DFM Report

Marine Fisheries in India: Structural Trends Across States and Production Dynamics in Andhra Pradesh

Jeena T Srinivasan, Jyothis Sathyapalan, and Vangapally Sreenivas

Dried Fish Matters

Dried Fish Matters Project
Department of Anthropology, Faculty of Arts
432 Fletcher Argue Building,
15 Chancellor Circle
The University of Manitoba,
Winnipeg, MB, R3T 2N2
CANADA
dried.fish.matters@umanitoba.ca

Social Sciences and Humanities Research Council of Canada
Conseil de recherches en sciences humaines du Canada
Canada

This work draws on research supported by the Social Sciences and Humanities Research Council of Canada.

Acknowledgement

This report was prepared as part of the study *"Dried Fish Matters: Mapping the Social Economy of Dried Fish for Food and Nutrition"*, coordinated by the University of Manitoba, Canada**,** and supported by the Social Sciences and Humanities Research Council (SSHRC), Canada**.** We gratefully acknowledge the financial support provided by SSHRC.

The analysis draws on both primary and secondary data sources. The primary data include a comprehensive survey of fishing units conducted in 2013–14 by the Centre for Economic and Social Studies (CESS), Hyderabad, by the second author as part of a study reviewing the rates and ratios used to compile the Gross State Domestic Product (GSDP) of the fisheries sector. This work was undertaken with the financial support of the Governments of Andhra Pradesh and Telangana**.** Additional qualitative data were collected through a field survey carried out in 2021–22 as part of the Dried Fish Matters project**.** We also acknowledge the use of secondary data from official sources, including the Marine Fisheries Censuses.

We would like to thank Prof. Derek Johnson of the University of Manitoba for his valuable input and support throughout the preparation of this report.

Authors

About the authors

Prof. Jeena T Srinivasan is a Professor of Economics at the Centre for Economic and Social Studies, Nizamiah Observatory Campus, Begumpet, Hyderabad 500 016, India.

Email: jeena@cess.ac.in

Prof. Jyothis Sathyapalan is a Professor of Economics at the National Institute of Rural Development and Panchayati Raj, Rajendranagar, Hyderabad, India.

Email: jyothis.nird@gov.in

Dr. Vangapally Sreenivas is a Research Investigator at the Centre for Economic and Social Studies, Nizamiah Observatory Campus, Begumpet, Hyderabad 500 016, India.

Email: srinivasvangapally.cess@gmail.com

Table of Contents

List of Tables

List of Figures

1. Introduction

The fisheries sector plays a vital role in India's economy, contributing significantly to employment, food security, and export earnings. With a coastline stretching 8,188 km and an Exclusive Economic Zone of 2.02 million sq km, India recorded a total fish production of 16.25 million metric tons (MMT) in 2021-22, of which 4.13 million metric tons and 12.12 million metric tons were from marine and inland fisheries, respectively. The sector accounts for about 1.1 per cent of gross value added (GVA) and 6.72 per cent of the gross agricultural value added in 2020-21. It also provides livelihood opportunities for approximately 28 million people. Contributing 8 per cent of global fish production, India ranks second among the world's fish producers (GoI, 2022).

The marine fisheries sector, which accounted for 63 per cent of India's total 2.42 MMT of fish production in 1980-81, saw its share drop to 25 per cent of the 16.25 MMT by 2021-22. Although marine fisheries production grew from 1.6 MMT to 4.13 MMT over this period, the inland fisheries sector experienced a significantly higher growth rate, leading to a decline in the marine sector's share of overall fish production. This shift in the composition of total fish production highlights two key developments. On one hand, it underscores the sustainability challenges facing the marine fisheries sector, including overfishing, unsustainable practices, and the depletion of marine resources. On the other hand, it points to a positive trend in leveraging inland water resources to boost food and nutrition security.

Moreover, available data also highlights shifts in the composition of fish production and its disposition over the years. In 1980-81, about 65 per cent of fish were marketed fresh, and 6 per cent were frozen. The remaining 29 per cent underwent various forms of processing, including curing, canning, reduction, and offal processing. By 2020-21, significant changes were evident, with 77 per cent of fish being sold fresh, 13.5 per cent frozen, and only 9 per cent undergoing processing GoI, 2022). Improvements in cold storage facilities, infrastructural development, and changes in consumer tastes and preferences have driven this shift. Although reliable data on the extent of dried fish processing and consumption in India is lacking, some information is available on its export. While dried fish accounts for a relatively small share of total fish exports, it has shown one of the fastest growth rates among marine product exports (Srinivasan,

2023). It is seen that the export of dried fish, which was around 3 per cent in 1995-96, increased to about 6 per cent by 2019-20.

Against this background, this report, which is divided into Part A (sections 2 to 4) and Part B (sections 4 & 5), provides a brief overview of the marine fisheries sector in India and Andhra Pradesh. It examines state-wise production trends during 2011-12 to 2021-22, analyses changes in key characteristics of marine fisheries using data from the 2010 and 2016 Marine Fisheries Censuses (Part A) and explores district-level production patterns across Andhra Pradesh across fishing seasons based on primary data (Part B). As the report is part of the larger Dried Fish Matters project (DFM), it highlights the dried fish sector where data are available.

2. Trends in marine fisheries production across states in India

As mentioned earlier, marine fisheries production in India has experienced significant changes over the years. To gain a nuanced understanding of these transformations, particularly the recent developments and regional dynamics, it is essential to examine state-wise production trends (Figure 1). Such an analysis highlights not only each state's contribution but also variations in production levels and growth rates.

