

Temporal trends and recent patterns in marine fish landings of Tamil Nadu and Puducherry

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Tamil Nadu, located along the southeast coast of India with a coastline of about 1,070 km, supports one of the largest, most diversified, and technologically advanced marine fisheries in the country. According to the CMFRI Marine Fisheries Census and Fisheries Statistics of India (CMFRI-FSI-DoF, 2020), the state comprises over 570 marine fishing villages and nearly 350 fish landing centres, serviced by a large fleet of mechanised, motorised, and non-motorised crafts, with mechanised units forming the dominant segment. Tamil Nadu consistently ranks among India's leading marine fish-producing states and sustains a complex multi-species fishery encompassing pelagic and demersal finfishes, crustaceans, and molluscs. The scale of operations, fleet modernisation, and resource diversity make the state a critical contributor to national marine fish production, coastal livelihoods, and export earnings, as well as an important region for examining long-term trends, seasonal dynamics, and structural changes in marine fisheries.

Puducherry, though limited in geographical extent, supports an active marine fishery along a coastline of approximately 45 km on the southeast coast of India. As reported in the CMFRI Marine Fisheries Census and Fisheries Statistics of India 2016, the Union Territory has around 40 marine fishing villages and nearly 20 fish landing centres, operated by a relatively small but predominantly mechanised fishing fleet, with fewer motorised and non-motorised crafts. Fishing activities are largely confined to nearshore and continental shelf waters and target a diverse assemblage of pelagic fishes, demersal resources, crustaceans, and cephalopods. Marine fisheries data for both Tamil Nadu and Puducherry are generated using the standardised, time-tested multi-stage stratified random sampling methodology

developed by the ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI), which serves as the national framework for marine fisheries assessment. Under this system, trained field investigators conduct systematic sampling at selected fish landing centres following scientifically designed schedules, ensuring statistically robust, consistent, and reliable estimates of catch, fishing effort, and species composition. This conventional data collection framework has been further strengthened in both regions through the implementation of the Fish Catch Survey and Analysis (FCSA) system, an integrated, end-to-end digital platform for data capture, validation, processing, and automated derivation of indicators required for fish stock assessment (Mini *et al.*, 2023). It enables near real-time monitoring of landings, fishing effort, and spatial fishing patterns, incorporates built-in quality control protocols, and supports standardised, reproducible analytical workflows, thereby substantially enhancing the efficiency, transparency, and scientific rigor of marine fisheries monitoring and long-term assessment. This study evaluates the long-term dynamics of marine fish landings in Tamil Nadu and Puducherry over a fifteen-year period (2010–2024), along with a detailed analysis of recent trends during 2022–2024, in order to capture evolving patterns in production, fishing structure, and species composition across these two fisheries systems.

Long-term trends in marine fish landings of Tamil Nadu (2010–2024)

The overall production trend of marine fish landings of Tamil Nadu exhibited a clearly fluctuating trend over the period under consideration. In the initial years, there

was a phase of consistent growth, culminating in a peak production of 7.75 lakh t in 2019. This high point was followed by a sharp decline in the early 2020s, which was largely attributed to disruptions caused by the COVID-19 pandemic (Fig. 1). Subsequently, the sector entered a short phase of relative stability before showing signs of recovery. By 2022, landings rebounded to 7.22 lakh t, reflecting a partial revival of fishing operations and market conditions. Despite this recovery, the overall pattern continued to alternate between periods of increase and decline. This ongoing variability suggested the influence of multiple factors such as changes in fish stock availability, variations in fishing effort, and operational conditions affecting the fisheries sector.

Seasonal pattern of landings indicated that in most years, the first (January–March) and third (July–September) quarters tended to exhibit relatively stronger landings, reflecting favourable fishing conditions and higher operational activity during these periods. The second quarter (April–June) generally presented moderate levels, consistent with seasonal patterns and regulatory restrictions such as monsoon-related fishing bans that may have affected effort. The fourth quarter (October–December) often showed a recovery phase, although its performance varied considerably between years depending on post-monsoon conditions and resource availability. Notably, certain years demonstrated simultaneous peaks across multiple

