without entirely compromising agricultural safeguards.

- **West Bengal:**

Integrated paddy–fish cultivation in West Bengal is governed by a combination of statutory protection and enabling policy frameworks. The legal foundation is provided by the West Bengal Inland Fisheries Act, 1984, which aims to ensure the conservation, development, and management of inland fisheries (Government of West Bengal, 1984). A crucial strengthening came through the West Bengal Inland Fisheries (Amendment) Act, 1993, which introduced Section 17A, imposing restrictions on the conversion of water bodies and water-retaining lands for non-fishery purposes (Government of West Bengal, 1993). This provision plays a key role in preventing the diversion of low-lying and waterlogged lands, thereby indirectly supporting their continued use for fish culture. The West Bengal Inland Fisheries Rules, 1985 further operationalise these provisions by providing procedural guidelines for scientific fish farming (Government of West Bengal, 1985).

At the policy level, the West Bengal Inland Fisheries Policy, 2023 establishes a comprehensive framework for expanding inland aquaculture through resource optimisation, scientific pisciculture, and community participation (Government of West Bengal, 2023). Although the policy does not explicitly designate rice–fish farming as a separate category, it promotes the utilisation of waterlogged, underutilised, and small water bodies, as well as decentralised and cluster-based aquaculture approaches. These provisions create an enabling environment for integrated systems such as paddy–fish farming. In coastal regions, integrated paddy–fish or paddy–shrimp systems are additionally governed under the Coastal Aquaculture Authority Act, 2005, which permits aquaculture subject to registration and environmental safeguards.

Overall, West Bengal follows a "protect and enable" model, in which statutory provisions such as Section 17A discourage conversion away from fisheries, while policy frameworks promote intensification and diversification within existing resources, allowing flexibility for integrated rice–fish cultivation tailored to local agro-ecological conditions.

- **Gujarat:**

Gujarat's approach to aquaculture development is grounded in a resource optimisation framework that promotes the utilisation of saline, waterlogged, and low-productivity lands—particularly in coastal regions—for aquaculture, including shrimp farming. A combination of fisheries regulation and land governance laws supports this approach. The Gujarat Fisheries Act, 2003, provides a broad framework for the regulation, conservation, and management of fisheries, including provisions for licensing and the control of fishing activities (Government of Gujarat, 2003). However, the legal basis for land conversion for aquaculture primarily derives from the Gujarat Land Revenue Code, 1879, particularly Section 65, which permits the conversion of agricultural land to non-agricultural use with prior approval, and Section 67, which enables the allocation or leasing of government land for specific purposes (Government of Gujarat, 1879 updated).

These provisions are operationalised through state-level land allocation practices that encourage the use of waste and saline lands for aquaculture development, especially in coastal belts, while the diversion of ecologically sensitive or common lands, such as gauchar, remains regulated (Government of Gujarat, n.d.). Aquaculture activities, particularly shrimp farming, are further subject to licensing and environmental safeguards under the Coastal Aquaculture Authority Act, 2005 (Government of India, 2005). Importantly, Gujarat does not impose explicit duration or seasonal restrictions on aquaculture activities; instead, aquaculture is treated as a continuous, commercially driven activity, regulated through land-use permissions, licensing, and environmental compliance rather than time-bound cultivation limits. Overall, Gujarat follows a "regulate and enable" model, in which land conversion is permitted under established legal provisions while maintaining regulatory oversight.

Best practices from other countries:

- **China:**

China ranks first globally in aquaculture production, maintaining its position as the world's largest producer for several decades (FAO, SOFIA 2022). It accounts for 35–40% of global aquaculture output, far exceeding that of countries like India and Indonesia (FAO SOFIA 2022).

Alongside its overall aquaculture leadership, China is also widely recognised as the global leader in integrated rice–fish farming systems, although no formal international ranking exists for this subsector (FAO GIAHS Programme). The country has the largest area under rice–fish cultivation, with millions of hectares historically under integrated systems. Notably, traditional rice–fish systems in regions such as Zhejiang have been designated as a Globally Important Agricultural Heritage System (GIAHS) by the FAO, highlighting their global significance (FAO GIAHS).

As a result, China serves as the global benchmark for integrating aquaculture within paddy ecosystems, demonstrating that high levels of fish production can be achieved not only through standalone aquaculture expansion but also through large-scale, policy-supported integrated farming systems (FAO, SOFIA 2022).