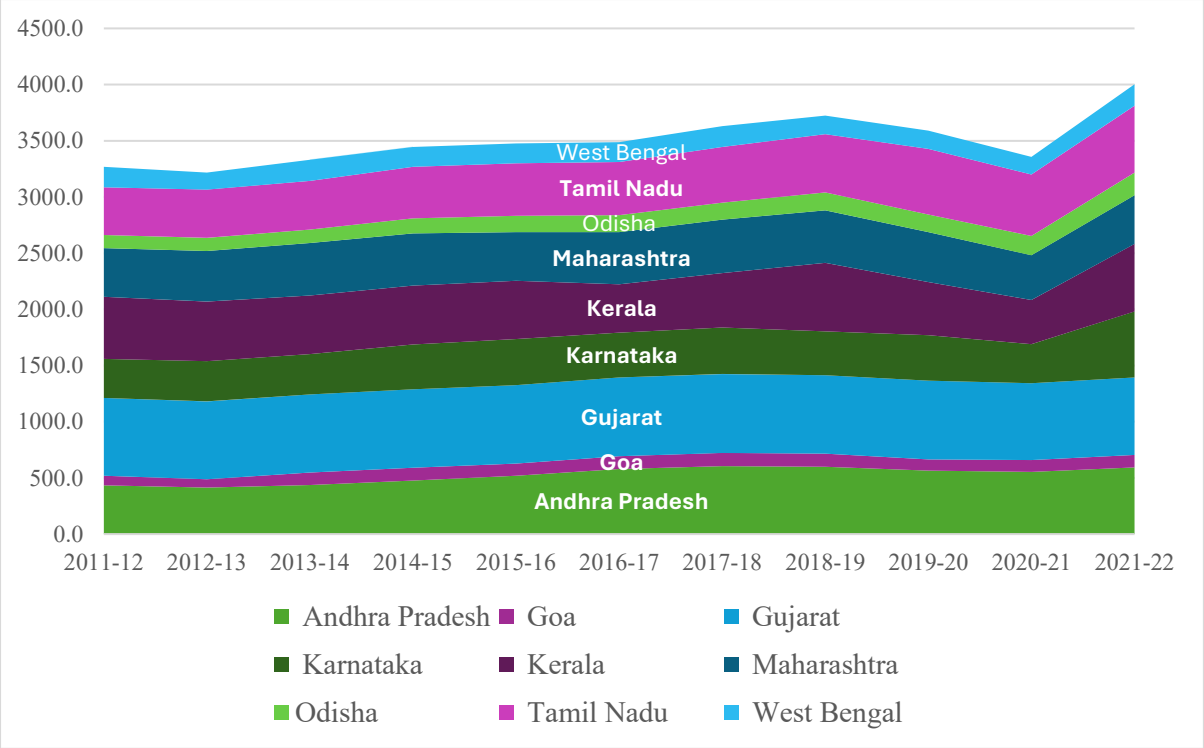


Figure 1. State-wise trends in marine fisheries production (in 000 tonnes)

Source: GoI (2022)

For the start year 2011-12 and end year 2021-22, Gujarat consistently emerged as the largest contributor to marine fisheries production in the country (Table 1). In 2011-12, Gujarat accounted for 20.54 per cent of the total marine production; however, this share declined to 16.67 per cent by 2021-22. Kerala also contributed significantly with a share of 16.41 per cent in 2011-12, though it experienced a slight decline to 14.56 per cent in 2021-22. Tamil Nadu maintained a stable position among the top contributors across both years, with its share increasing from 12.66 per cent in 2011-12 to 14.42 per cent in 2021-22. Andhra Pradesh also showed consistent performance, with its share increasing from 12.85 per cent to 14.39 per cent during this period. Maharashtra, a major contributor, reported a 12.86 per cent share in 2011-12, which slightly declined to 10.49 per cent by 2021-22. Karnataka, in contrast, reported an increase from 10.30 per cent to 14.27 per cent during the same period, reflecting an upward trend in its contribution to marine fisheries production. and was the second largest contributor to marine fisheries production.

Table 1. State-wise contribution (in 000 tonnes) and semi-logarithmic (log-linear)[1] growth rates (in per cent) in marine fisheries production during 2011-12 to 2021-22.

	2011-12		2021-22		Growth rates (in per cent)
	Quantity	%	Quantity	%	
Andhra Pradesh	433.3	12.85	594.0	14.39	3.74***
Goa	86.2	2.56	111.0	2.69	2.34*
Gujarat	692.5	20.54	688.0	16.67	-0.05
Karnataka	347.4	10.30	589.0	14.27	2.58**
Kerala	553.2	16.41	601.0	14.56	-0.007
Maharashtra	433.7	12.86	433.0	10.49	-0.004
Odisha	114.3	3.39	201.0	4.87	5.05***
Tamil Nadu	426.7	12.66	595.0	14.42	3.5***
West Bengal	182.0	5.40	191.0	4.63	-0.002
Puducherry	37.6	1.12	39.0	0.94	
All India	3371.8	100.00	4127.0	100	1.47***

Note: ***, **, and * indicate statistical significance at 1 per cent, 5 per cent, and 10 per cent levels, respectively. Source: GoI (2022)

Among smaller contributors, Odisha recorded an increase from 3.39 per cent in 2011-12 to 4.87 per cent in 2021-22, while West Bengal registered a marginal decrease from 5.40 per cent to 4.63 per cent during the same period. Goa remained a minor contributor, with a slight increase from 2.56 per cent to 2.69 per cent over the decade.

Overall, Gujarat, Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, and Maharashtra remained the principal states driving marine fisheries production, though their share of total production shifted over time.

The semi-logarithmic growth rates of marine fisheries production during 2011-12 to 2021-22 reveal considerable variation across states. Odisha exhibited the highest growth rate (5.05 per cent), followed by Andhra Pradesh (3.74 per cent) and Tamil Nadu (3.5 per cent). Karnataka (2.58 per cent) and Goa (2.34 per cent) showed moderate growth, while Gujarat, Kerala, West Bengal, and Maharashtra showed

[1] The growth rate estimation uses the semi-logarithmic equation $\ln(Y_t) = \alpha + \beta t$, with β capturing the percentage change in Y (marine production) for each additional time period (year).

negligible to slightly negative growth rates, indicating stagnation or decline in production. At the national level, the total growth stood at 1.47 per cent, suggesting overall positive momentum despite state-level disparities.