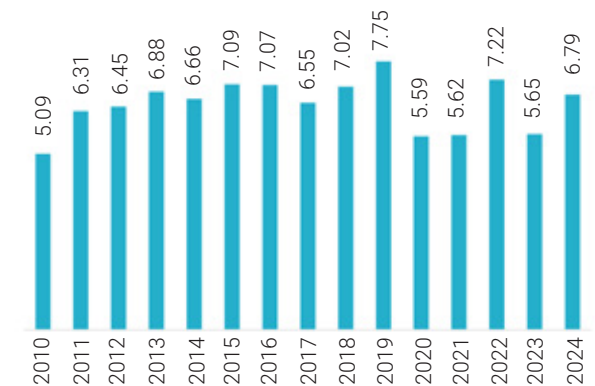


Fig. 1. Marine fish landing trends (lakh tonnes) in Tamil Nadu during 2010–2024 period.

quarters, suggesting episodes of enhanced stock abundance or increased fishing effort. Conversely, some years reflected sharp decreases in one or more quarters, indicative of climatic impacts, reduced effort, or management interventions (Fig. 2).

Sector-wise trends indicated that the mechanised sector overwhelmingly dominated the landings, maintaining a stable and substantial share throughout the period, reflecting its advanced technological capacity, higher fishing effort, and greater operational range (Fig. 3). The motorised sector provided a moderate but variable contribution, with noticeable fluctuations that likely corresponded to changes in coastal resource availability, seasonal fishing intensity, and economic factors influencing fishing operations. In contrast, the

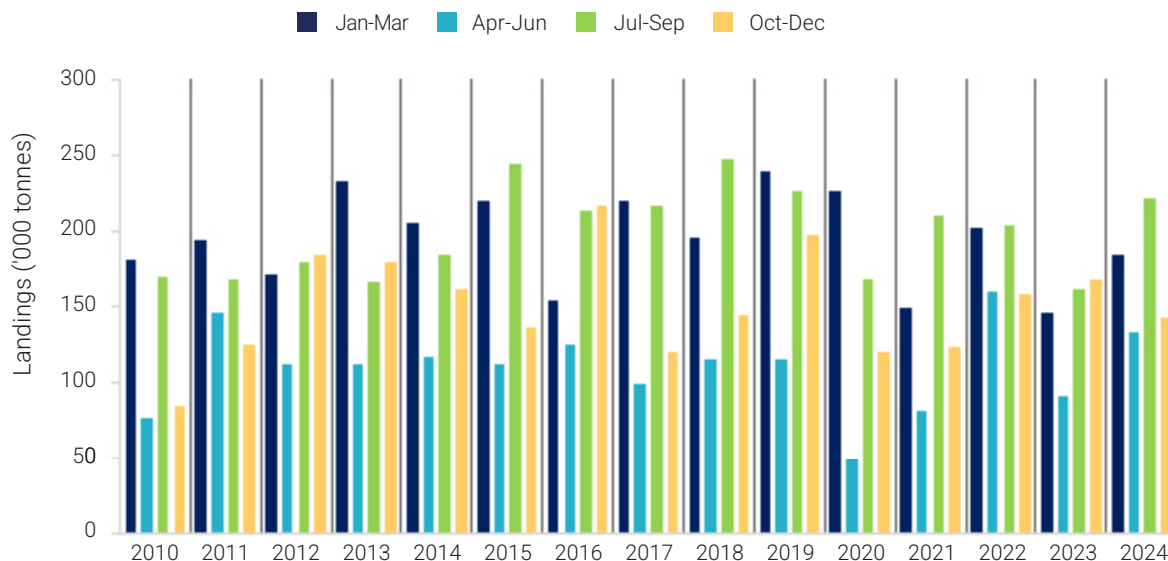


Fig. 2. Quarterly distribution of landings (in thousand tonnes) during 2010–2024 periods in Tamil Nadu

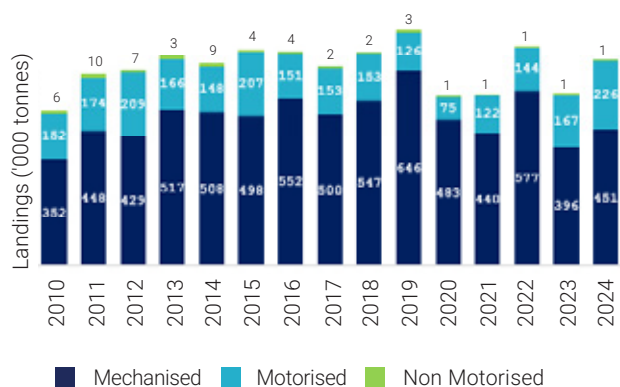


Fig. 3. Sector-wise fish landings (in thousand tonnes) during 2010–2024 period in Tamil Nadu

non-motorised sector contributed only a very small fraction of the total landings and exhibited a gradual decline over the years, indicative of the decreasing dependence on traditional craft and the sector's limited capacity to compete with more modernised fleets.