Integrated rice–fish farming in China is governed through a convergence of farmland protection regulations, ecological agriculture policies, and aquaculture development programmes rather than a single dedicated law. This regulatory framework has indirectly promoted integrated systems as a compliant alternative for expanding aquaculture (Zhang et al., 2023). At the same time, national policies on ecological civilisation, circular agriculture, and green development actively encourage rice–fish farming due to its ability to reduce agrochemical use, enhance biodiversity, and improve nutrient recycling (State Council of China; FAO GIAHS; IDRC, 2010). Aquaculture policies further support these systems through extension services, pilot programmes, and the promotion of Rice–Aquatic Animal Integrated Farming (RAAIF), which includes rice–fish, rice–crab, and rice–crayfish models (MARA; Zhang et al., 2023). Additionally, China's grain security strategy reinforces their adoption, as integrated systems maintain or increase rice yields while adding fish production, thereby aligning with national food security goals (State Council; FAO; IDRC, 2010).

- **Indonesia:**

In 2022, Indonesia ranked 3rd among the world's top producers of aquatic animals, contributing approximately 7% of global production, following China and India (FAO, 2024). Integrated paddy–fish cultivation in Indonesia is governed by a convergent, multi-sectoral policy framework rather than a single dedicated statute (FAO, 2011). The system—locally known as minapadi—is formally recognised and promoted through the combined efforts of the Ministry of Marine Affairs and Fisheries and the Ministry of Agriculture, and is positioned as a strategy for aquaculture expansion, sustainable intensification, and rural income diversification (FAO, 2022). National aquaculture policies prioritise inland fish production and sectoral growth as part of broader development and food security goals (FAO, 2024), while agricultural policy approaches emphasise ecological practices such as integrated pest management and reduced chemical inputs, within which rice–fish systems are actively embedded (FAO, 2011).

Drawing on the experiences of major fish-producing states in India and globally, it is evident that the growth of integrated paddy–fish cultivation is closely linked to the nature of land-use policies and institutional support frameworks. In contrast, Kerala continues to operate under a relatively restrictive land-use regime, particularly regarding the conversion and utilisation of paddy lands, thereby limiting the expansion of aquaculture despite favourable ecological conditions. These models highlight that the efficient use of paddy lands and wetlands can serve as a viable pathway to enhance both farm incomes and ecological sustainability.

5. Key Challenges associated with the Paddy Land Utilisation for Aquaculture in Kerala

- **Restrictive Land Use and Regulatory Constraints**

A major challenge that emerged from stakeholder consultations is the restrictive and, at times, fragmented regulatory framework governing paddy land use and aquaculture in Kerala. The Kerala Conservation of Paddy Land and Wetland Act, 2008, imposes stringent controls on land conversion, with Section 3 explicitly prohibiting the reclamation or conversion of notified paddy lands and wetlands, and Section 13 regulating any change in land use through a permission-based mechanism. While these provisions are rooted in the objectives of wetland conservation and food security, they significantly limit farmers' flexibility to diversify into aquaculture or other economically viable alternatives.

In parallel, the Kerala Inland Fisheries and Aquaculture Act, 2010, introduces a licensing regime for aquaculture activities across public and private water bodies, including ponds, canals, and brackish water areas. The 2021 amendment intensified the regulatory burden by restructuring Section 5 and introducing Subsection (11), which extended licensing requirements to filtration-based practices. This change has had unintended consequences for traditional systems such as Chemeen Kettu (filtration-based aquaculture), where farmers are now required to obtain licenses even for practices that have historically been embedded within paddy field ecosystems.

Although the Kerala Conservation of Paddy Land and Wetland Act 2008 provides limited flexibility —such as permitting intermediate fish cultivation within paddy fields—this allowance is constrained by both regulatory and ecological factors. In practice, fish cultivation is largely restricted to the off-season, and the shortened production cycle is often insufficient for commercially viable fish growth. The additional requirement of filtration licenses under the Kerala Inland Fisheries and Aquaculture Act further complicates the scaling up of integrated or seasonal aquaculture models, effectively discouraging farmers from adopting diversified livelihood strategies.

As a result, stakeholders perceive the regulatory environment as rigid, overlapping, and misaligned with ground realities. While the intent of these laws is to safeguard ecologically sensitive wetlands, their implementation often constrains adaptive land-use decisions, particularly in regions like Kuttanad where paddy cultivation is increasingly unviable. This regulatory rigidity, coupled with procedural complexities in obtaining permissions and licenses, has emerged as a significant barrier to the sustainable expansion of aquaculture within existing paddy landscapes.