3. Structural trends in marine fisheries: evidence from the Marine Fisheries Census

This section draws on comparative data from the Marine Fisheries Censuses conducted by the Central Marine Fisheries Research Institute (CMFRI) in 2010 and 2016 to analyze the evolving trends in the sector[2]. It focuses on key indicators such as the number and distribution of fishing villages and landing centers, fisher population and families, poverty levels among fisher households, occupational roles within fisheries, and patterns of ownership of crafts and gears. Despite well-known limitations, including under-enumeration in certain regions, definitional inconsistencies, and variations in coverage across states, the CMFRI census remains the only national-level, periodically repeated, and sector-specific enumeration of marine fishing communities in India.

CMFRI conducts a door-to-door household census of all marine-fishing households in coastal villages, identified as having fishing as their primary livelihood. As a household-based survey, it records only the activities of resident family members and mostly excludes migrant workers, factory labor, and others engaged in post-harvest activities outside fishing households. Even when migrant workers reside in fishing villages, they are counted only if they belong to a marine-fishing household, meaning that temporary or non-household-based workers, particularly those in peeling sheds and processing plants, are not captured. As a result, the census provides a picture of household-level engagement but does not represent the full scale of labor and value chain activities in the marine fisheries sector. Some variation also arises from changes in classification criteria between census rounds and minor discrepancies between state-level and national-level tabulations.

[2] CMFRI 2016 is the latest marine fisheries census data available one.

Recognizing these constraints, this study undertakes a cautious comparative analysis, prioritizing indicators that remain stable across census rounds and interpreting changes primarily in terms of directional shifts rather than precise magnitudes. By documenting patterns across India's maritime states and examining them in detail for Andhra Pradesh, a major coastal state with a substantial active fishing population, this analysis offers a detailed understanding of the structural shifts underway and illustrates how the national trends manifest at the state level.

3.1 Changes in the number of fishing villages, landing centers, and families

As we will see below, the structure and composition of fishing communities —including their villages, landing centers, and households—have undergone notable changes over time, reflecting broader shifts in the marine fisheries sector. A fishing village is defined as a settlement comprising houses or dwelling places where marine fishers reside, and it is officially recognized by the state fisheries department. A landing center refers to a designated location or harbor where fishers land their fishing craft and unload their catch. Similarly, the fisher family is defined as a household in which at least one member is engaged in marine fishing or associated activities, or both (CMFRI, 2020).

The Marine Fisheries Census 2016 recorded 3,477 marine fishing villages in India across nine coastal states and the Union territories of Puducherry, Daman & Diu, Lakshadweep, and Andaman & Nicobar Islands, registering an increase from 3,288 villages reported in the 2010 Census. Orissa, Tamil Nadu, and Andhra Pradesh recorded the highest numbers of marine fishing villages in the country, with 739 (21.3 per cent), 575 (16.5 per cent), and 533 (15.3 per cent), respectively. While the number of fishing villages has increased overall, a few states, such as Odisha, Andhra Pradesh, West Bengal[3], and Kerala, reported a decline in 2016 compared to 2010 (Figure2)

[3] In West Bengal, villages mean Gram Panchayats (CMFRI-DoF (2020).

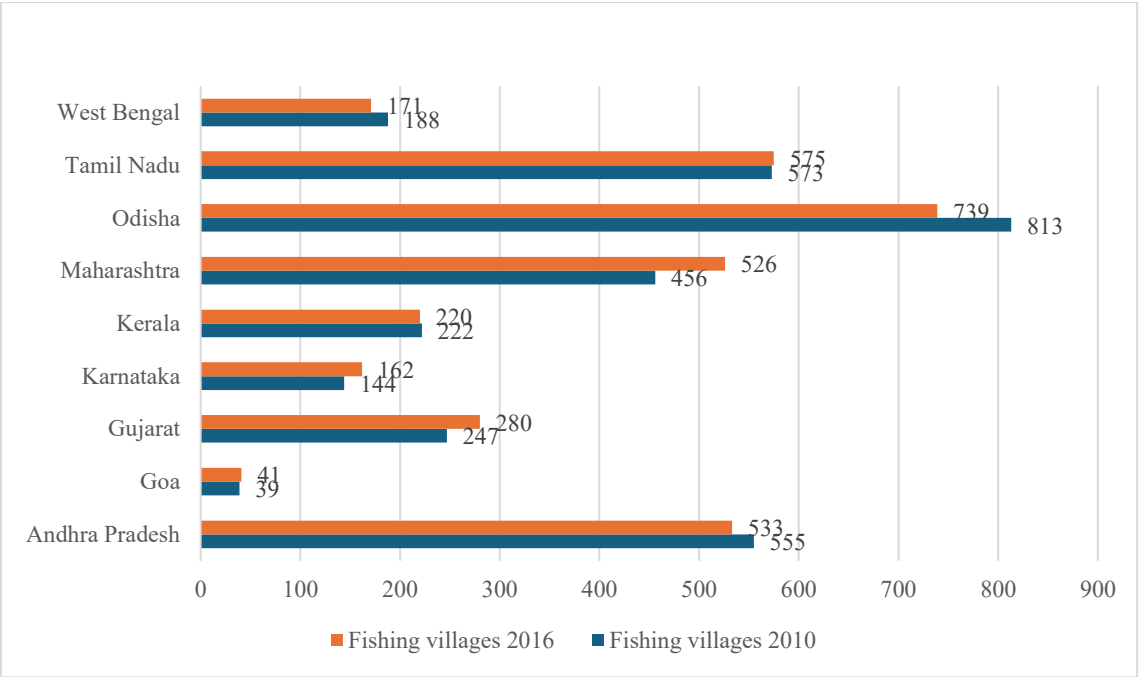


Figure 2: State-wise distribution of marine fishing villages in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

While the number of marine fishing villages increased nationally, the Marine Fisheries Census reported a slight decline in the marine fish landing centers, from 1,511 in 2010 to approximately 1,363 in 2016. In the 2016 Census, Tamil Nadu, Andhra Pradesh, and Kerala recorded the highest numbers of landing centers, with 349 (25.6 per cent), 234 (17.2 per cent), and 174 (12.8 per cent) centers, respectively, compared to 404 (26.8 per cent), 353 (23.3 per cent), and 187 (12.4 per cent) centers in the 2010 Census. The number of landing centers declined across all maritime states, except for Maharashtra, which reported a marginal increase of three centers (Figure 3).