Species group composition of marine fish landings in Tamil Nadu during 2010–2024 revealed a clear and consistent dominance of pelagic resources forming the largest component of the catch every year (Fig. 4). Demersal resources constituted the second major group, although their contribution fluctuated noticeably across the years, reflecting variations in fishing pressure, stock distribution, and related factors on the continental shelf. Crustaceans contributed a smaller yet significant share, showing periodic increases that may have been related to favourable recruitment and targeted fishing effort. Molluscs, though representing the smallest portion of the landings, displayed intermittent peaks that indicated occasional increases in availability or

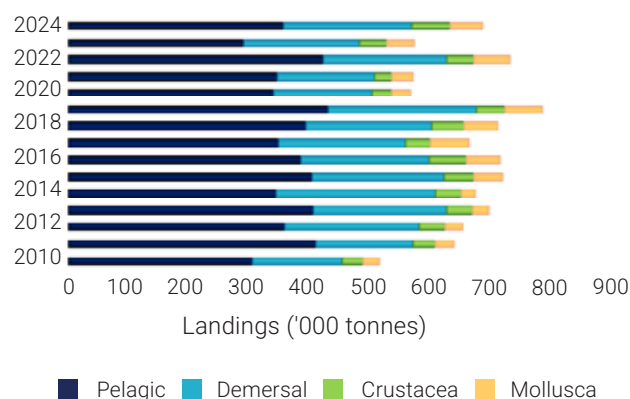


Fig. 4. Assemblage-wise marine fish landings (in thousand tonnes) during 2010–2024 period in Tamil Nadu

enhanced exploitation during certain years. While the overall structure of the landings remained broadly consistent, with pelagic species leading and molluscs contributing the least, the relative proportions of each group varied over time. The pattern underscored the importance of balanced management across all resource groups to ensure long-term sustainability.

Trends in the species composition of marine landings in Tamil Nadu showed noticeable changes, with some groups exhibiting periodic peaks while others declined gradually (Fig. 5). Lesser sardines contributed significantly in multiple years, with phases of higher landings followed by moderate levels, reflecting natural year-to-year variation. Silverbellies remained an important component of the catch, though their contribution showed a gradual decline in recent years. Cephalopods displayed a rising trend from around 2016 onwards, stabilising thereafter at moderate levels. Oil sardine exhibited pronounced fluctuations, with certain years recording very high landings, contrasted by notably

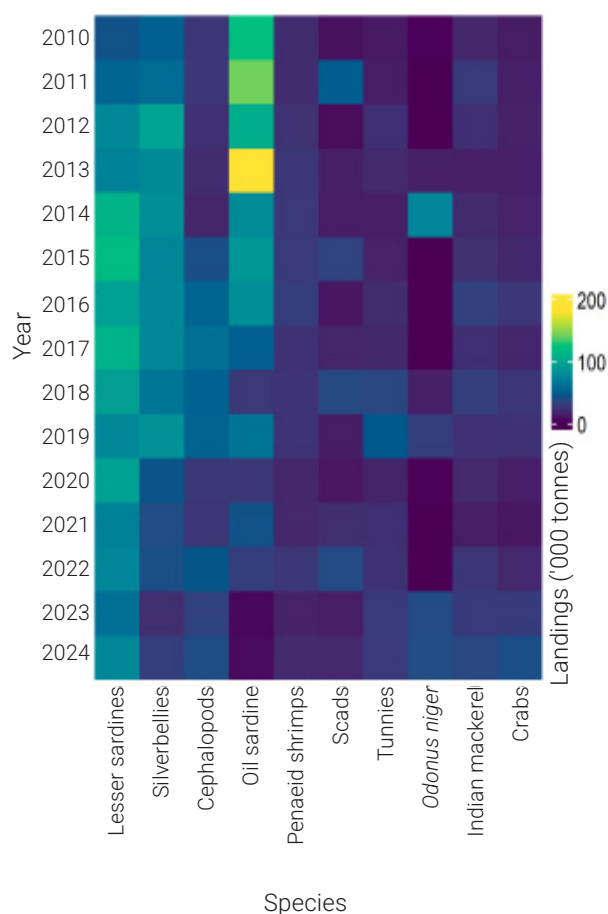


Fig. 5. Major fishery resources landed (2010–2024) in Tamil Nadu

low availability during 2023 and 2024. Penaeid shrimps showed relatively steady contributions with occasional peaks. Scads and tunnies exhibited considerable year-to-year variation, with occasional surges in their landings. *Odonus niger* stood out due to its distinctly irregular landing pattern, marked by notable spikes in 2014 and again in 2019 when unusually high catches were recorded in the state, compared to its low and sporadic landings during the rest of the period.