Voice from the Ground

"We (farmers) are increasingly finding ourselves trapped between declining paddy incomes and rigid regulatory controls. Despite owning the land, we lack the autonomy to respond to changing economic realities. In situations where paddy cultivation is no longer viable, the absence of flexibility to diversify into alternative crops or aquaculture directly threatens our livelihoods and long-term sustainability." – Paddy farmers from Ernakulam

- **Declining Viability of Paddy Cultivation and Loss of Integrated Aquaculture Potential**

The structural decline of paddy cultivation in Kerala, driven by persistent economic unviability, has emerged as a critical challenge with direct implications for the development of inland fisheries. Over the past four decades, the sector has witnessed a significant contraction, with paddy production declining from 13.06 lakh tonnes in 1982–83 to 5.96 lakh tonnes in 2022–23 (a reduction of 54.4 percent), while the cultivated area has fallen more sharply from 7.78 lakh hectares to 1.92 lakh hectares (a decline of 75.4 percent). This sustained decline reflects deep-rooted economic constraints, including rising labour costs, increasing input expenses, land fragmentation, and stagnant returns from rice cultivation, all of which have reduced the viability of paddy as a primary livelihood.

At the farm level, the low cost–benefit ratio further discourages continued cultivation. Delays in procurement payments and market uncertainties exacerbate income instability, making paddy farming increasingly unattractive, particularly for younger generations. As a result, farmers are withdrawing significantly from cultivation, leading to an increase in fallow land and underutilised agricultural resources.

This economic shift has also led to the gradual erosion of traditional integrated paddy–fish farming systems such as Pokkali and Kaipad, which historically combined rice cultivation with fish or prawn farming to enhance income and ecological sustainability. These systems once represented a low-input, climate-resilient model that supported both agricultural production and inland fisheries. However, rising costs, declining profitability, regulatory rigidities, and the expansion of alternative livelihood opportunities—including tourism and non-farm employment—have significantly reduced their adoption.

The decline of these integrated systems is a significant loss for Kerala's inland fisheries sector, especially given the increasing fallow land and underutilised paddy fields. Thus, revitalising and modernising integrated paddy–fish cultivation can serve as a strategic pathway to enhance farmers' income, improve land productivity, and expand inland aquaculture, thereby addressing both agrarian distress and the state's growing fish demand–supply gap.

Voice from the Ground:

"Paddy cultivation is no longer sustainable for us. The costs of labour, inputs, and maintenance continue to rise, but returns remain very low, and payments are often delayed. Many of us are forced to leave our land fallow because continuing cultivation only leads to losses. Earlier, systems like Pokkali allowed us to combine paddy with fish or prawn farming, which helped us earn better and manage risks. Today, due to rising costs, regulatory hurdles, and lack of support, even these traditional practices are disappearing. If we had the flexibility to use our land for integrated farming or aquaculture, it would provide a more stable income and encourage us to continue farming." - Paddy farmers from Kuttanad

- **Lack of Value Chain Development and Limited Market Realisation for Traditional Crops**

A significant challenge affecting the sustainability of traditional agro-ecological systems in Kerala is the weakness of agricultural value chains, particularly for niche crops such as Pokkali rice. Despite its Geographical Indication (GI) status and recognition as an organic, climate-resilient variety, Pokkali rice suffers from poor market integration and low price realisation. The absence of strong branding, limited aggregation and processing infrastructure, and weak market linkages prevent farmers from capturing the premium associated with its ecological and nutritional value. As a result, there exists a clear disconnect between the crop's inherent value and the returns received by farmers.

This weak market ecosystem directly contributes to the decline of traditional integrated paddy–fish farming systems, as farmers are discouraged from continuing cultivation when economic returns remain inadequate. In the absence of reliable and remunerative markets, even sustainable and historically significant systems such as Pokkali are being gradually abandoned. Strengthening value chains through improved branding, value addition, and better market access is therefore essential not only for enhancing farmers' incomes but also for revitalising integrated farming practices and supporting the development of inland fisheries.

Voice from the Ground:

"Pokkali rice is well known and even has special recognition, but we don't get a fair price for it. There is no proper system for marketing it, and we are forced to sell at low prices. Without better market support, continuing this cultivation is not viable." - Paddy farmers from Ernakulam

- **Labour Shortages and Generational Shift Away from Farming**

A key challenge contributing to the decline of agriculture in Kerala is the growing shortage of agricultural labour, which is compounded by a generational shift away from farming. Stakeholder insights indicate that farming, particularly labour-intensive systems such as paddy and integrated Pokkali cultivation, requires sustained effort, time, and carries uncertainty in returns. However, younger generations are increasingly moving towards non-farm employment opportunities that offer more stable, regular, and quicker income streams. This shift has led to an ageing farming population, making it increasingly difficult to sustain traditional cultivation practices.