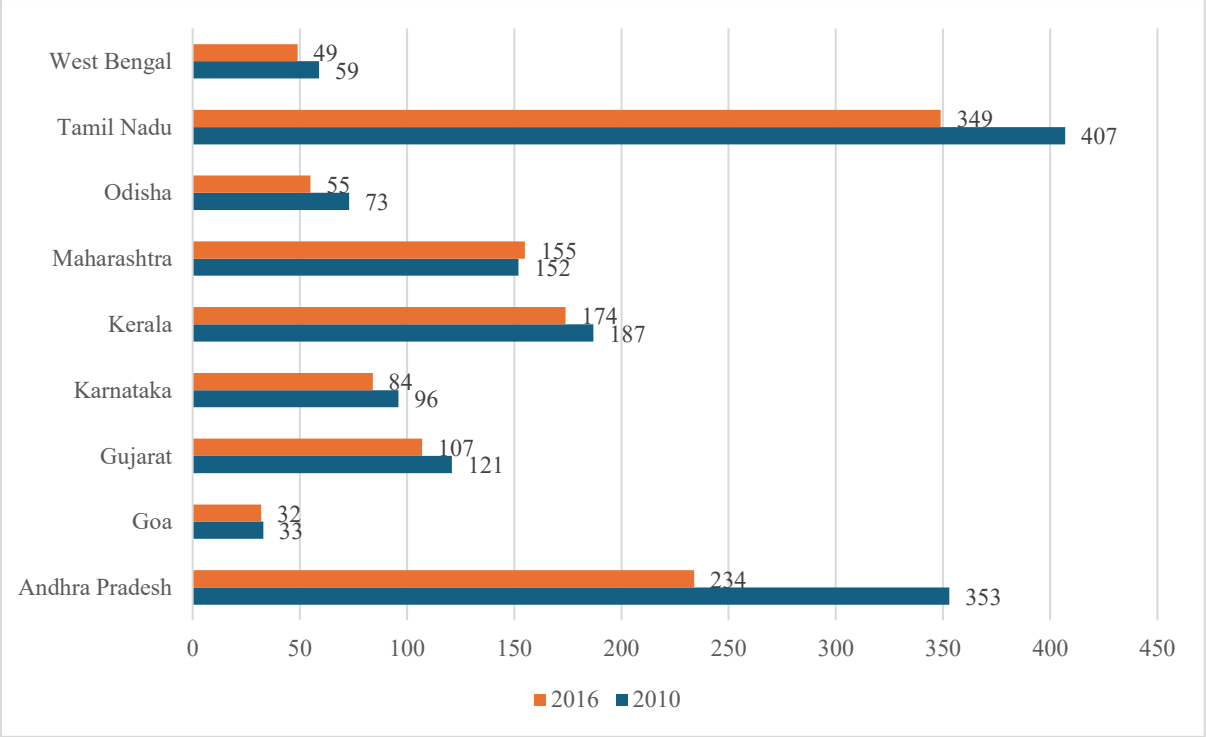


Figure 3: State-wise distribution of marine fish landing centers in 2010 and 2016
Source: CMFRI (2012); CMFRI-DoF (2020)

However, there has been a reported increase in the number of marine fisher families from 864,550 to 893,258 between the 2010 and 2016 Marine Fisheries Census at all India levels (Figure 4).

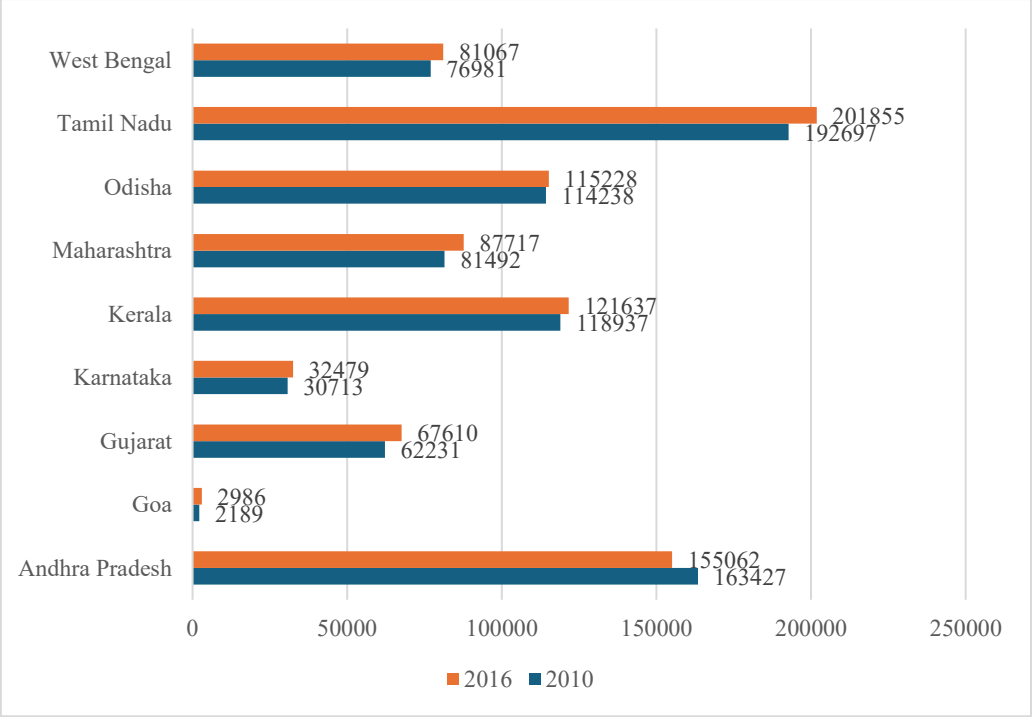


Figure 4: State-wise distribution of marine fisher families in 2010 and 2016
Source: CMFRI (2012); CMFRI-DoF (2020)

Fisher families exhibited an upward trend in eight maritime states between 2010 and 2016. The number of fisher families increased from 192,697 to 201,855 in Tamil Nadu and from 118,937 to 121,637 in Kerala. In contrast, Andhra Pradesh recorded a decline of 8,365 fisher families during the same period. The reasons for this reduction remain unclear; however, it is plausible that these households exited the fisheries sector, transitioned to alternative livelihoods, or migrated in search of better economic opportunities. Field observations in Andhra Pradesh suggest that fishers have migrated to Gujarat and other states to work as laborers or crew members, while others have relocated to nearby cities and towns to seek employment in non-fishing sectors.