Recent trends in marine fish landings in Tamil Nadu (2022–2024)

Noticeable fluctuations, highlighting the dynamic and multi-species nature of the state's fisheries were evident. Following a relatively high level of production in 2022, there was a marked decline in 2023, which was then followed by a moderate recovery in 2024. These variations likely corresponded to changes in fishing intensity and seasonal resource availability across the years. Despite these fluctuations, Tamil Nadu continued to maintain a significant share in India's total marine fish production, supported by its extensive mechanised fleet and diverse fishing operations. Annual landings revealed a consistent seasonal rhythm, with higher landings typically observed during the first and third quarters that corresponded to peak fishing seasons when favourable conditions supported increased activity and resource availability. The second quarter generally reflected a decline, aligning with the monsoon-related lull or fishing restrictions, while the fourth quarter maintained moderate but steady

production levels. Although year-to-year fluctuations were evident, particularly with lower yields in 2023 and recovery in 2024, the overall pattern remained stable, underscoring Tamil Nadu's well-established seasonal cycle of marine fish landings and the sustained efficiency of its fishing operations. During 2022–2024, the craft-wise composition of marine fish production in Tamil Nadu clearly reflected the dominant role of the mechanised sector, which continued to be the primary contributor despite year-to-year fluctuations in landings. The motorised sector exhibited a gradual increase over this period, particularly in 2024, indicating the expanding participation of small and medium-scale fishers operating motorised crafts. In contrast, the non-motorised sector contributed only marginally, underscoring the limited role of traditional, non-powered fishing units in the state's marine fisheries. A clear pattern emerged in the species group composition of marine fish production in Tamil Nadu during 2022–2024, with pelagic resources forming the dominant share of total landings despite some fluctuations. The demersal group also remained a significant and stable component, comprising bottom-dwelling species such as croakers, threadfin breams, and perches. Crustaceans, mainly penaeid shrimps and crabs, contributed at moderate levels with some variability over the years. Molluscs, including squids and cuttlefish, maintained a steady presence throughout the period, reinforcing their consistent role in the overall species composition. Lesser sardines and oil sardine remained important contributors to the overall landings, although oil sardine showed a sharp decline after 2022. Cephalopods maintained a strong and consistent presence, underscoring their continued importance in the fishery. Indian mackerel

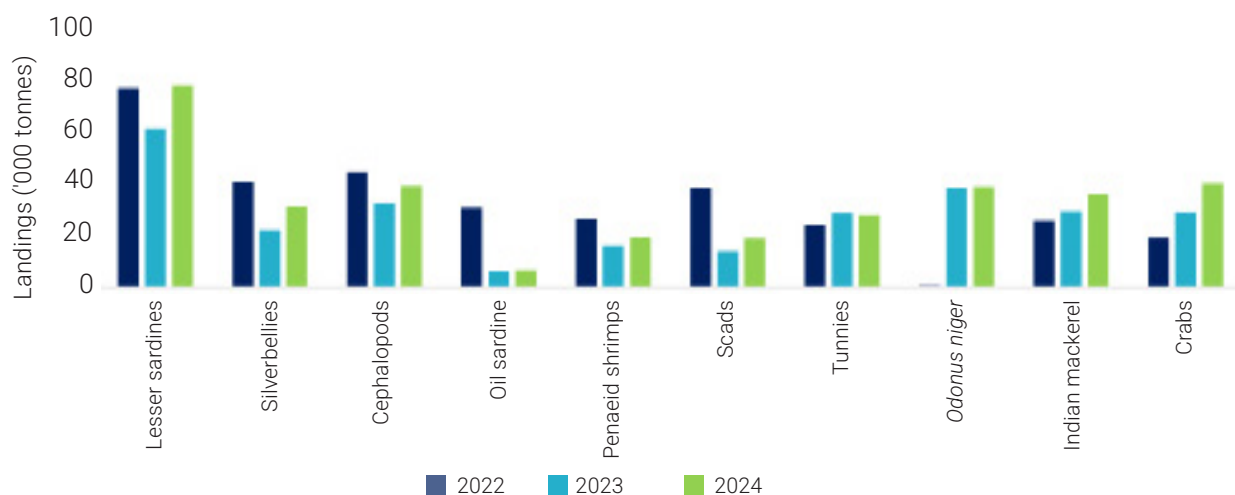


Fig. 6. Major fishery resources landings (in thousand tonnes) 2022 –2024 period in Tamil Nadu