At the same time, the labour shortage has significantly increased wage costs, further reducing agricultural profitability and discouraging continued cultivation. This dual pressure—declining labour availability and rising costs—has accelerated the abandonment of labour-intensive farming systems and contributed to the growing area of fallow land. In the absence of mechanisation or alternative labour arrangements, this trend poses a serious constraint not only on agricultural sustainability but also on the revival of integrated paddy–fish systems that depend on timely and coordinated farm operations.

Voice from the Ground:

"The younger generation is not willing to wait six months for a harvest. They want quick returns and steady income, so very few are interested in continuing farming." - Paddy farmers from Kadamakudy.

- **Environmental and Climate Change as Constraints to Agriculture and Aquaculture**

Environmental and climate-related factors have emerged as a significant challenge, increasing uncertainty and risk for both agriculture and aquaculture in Kerala. Stakeholders highlighted that frequent flooding, erratic rainfall patterns, and rising incidence of pest attacks have disrupted traditional cultivation cycles and reduced productivity. In vulnerable regions such as Kuttanad, prolonged waterlogging and elevated water levels often damage standing crops and weaken bund infrastructure, forcing farmers to scale down from multiple cropping seasons to a single cycle. Such climatic instability has made farm outcomes increasingly unpredictable, discouraging farmers from making long-term investments in cultivation.

These environmental stresses also affect the aquaculture sector, where concerns such as salinity intrusion, water quality fluctuations, and ecosystem degradation undermine the viability of fish and shrimp farming. The combined impact of climate variability and ecological pressures has heightened production risks in both sectors, further reinforcing farmers' reluctance to continue or expand cultivation. In this context, environmental uncertainty not only undermines agricultural sustainability but also constrains the potential for scaling inland fisheries and integrated farming systems.

Voice from the Ground:

"Flooding and changing weather patterns make it difficult to predict yields. Sometimes an entire season's effort is lost." - Paddy farmers from Kadamakudy

- **Fragmented landholdings and Technological gaps**

A significant structural constraint affecting both agricultural productivity and the expansion of inland aquaculture in Kerala is the combined impact of fragmented landholdings and limited technical capacity among farmers. The state's agrarian structure is dominated by small and marginal holdings, which restricts the scalability of farming operations and limits farmers' ability to invest in the infrastructure required for integrated systems such as paddy–fish cultivation. Often, landowners intentionally leave land fallow, mostly when its productivity is too low, in anticipation of future conversion for commercial purposes, thereby contributing to the growing underutilisation of cultivable land and weakening the agricultural base.

At the same time, even where there is a willingness to adopt aquaculture, a lack of technical knowledge remains a critical barrier. Farmers often lack the necessary skills to manage fish farming effectively, including water quality management, disease control, and stocking practices. The limited reach of extension services and inadequate training have further constrained adoption, as evidenced by the limited success of initiatives such as the "One Paddy One Fish" scheme. Together, these factors create a situation in which both land and human capacity remain underutilised, restricting the growth of integrated farming systems and inland fisheries in the state.

6. Key Legislative, Institutional and Development-Oriented Policy Recommendations/Reforms

Legislative Reforms:

The Department of Fisheries should initiate the following proposed amendments to the Kerala Inland Fisheries and Aquaculture Act, 2010, and to the Kerala Inland Fisheries and Aquaculture (Amendment) Act, 2021, by preparing the necessary legislative proposals in consultation with the Law Department and obtaining the requisite approvals from the state government. Thereafter, the amendment bill may be introduced in the Kerala Legislative Assembly for consideration and enactment, thereby facilitating the proposed statutory reforms

- **Enabling Aquaculture in Economically Unviable Paddy Lands**

Existing Provision:

The Kerala Inland Fisheries and Aquaculture (Amendment) Act 2021, under Section 8, Sub-section (2) (e), restricts aquaculture in paddy fields in the following manner:

"Section 8: Restriction of aquaculture activities.

Sub-section (2): The Government may, by Gazette notification, limit, restrict or prohibit permanently or temporarily, all or any of the following matters in aquaculture-allied activities, namely:—

(e) prohibit engaging in aquaculture activities in any paddy field, which are suitable for paddy cultivation of at least one crop, during the period of paddy cultivation: Provided that the above prohibition is not applicable to those paddy fields which are certified by the Principal Agriculture Officer of the concerned district as unfit for paddy cultivation."

Discussion:

In recent years, paddy cultivation in several regions of Kerala has become increasingly non-remunerative due to rising input costs, labour shortages, low market prices, and declining productivity, leading to an increase in fallow land and farmer distress. Fallow land in Kerala has increased significantly over the decades, with current fallows rising from about 23–43 thousand hectares in the 1970s to over 50 thousand hectares in recent years, indicating a steady decline in active cultivation. Permitting Aquaculture in paddy fields where cultivation is demonstrably economically unviable will enable a transition to more viable, income-generating alternatives, thereby improving livelihood security and reducing the underutilisation of agricultural land.