3.2. Poverty among fisher families

It is noteworthy that the number of marine fisher families below the poverty line (BPL) (those possessing a BPL ration card issued by the state government) increased from 523,691 (61 per cent) in 2010 to approximately 600,890 (67.3 per cent) in 2016. Notably, more than half of these BPL families are concentrated in Tamil Nadu (30.6 per cent) and Andhra Pradesh (25.1 per cent). Except for Odisha and Goa, which

recorded modest declines in poverty from 49.26 per cent to 42.18 per cent and from 22.34 per cent to 21.77 per cent, respectively, all other central maritime states experienced an increase in poverty levels among fisher families (Figure 5).

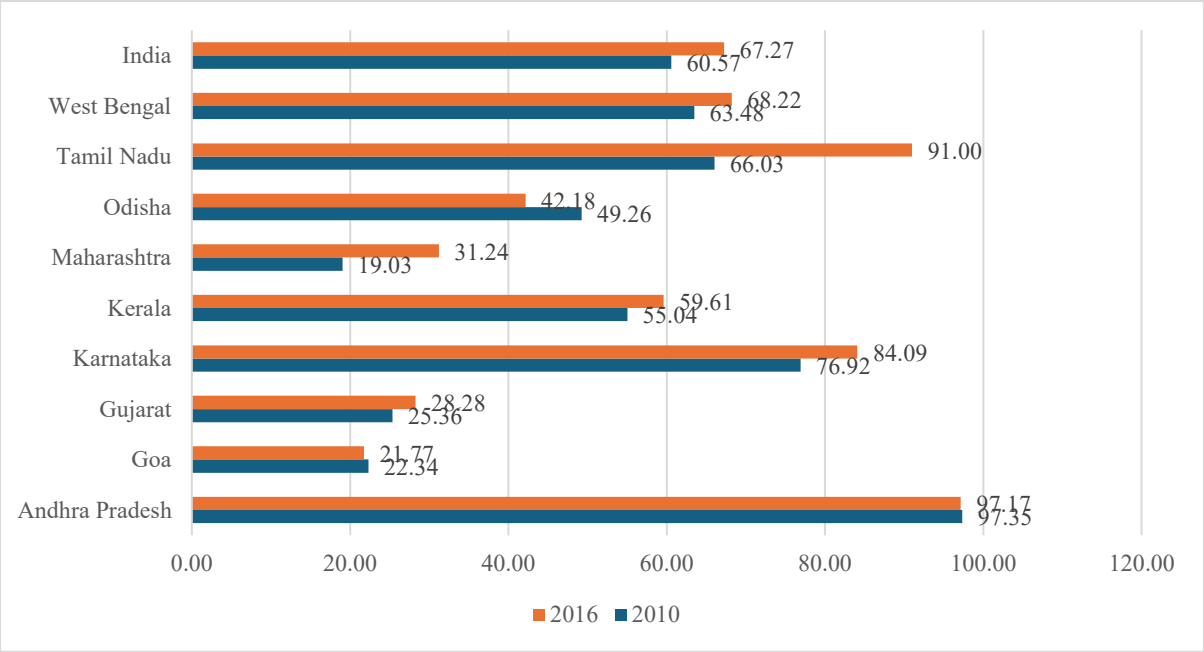


Figure 5: Percentage of fisher families below the poverty line in 2010 and 2016
Source: CMFRI (2012); CMFRI-DoF (2020)

Tamil Nadu experienced the most significant increase, with poverty levels among fisher families rising sharply from 66 per cent to 91 per cent during this period. Similarly, Karnataka registered a substantial increase, with poverty levels climbing from 76.92 per cent to 84.09 per cent between 2010 and 2016 (Figure 5).

3.3 Trends in the fisher population

Despite the observed increase in the number of fisher families, the total population of marine fishers in India has declined from 3,999,214 in the 2010 Census to 3,775,577 in 2016. This downward trend suggests a gradual shift away from traditional fishing occupations. Notably, Gujarat and Goa were the only states to report an increase in the fisher population during this period (Figure 6).

Field observations from Andhra Pradesh indicate that a significant number of fishers have migrated to other states, particularly Gujarat, to work as crew members or

laborers in marine fisheries. However, systematic data on the scale and characteristics of such interstate migration remain limited, preventing a more detailed analysis. Regionally, around 63 per cent of the total marine fisher population is concentrated in Tamil Nadu, Kerala, Odisha, and Andhra Pradesh. Another 29 per cent are in Gujarat, Maharashtra, and West Bengal, with the remaining proportion distributed across Karnataka, Goa, and other union territories.