recorded a notable increase in 2024, emerging as one of the key contributors, while tunas showed relatively stable contributions over the period (Fig. 6). In contrast, scads exhibited clear variability, with a sharp decline in 2023 followed by a partial recovery in 2024. Penaeid shrimps and crabs represented important crustacean resources, displaying moderate fluctuations across the years. *Odonus niger* showed a marked rise in 2023 and 2024, indicating a noticeable shift in species composition during the later part of the period.

Long-term trends in marine fish landings of Puducherry (2010–2024)

Overall production trend of the marine fish landings of Puducherry exhibited a fluctuating trend over the period under review. Beginning from relatively low levels in the initial years, landings increased sharply to reach a peak of 0.79 lakh t in 2015, reflecting a phase of heightened fishing activity and improved availability (Fig. 7). This peak was followed by a clear decline, with landings decreasing steadily over the subsequent years, indicating a period of reduced output. In the later years, a partial recovery became evident, with landings stabilising and showing gradual improvement. However, the production levels did not fully return to the peak observed in 2015, highlighting the continued variability in the overall trend.

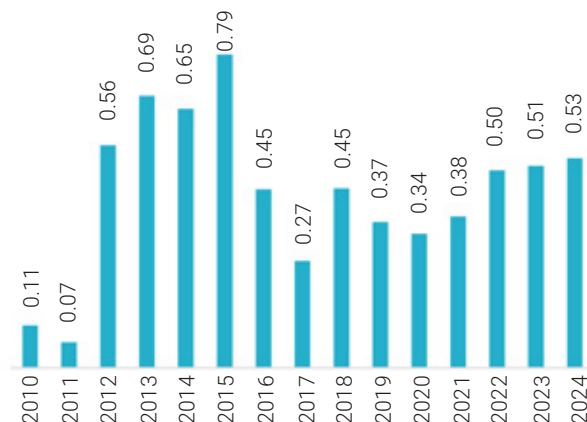


Fig. 7. Marine fish landing trends (lakh tonnes) in Puducherry during 2010–2024 period.

Seasonal pattern of landings in Puducherry showed a highly variable pattern across the years, marked by strong seasonality and pronounced inter-annual fluctuations (Fig. 8). The third quarter consistently emerged as the most productive period, with several years showing distinct peaks, indicating favourable monsoon-related fishing conditions and enhanced resource availability during this season. The second and fourth quarters contributed moderately, though their levels varied widely from year to year, reflecting differences in fishing effort and seasonal resource distribution. The first quarter generally recorded the lowest landings, yet occasional spikes suggested episodic increases in effort or the availability of specific resource groups. Over time, the