Suggestion:

"(e) Aquaculture activities may be undertaken in paddy fields, including during the paddy cultivation period, at the discretion of the landholder, irrespective of the suitability of the land for paddy cultivation, where the landholder determines that paddy cultivation is not economically viable under prevailing conditions.

Such determination shall not require prior approval, certification, or intimation to any authority."

- **Enabling Year-Round Integrated Paddy–Fish Farming**

Existing Provision:

The Kerala Inland Fisheries and Aquaculture Act, 2010, restricts year-round paddy-fish integrated cultivation under Section 8, Sub-Section (3)(d) in the following manner:

"Section 8: Restriction of aquaculture activities.

Sub-section (2): The Government may, by Gazette notification, limit, restrict or prohibit permanently or temporarily, all or any of the following matters in aquaculture-allied activities, namely:—

(d) integrated fish farming detrimental to the paddy cultivation without rotation of crops";

Discussion:
At present, regulatory uncertainty—particularly the implicit preference for crop rotation—acts as a disincentive for paddy farmers to adopt integrated paddy-fish cultivation, which could otherwise significantly enhance the efficiency of paddy land utilisation. Such policies, in turn, led to the gradual erosion of traditional integrated paddy–fish farming systems such as Pokkali and Kaipad, which historically combined rice cultivation with fish or prawn farming to enhance income and ecological sustainability. These systems once represented a low-input, climate-resilient model that supported both agricultural production and inland fisheries. The decline of these integrated systems represents a critical missed opportunity for Kerala's inland fisheries sector, particularly amid increasing fallow land and underutilised paddy fields.

Allowing year-round continuous paddy–fish cultivation, subject to scientific management and environmental safeguards, enables farmers to diversify income streams, reduce dependence on a single crop, and improve overall farm profitability. Evidence from multiple regions shows that integrating aquaculture with paddy cultivation can increase net returns per unit of land, optimise water use, and create additional employment opportunities. This is particularly important for Kerala, where rising labour costs and declining profitability of standalone paddy cultivation have rendered farming economically unviable for many smallholders.

Suggestion:

"Integrated paddy–fish farming shall be permitted, including on a year-round basis, as a recognised and sustainable agricultural practice, at the discretion of the landholder, without the requirement of prior approval."

- **Reforming Filtration Regulations to Encourage Integrated Aquaculture in Kerala**

Existing Provisions:

Section 5, Sub-section 11 of the Kerala Inland Fisheries and Aquaculture (Amendment) Act, 2021, restricts the traditional integrated paddy-fish cultivation by bringing it under licensing in the following manner:

"No person who has not obtained acquired registration certificate and licence to arrange filtration, as per the provisions of the Act and the rules made thereunder, shall arrange filtration in private or public water body. Filtration arranged after obtaining licence or registration certificate shall be subject to the following restrictions and prohibitions, namely:—

(a) no other aquaculture activities shall be carried out, than by using fish seed certified as per the Kerala Fish Seed Act, 2014 (Act 4 of 2015), on the basis of the licence obtained for filtration;

(b) no person shall use antibiotics, chemicals, pesticides and other drugs used for aquaculture in the filtration area;

(c) no person shall use one or more lamps having light more than twenty watts, for attracting fishes into the sluices in the filtration area at night;

(d) no person shall attract fishes to the filtration area by giving feed;

(e) no person shall deposit fry which were not certified under the Kerala Fish Seed Act, 2014 (Act 4 of 2015), in the filtration areas;

f) no person shall use nets of mesh size less than twenty millimeters in sluices, to collect fish from the filtration area;

(g) no person shall reclaim the conventional filtration area;

(h) in the filteration area where traditional right of fishing exists, no person shall conduct such fishing except for the period allowed by the Government through Gazette notification, published from time to time:

(Provided that in the water area in respect of which registration certificate and licence have been obtained for carrying out aquaculture activities, there shall not be any conventional right of fishing and filtration shall not be carried out in that area for any reason. If filtration is to be carried out again, in the said area, registration and licence for carrying out filtration are to be newly obtained after cancelling the registration and licence obtained for aquaculture activities, and above said fishing right is to be restored in the said area.