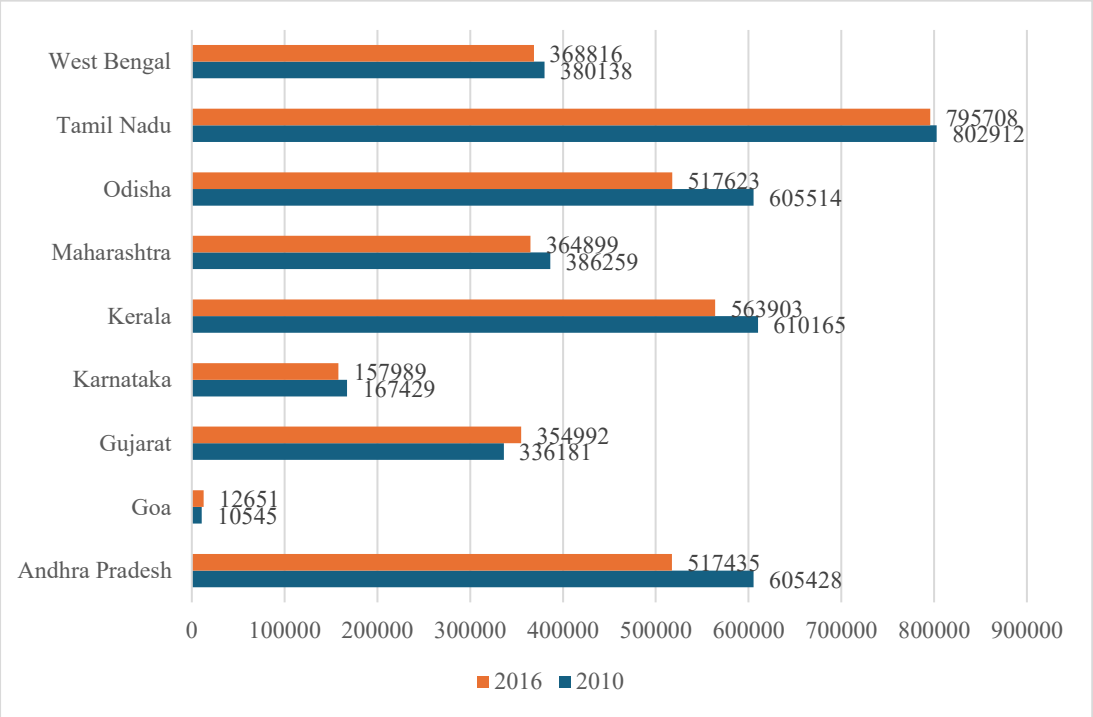


Figure 6: State-wise total fisher population in 2010 and 2016
Source: CMFRI (2012); CMFRI-DoF (2020)

3.4 Spatial density of fishing communities along the coastline

Calculating the density of fisher population and fisher families per kilometre of coastline provides a spatial indication of the settlement pressure and the intensity of fisheries-dependent livelihoods along India's coast, insights that absolute numbers alone cannot offer. At the all-India level, the analysis shows a slight rise in fisher family density from 106 to 109 families per km, and a modest decline in fisher population density from 490 to 462 fishers per km of coastline between 2010 and 2016. This contrast suggests that while an active fisher population may be decreasing, coastal fishing settlements remain populated, possibly due to non-fishing livelihoods, ageing fisher households, or shrinking household size.

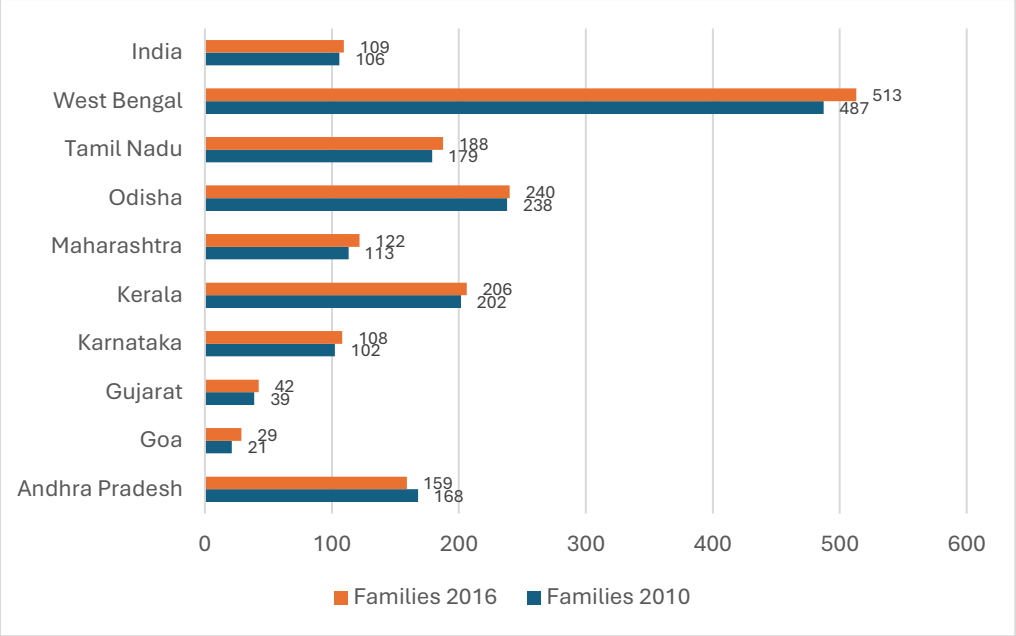


Figure 7: State-wise density of fisher families per km of coastline in 2010 and 2016
Source: CMFRI (2012); CMFRI-DoF (2020)