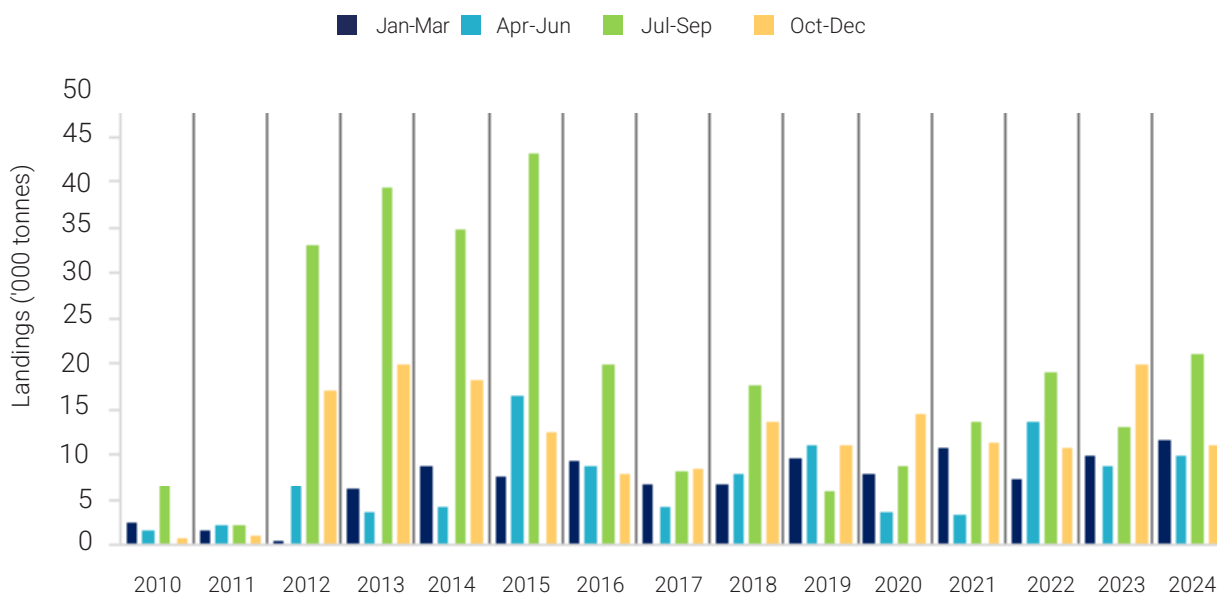


Fig. 8. Quarterly distribution of landings (in thousand tonnes) during 2010–2024 periods in Puducherry.

pattern transitioned from a few years dominated by exceptionally high third-quarter landings to a more balanced distribution in recent years, where contributions from all quarters appeared comparatively steadier.

The sector-wise contribution to marine fish landings in Puducherry showed a clear dominance of the mechanised fleet throughout the period, with particularly pronounced peaks during the mid-2010s (Fig. 9). These elevated landings reflected periods of high fishing intensity, favourable resource availability, or expansion in mechanised operations. The subsequent years showed a notable decline, followed by a gradual recovery. The motorised sector, though much smaller in scale, displayed considerable variability, with recent years showing substantial increases that suggested targeted exploitation of nearshore resources or shifts in fishing effort. The non-motorised sector contributed only marginally and remained relatively stable, reflecting its limited capacity and localised fishing range.

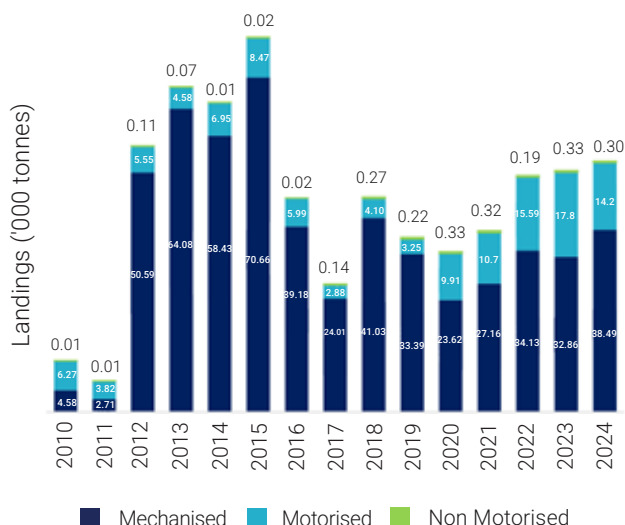


Fig. 9. Sector-wise fish landings (in thousand tonnes) during 2010–2024 period in Puducherry

Species group composition indicates that in the early years (2010–2011), overall landings were very low across all groups, with only marginal contributions from pelagic, demersal, crustacean, and molluscan resources. A sharp rise became evident from 2012 onwards, culminating in a peak around 2015, where pelagic resources contributed the largest share, followed by substantial inputs from demersal and molluscan groups. Crustaceans also showed a noticeable increase during this phase, though their share remained comparatively moderate (Fig. 10). Following this peak, a declining trend was observed

between 2016 and 2020, with reductions seen across all major groups but with pelagic resources retaining its leading position despite the overall drop in landings. Demersal resources remained the second most important component, though at reduced levels, while crustaceans and molluscs fluctuated at lower magnitudes. From 2021 onwards, a gradual recovery was visible, with all groups showing improved contributions. Pelagic resources again dominated the composition, while demersal, crustacean, and molluscan groups displayed moderate and relatively stable shares.