(i) no registration shall be given to anyone to engage perennial filtration freshly;

(j) no person shall use any kind of pesticides, toxins, explosives, fish anesthetics or other chemicals directly or mixing with any other material, to catch fish alive or otherwise, in areas where filtration is engaged; and

(k) no person shall deposit or cause to be deposited, directly or by any other means, any form of bio-chemicals, waste, household waste, plastic waste etc. which cause water pollution in the filtration area;"

Discussion:

The existing regulatory framework governing filtration in Kerala is highly restrictive, activity-specific, and institutionally rigid, thereby limiting the scalability of aquaculture, particularly traditional integrated paddy–fish systems. The law treats filtration and aquaculture as mutually exclusive activities, requiring the cancellation and re-issuance of licences when switching between them. This creates procedural delays, uncertainty, and discourages farmers from adopting diversified or integrated production systems. Additionally, blanket prohibitions on practices such as controlled feeding, use of inputs, and operational flexibility constrain productivity and prevent the adoption of scientific aquaculture methods.

In contrast, more successful aquaculture states such as Andhra Pradesh follow a unified, farm-based regulatory approach, focusing on overall production systems rather than micro-regulating individual practices. Kerala's current framework also fails to adequately account for changing climatic conditions, livelihood needs, and the economic viability of smallholders, particularly in waterlogged paddy ecosystems where integration offers a sustainable pathway. Therefore, there is a clear need to transition from a "restrict and separate" model to a "regulate and integrate" framework, enabling flexibility while maintaining ecological safeguards.

Suggestion:

"No registration certificate or licence shall be required for carrying out filtration in any private or public water body. Filtration and aquaculture activities, including integrated systems, may be undertaken concurrently, subject to compliance with environmental safeguards and standards as may be prescribed under this Act and the rules made thereunder. The regulation of such activities shall be based on overall environmental compliance, water quality standards, and sustainable resource management, rather than activity-specific restrictions.

Without prejudice to the generality of the above, the following principles shall apply, namely:

(a) aquaculture activities shall utilise certified fish seed in accordance with applicable laws;

(b) use of inputs, including feed, chemicals, and other materials, shall be governed by standards and guidelines prescribed by the competent authority;

(c) no activity shall result in water pollution, ecological degradation, or obstruction to natural water flow affecting adjoining lands;

(d) traditional fishing rights, where existing, shall be harmonised with aquaculture activities in such manner as may be notified by the government.

(e) filtration, aquaculture, or integrated systems shall not require separate or multiple licences, and may be carried out under a unified regulatory framework;

(f) the Government may prescribe general guidelines, including zoning, environmental safeguards, and operational standards, to ensure sustainable and equitable use of water resources;

(g) any activity involving harmful substances such as toxins, explosives, or materials causing environmental damage shall be prohibited.

Provided that no activity undertaken under this section shall adversely affect the ecological integrity of the area or the agricultural viability of adjoining paddy lands."

- **Decriminalisation of first-time violations:**

The Kerala Inland Fisheries and Aquaculture Act 2010 criminalises violations of the Act at the first time itself with imprisonment as a penalty under Section 36, Sub-sections (1) & (2).

Existing Provision:

"(1) Any person who contravenes any prohibition or restriction or regulation imposed by any of the provisions of this Act or the rules made thereunder or contravenes any of the terms or conditions of any licence or permit granted to him under this Act, shall be punishable with imprisonment for a term which may extend to three months or with fine which may extend to ten thousand rupees or with both:

Provided that in the case of a second or subsequent offence, he shall be punished with imprisonment for a. term which may extend to six months or with fine which may extend to ten thousand rupees or with both.

(2) Whoever, in contravention of any of the conditions or provisions in the licence or permit obtained by him under any provision of this Act or the rules made thereunder,—

(a) uses fishing vessel, Chinese dip-net and stake nets shall be punishable with imprisonment for a term which may extend to three months or with a fine that may extend to ten thousand rupees or with both: Provided that in the case of a second or subsequent offence, he shall be punished with fine which may extend to fifteen thousand rupees or with imprisonment for a term, which may extend to six months or with both.

(b) uses a free net shall be punished with a fine, which may extend to five thousand rupees: Provided that in the case of a second or subsequent offence, he shall be punished with fine up to ten thousand rupees;

(c) conducts aquaculture or filtration or sale or exhibition of ornamental fishes shall be punished with imprisonment for a term that may extend to six months or with a fine that may extend to twenty-five thousand rupees or with both:

Provided that in the case of a second or subsequent offence, he shall be punished with imprisonment for a term that may extend to one year or with a fine that may extend to fifty thousand rupees or with both."