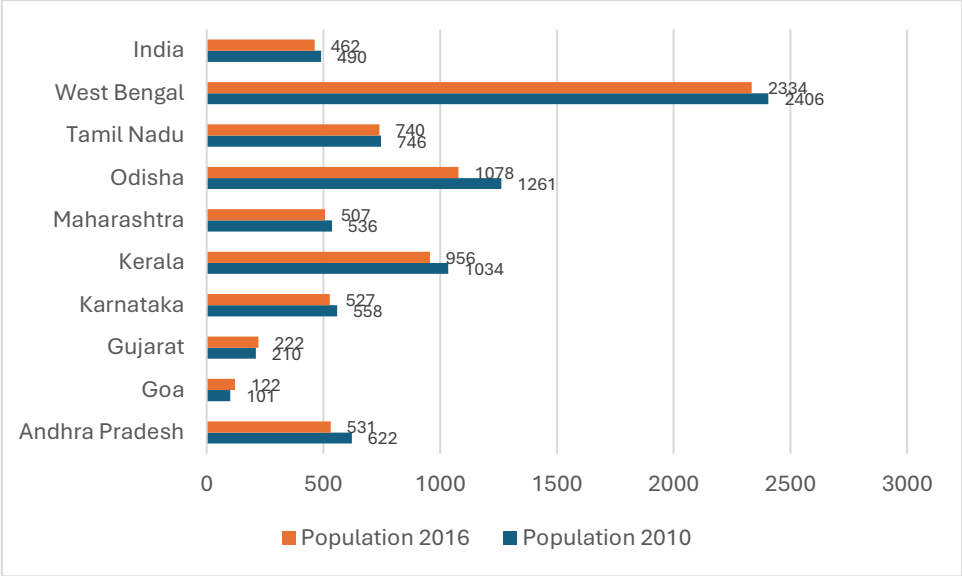


Figure 8: State-wise density of fisher population per km of coastline in 2010 and 2016
Source: CMFRI (2012); CMFRI-DoF (2020)

State-wise patterns reveal substantial variation. West Bengal consistently exhibits the highest density in both periods, with fisher population density remaining extremely high (declining slightly from 2,406 to 2,334 fishers/km) and fisher family density increasing from 487 to 513 families/km of coastline, reflecting its short coastline and densely

populated coastal settlements. Odisha, Kerala, and, to a lesser extent, Tamil Nadu also show high densities, with all three recording declining population density (for example, Kerala from 1,034 to 956 fishers/km of coastline) but marginal increases in family density, indicating reduced engagement in active fishing. States with moderate densities, such as Andhra Pradesh, Karnataka, and Maharashtra, show declines in both population and, in the case of Andhra Pradesh, family density, suggesting outmigration, diversification of livelihoods, or a decline in dependence on marine fisheries. In contrast, Gujarat and Goa, which have the lowest national densities, show small increases over time, suggesting modest growth in their coastal fishing settlements.

Overall, the density analysis helps identify regions under concentrated demographic pressure (West Bengal, Odisha, Kerala, and Tamil Nadu), regions showing demographic thinning (Andhra Pradesh, Karnataka, Maharashtra), and regions with low but gradually increasing settlement intensity (Gujarat and Goa).

3.5. Trends in the occupational pattern of fishers

According to the 2010 Marine Fisheries Census, of the 1,665,342 occupied fisher population, 990,083 individuals (59.5 per cent) were active fishermen, followed by 223,306 (13.42 per cent) engaged in marketing activities and 199,146 (11.96 per cent) working as fishing laborers (Figure 9). The remaining population was involved in ancillary activities such as net-making or repair (5.2 per cent), curing or processing (3.2 per cent), peeling (1.9 per cent), and other related works.

By the 2016 Census, the working fisher population decreased to about 1,528,409. Still, population distribution across various activities remained almost as in the 2010 Census data at all Indian levels. However, by 2016, a decline in the number of laborers to 7.62 per cent and a marginal increase in the number of fishers engaged in peeling (3 per cent), and other activities had been observed (Figure 10).

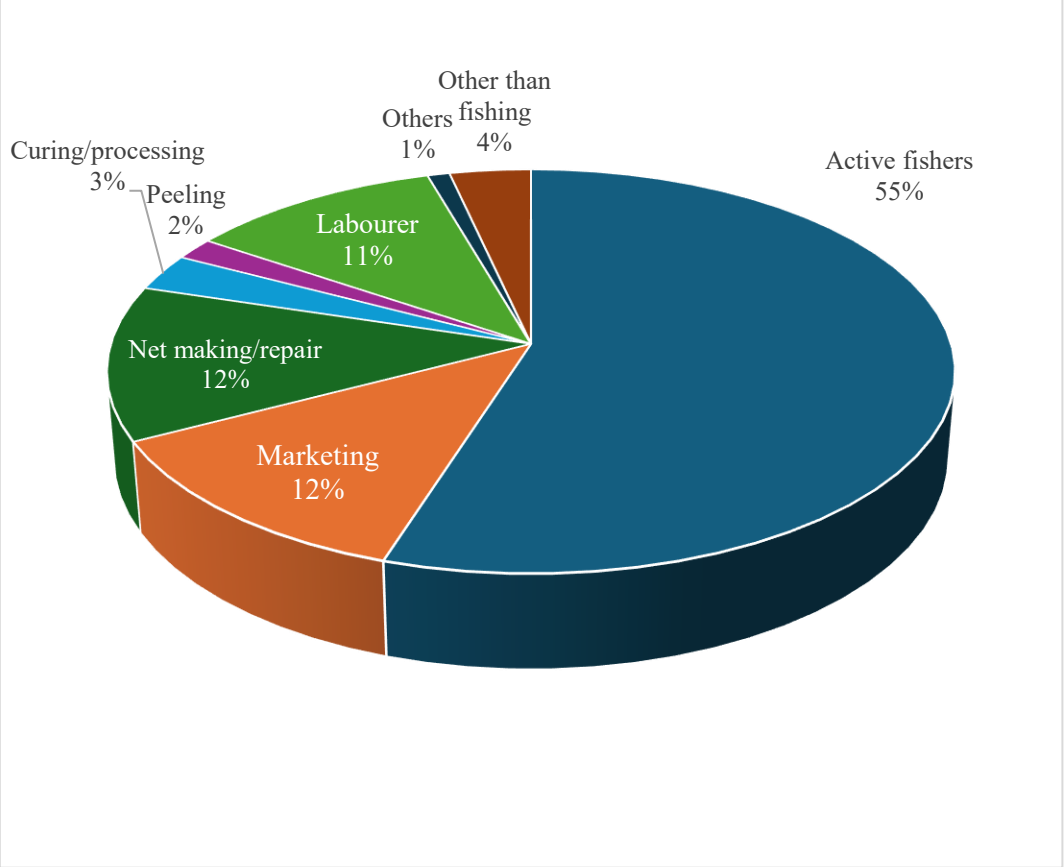


Figure 9: Occupational Profiles of Fishers in 2010

Source: CMFRI (2012); CMFRI-DoF (2020)