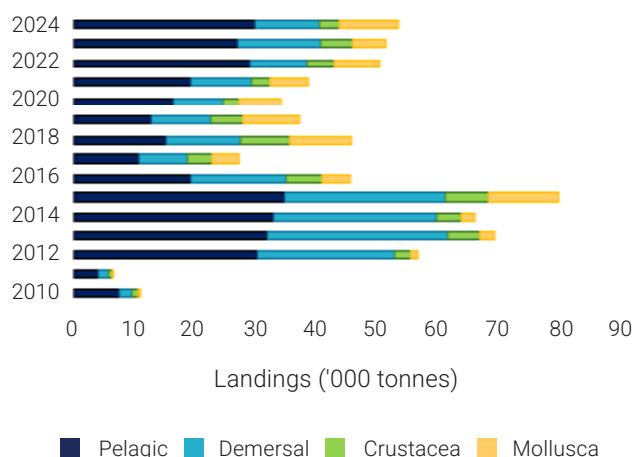


Fig. 10. Assemblage-wise marine fish landings (in thousand tonnes) during 2010–2024 period in Puducherry

Cephalopods stood out as one of the most dynamic groups, showing pronounced peaks interspersed with moderate phases, indicating fluctuating yet significant contributions to the fishery. Penaeid shrimps and scads exhibited moderate but variable landings, with noticeable increases during the period from 2015 to 2018 (Fig. 11). Silverbellies displayed a striking trend, with very high contributions in the early 2010s followed by a sharp decline and subsequent stabilisation at much lower levels. Ribbonfish, crabs, and lizardfishes maintained relatively steady contributions overall, although each showed occasional spikes reflecting episodic increases in landings. Lesser sardines were prominent in the early years but declined considerably in the later period. Indian mackerel contributed at moderate levels throughout, with a gradual increasing tendency in recent years. Threadfin brems remained consistent at low-to-moderate levels. Oil sardine exhibited marked fluctuations, with periods of high landings followed by sudden declines. Snappers, while contributing only a small share, showed slight increases in recent years.

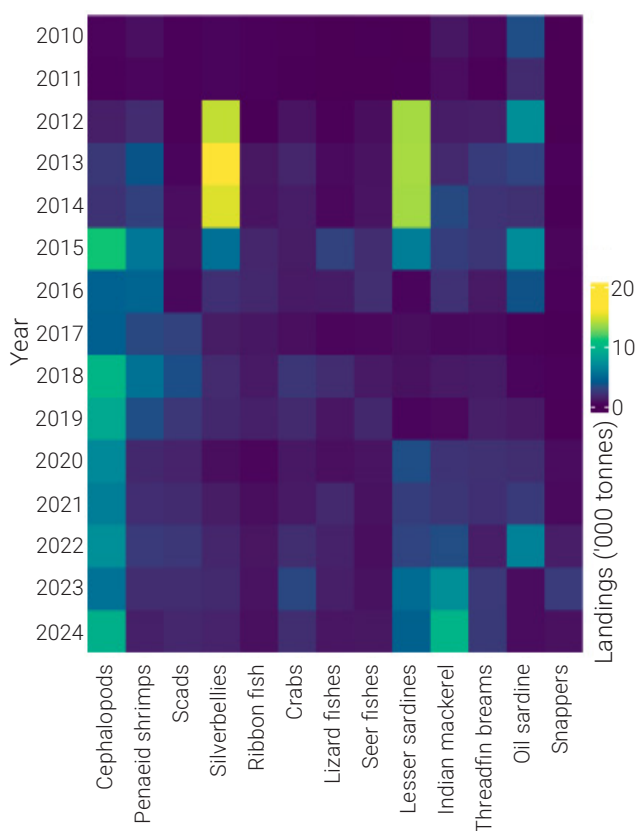


Fig. 11. Major fishery resources landed (2010–2024) in Puducherry

Recent trends in marine fish landings in Puducherry (2022–2024)