Discussion:

The Kerala Inland Fisheries and Aquaculture Act, 2010, aims to codify and amend laws governing inland fisheries and aquaculture. It prioritises sustainable development, conservation, and the protection of inland fisheries, while also upholding the traditional rights of fishermen and ensuring food security. This Act establishes penalties for non-compliance; violating the rules of this Act or its regulations or the terms of a licence or permit can lead to imprisonment for up to three months, a fine of up to ten thousand rupees, or both. Repeat offenders may face up to six months' imprisonment, a fine of up to ten thousand rupees, or both (Section 36(1)).

Using fishing vessels, Chinese dip-nets, stake nets, or free nets in contravention of the conditions of a licence or permit can result in imprisonment for up to three months, a fine of up to ten thousand rupees, or both. Repeat offences may incur a fine of up to fifteen thousand rupees or imprisonment for up to six months, or both (Section 36(2))

Conducting aquaculture, filtration, or hatchery operations contrary to the terms of a licence or permit may lead to imprisonment for up to six months, a fine of up to twenty-five thousand rupees, or both. Repeat offenders may face imprisonment for up to one year, a fine of up to fifty thousand rupees, or both (Section 36(2)).

Various provisions within this Act regulate and supervise fishery activities in public water bodies, including aquaculture areas. It prohibits destructive fishing methods and mandates the certification of fish seeds. Proper registration is obligatory for fishing vessels and aquaculture facilities, with mandatory returns to be submitted to authorised officers.

While the Act underscores the importance of sustainable practices, implementation challenges often arise at the grassroots level. This is evident in the case of petitioners, members of the Kerala Fishermen Welfare Fund Board, who have been operating Chinese fishing nets using electricity (Sukulal vs State of Kerala, 23 February, 2021).

The petitioners, traditional fishermen from Vechoor village on the banks of Vembanad Lake, claim that despite operating their nets on their property, the authorities have not taken any action to regularise their activities by issuing licences. Notices were posted on their nets, directing removal by a certain date and alleging illegal use, resulting in harassment by the authorities. Their requests for regularisation were denied, on the grounds that issuing licences for Chinese nets is not permissible under the current rules.

The authorities state that no new licences for Chinese nets have been issued since a 1983 policy decision and that the petitioners' nets are illegal. They also argue that illegal nets cause hardships for legal fishermen. The petitioners counter that the policy decision is outdated and irrelevant after the new Act and Rules were introduced in 2010 and 2013, which do not explicitly prohibit the granting of licences.

The court observed that while the Act and Rules do not provide for regularisation, they do not prohibit the granting of licences either. The discrepancies between the recent act and the earlier rules are causing confusion among the implementation officials and the fishing community. It is essential to balance sustainable fisheries development and management with the traditional rights and livelihoods of fishermen.

Therefore, instead of resorting to extreme punitive measures such as imprisonment, the government, particularly at the LSG (Local Self Government) level, should focus on sensitising and educating the community. The Act provides for the compounding of offences. Thus, it is suggested that imprisonment be eliminated as a penalty for first-time offences and that compounding be retained. However, for subsequent offences, imprisonment may still be applicable.

Suggestion:

Section 36 (1): “Any person who contravenes any prohibition, restriction, or regulation imposed under this Act or the rules made thereunder, or violates any term or condition of a licence or permit granted under this Act, shall, for the first offence, be punishable with a fine which may extend to ten thousand rupees.

Provided that for a second or subsequent offence, such a person shall be punishable with imprisonment for a term which may extend to six months or with fine that may extend to ten thousand rupees or with both."

Section 36 (2) (a): "a person who uses a fishing vessel, Chinese dip-net and stake net shall, for the first offence, be punishable with fine which may extend to ten thousand rupees:

Provided that for a second or subsequent offence, such person shall be punishable with imprisonment for a term which may extend to six months or with fine which may extend to fifteen thousand rupees or with both."

Section 36 (2) "(c) conducts aquaculture or filtration or sale or exhibition of ornamental fishes shall, for the first offence, be punishable with fine which may extend to twenty-five thousand rupees:

Provided that for a second or subsequent offence, such a person shall be punishable with imprisonment for a term which may extend to one year or with fine which may extend to fifty thousand rupees or with both."

Institutional and Development-Oriented Reforms

- **Strengthening the Aquaculture Value Chain:**

To unlock the potential of aquaculture in Kerala, a value chain–based approach is needed that addresses gaps beyond production. The sector is currently constrained by fragmented supply chains, limited access to quality seed and feed, inadequate cold storage and transport infrastructure, and weak market linkages. Policy interventions should focus on strengthening input systems (seed and feed), developing decentralised infrastructure (cold chains, ice plants, logistics), and promoting aggregation through enabling land leasing legally for leveraging the economies of scale, cooperatives, Fish Farmer Producer Organisations (FFPOs), and Self-Help Groups (SHGs) to improve market access and bargaining power. Additionally, support for value addition, processing, branding, and digital market platforms can help stabilise demand and improve returns. A cluster-based approach with PPP participation can further enhance efficiency, reduce post-harvest losses, and enable scalable and sustainable aquaculture growth.

- **Enhancing Workforce Skills for Aquaculture Expansion:**

A key constraint to the expansion of aquaculture—particularly integrated paddy–fish systems—in Kerala is the limited availability of skilled labour combined with an overall shortage of workers, which has driven up labour costs and reduced the economic viability of such practices. Aquaculture in paddy fields requires specific technical skills (e.g., water management, stocking, disease control, and harvesting), which are currently not widely available among the rural workforce. This gap, coupled with high wage rates, discourages farmers from adopting or scaling aquaculture activities. Addressing this challenge requires targeted capacity-building interventions, including structured training programmes, extension services, and skill development initiatives tailored to integrated farming systems. Strengthening the local skill base would not only improve productivity and efficiency but also enable Kerala to better leverage its existing agro-ecological potential for sustainable aquaculture expansion.

- **Promoting Mechanisation for Efficient and Scalable Aquaculture**

To address labour shortages, rising wage costs, and low productivity in aquaculture systems—particularly integrated paddy–fish farming—in Kerala, there is a need to promote context-specific mechanisation across the production cycle. Policy interventions should support the adoption of small-scale, field-compatible machinery for activities such as pond preparation, water management, feeding, harvesting, and post-harvest handling. This can be facilitated through capital subsidies, custom hiring centres, and shared equipment models (e.g., through cooperatives, SHGs, and FFPOs) to make mechanisation accessible to smallholders. Additionally, integrating mechanisation with training and extension services will ensure effective utilisation and maintenance of equipment. Such an approach can reduce labour dependency, lower operational costs, improve efficiency, and enhance overall productivity, thereby making aquaculture more economically viable and scalable.

- **Strengthening Institutional Convergence**

To improve the viability of aquaculture in Kerala, it is essential to ensure effective convergence and coordination among key institutions, including Padasekhara Samithis, Panchayats, Krishi Bhavans, and the Fisheries Department. The current fragmented institutional landscape leads to delays, conflicting mandates, and weak implementation, which, when combined with climate variability, undermines farmer confidence and adoption. Hence, there is a need for establishing clear coordination mechanisms, such as district- or block-level convergence platforms, joint planning frameworks, and defined roles and accountability across departments. Integrating climate-resilient planning, real-time advisories, and unified extension services can further enhance system stability. Thus, strengthening institutional convergence will reduce operational inefficiencies, improve resource use, and enable the scalable and sustainable adoption of aquaculture.

7. Conclusion

Kerala's fisheries sector reflects a clear structural imbalance: while demand continues to rise, the state meets only about 60% of its fish requirement, and inland fisheries—globally recognised as the main growth driver—remain underutilised, contributing just ≈30% of total production as of 2024-25 and less than 2% of national inland output. At the same time, the agrarian base that could support this transition is weakening, with paddy cultivation declining by over 54% in production and 75% in area, and fallow lands expanding to over 50,000 hectares.

This is not merely a resource constraint but a policy and regulatory challenge. Kerala possesses significant inland water resources and a strong legacy of integrated farming systems, yet restrictive, fragmented, and process-heavy regulations continue to limit farmers' ability to respond to changing economic realities. The result is a paradox of abundant resources but limited utilisation, where both agricultural land and aquaculture potential remain underexploited.

The evidence presented in this study points to a clear direction: Kerala must transition from a conservation-centric, restrictive framework to an enabling, outcome-based approach that prioritises productive land use, farmer choice, and economic viability. Allowing flexible use of paddy lands—particularly where cultivation is no longer remunerative—and promoting integrated paddy–fish systems can convert fallow and underutilised areas into economically productive and ecologically sustainable assets.

However, regulatory reform must be accompanied by institutional strengthening and market development. Without improvements in value chains, technical capacity, mechanisation, and inter-departmental coordination, policy changes alone will not translate into outcomes. A holistic approach that combines legal flexibility with ecosystem support is essential to unlock the full potential of inland fisheries. By aligning policies with ground realities and enabling farmers to optimise land use based on viability and sustainability, the state can address agrarian distress, enhance incomes, and build a more resilient and self-reliant fisheries sector.

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097457 09174

cppr@cppr.in

www.cppr.in

First Floor, Mandoli House,
New Link Rd, opp. Metro Pillar 821,
Kochi, Kerala 682020, India