The marine fish production of Puducherry during

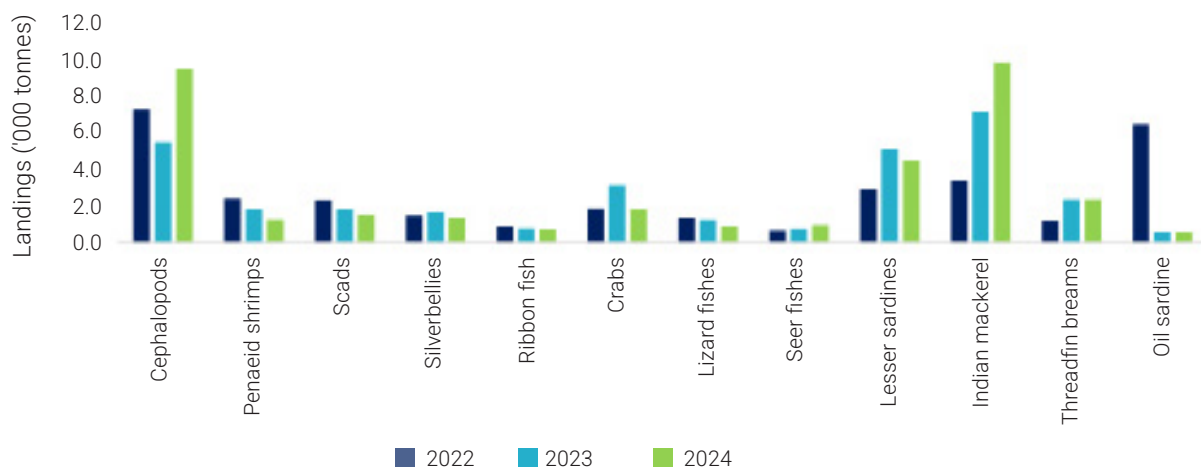


Fig. 12. Major fishery resources landings (in thousand tonnes) 2022–2024 period in Puducherry

2022–2024 showed a gradual but steady increase over the three-year period indicating improvement in fishing activity and resource availability along the region's coast. The quarterly distribution of marine fish production in Puducherry during 2022–2024 reflected the overall production showed a gradual increase, and the seasonal rhythm remained consistent, highlighting both stability and a slight upward trend in Puducherry's marine fishery. The sector-wise contribution highlighted the continued dominance of the mechanised sector while the non-motorised sector had the limited role of traditional, non-powered fishing units in the regional fishery. A consistent dominance of pelagic resources, which formed the largest share of total landings across all three years although there was a slight decline in overall production in 2023 compared to 2022 was recorded. Demersal resources constituted the second-largest component and remained relatively stable throughout the period, with a slight rise observed in 2023 and 2024. Crustaceans contributed a smaller share compared to pelagic and demersal groups, but showed a gradual increase over the three years while molluscan resources displayed moderate contributions with some variability, showing a slight dip in 2023 followed by an increase in 2024. The species-wise composition from 2022 to 2024 highlighted a diverse, small-scale fishery dominated by pelagic species and cephalopods (Fig. 12). Other species, including scads, silverbellies, ribbonfish, tunas, lizard fishes, seer fishes, threadfin breams, and snappers, contributed smaller but consistent shares, indicating a mixed-species fishery.

The integrated assessment of long-term and recent trends in marine fish landings across Tamil Nadu

and Puducherry highlighted two interlinked yet distinct fisheries systems characterised by variability, seasonality, and evolving operational structures. Tamil Nadu continued to sustain a large, diversified, and mechanised-dominated fishery, with high overall production supported by pelagic resources and cephalopods, despite experiencing notable fluctuations, including the pandemic-related decline around 2020 and a subsequent partial recovery. The seasonal pattern of landings remained consistent, with peak contributions aligning with established fishing cycles. In contrast, Puducherry represented a smaller-scale fishery that showed pronounced cycles of increase, decline, and gradual recovery, with recent years indicating modest improvement in production levels. Across both regions, mechanised fishing remained the principal mode of operation, while motorised crafts gained importance and non-motorised units contributed minimally. Resource composition continued to be dominated by pelagic groups, with demersal resources, crustaceans, and molluscs providing stable supplementary contributions. At the species level, the trends reflected variability in individual groups alongside steady contributions from key resources such as cephalopods, Indian mackerel, shrimps, and crabs. Taken together, the

findings indicated fisheries systems that were adaptive and productive, yet marked by increasing variability, underscoring the importance of continued monitoring, effective management, and sustained efforts to ensure long-term stability and productivity along the southeast coast of India.

Acknowledgement

This work was conducted under ICAR-CMFRI in-house research project “*Science for Sustainability: Developing an Integrated Assessment Framework (IAF) to inform management decisions for marine fisheries of Tamil Nadu & Puducherry (SFD/IAF/13)*” with data used for this analysis collected under the in-house project “*Geo-referenced Marine Fisheries Resources Information System for Indian EEZ Based on Enhanced Survey Protocols and Methodological Platforms for Stock Assessment, Modelling and Forecasting (FRAEED/GIS/01)*”.

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