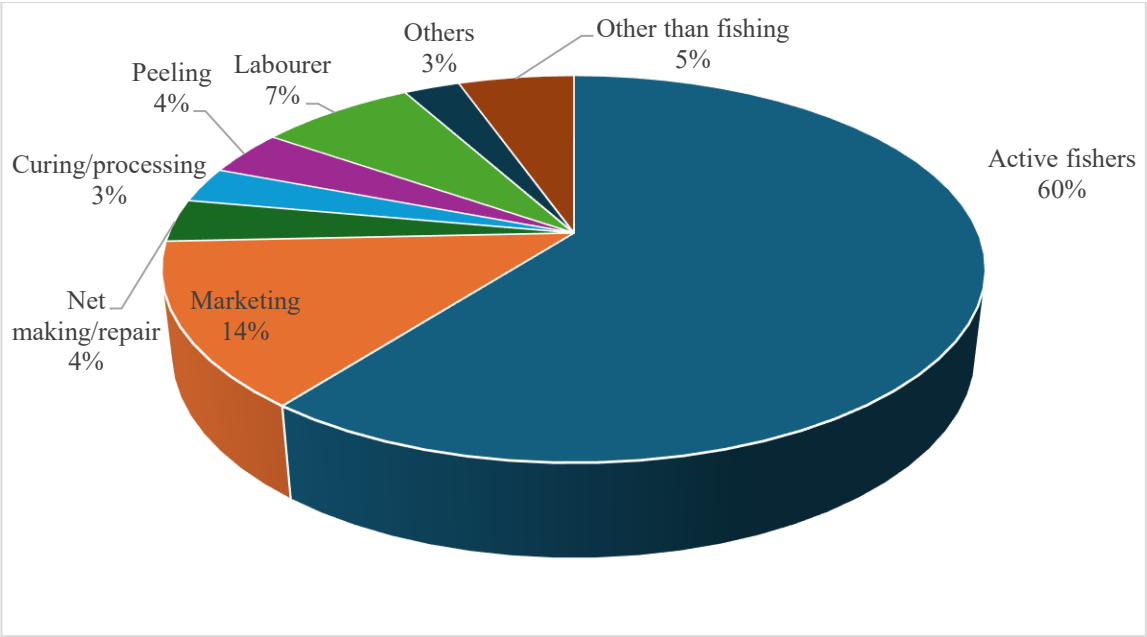


Figure 10: Occupational Profiles of Fishers in 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

When examining the state-wise figures of those engaged in fishing and related activities for the same period, only Tamil Nadu, Gujarat, Kerala, and Goa showed an increase, while all other states showed a decline (Figure 11). Andhra Pradesh and Odisha recorded the sharpest declines, with figures falling from 301,956 to 239,919 and from 260,210 to 194,502, respectively, between 2010 and 2016.

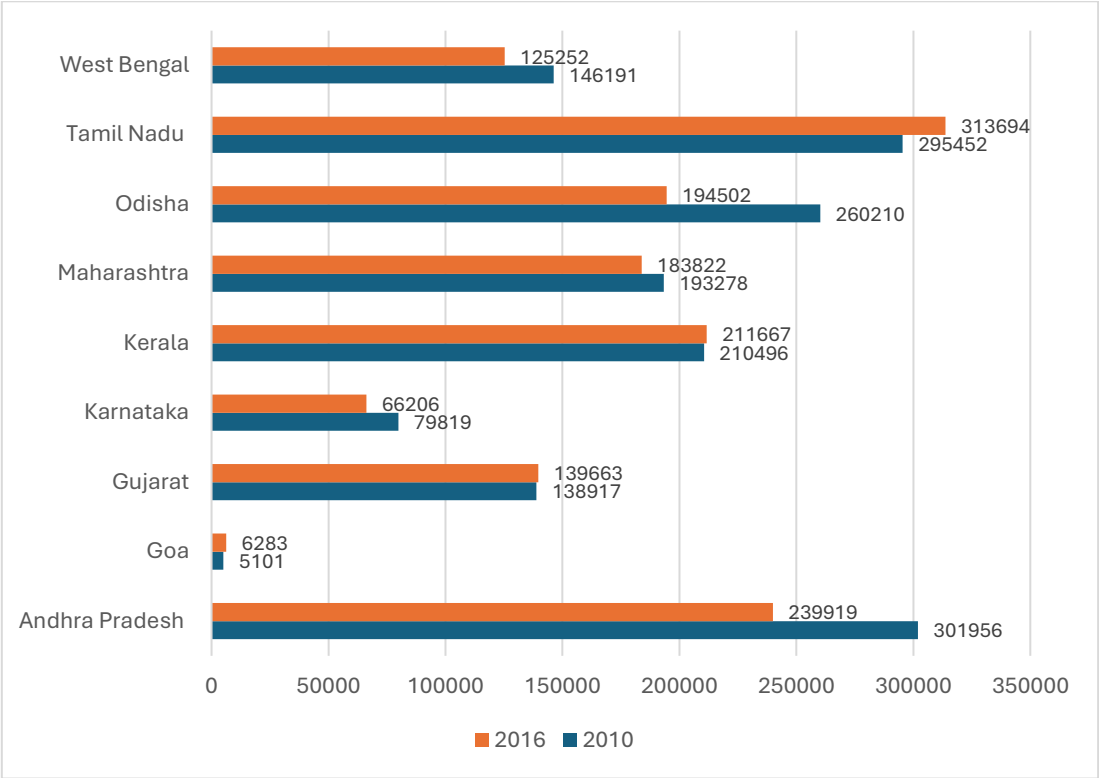


Figure 11: Number of fishers employed in fishing and related activities across states in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

Further, the analysis of the number of active fishers reveals both intertemporal and interstate differences. Andhra Pradesh and Odisha reported significant declines, and Kerala, Gujarat, and West Bengal recorded modest declines (Figure 12). Maharashtra and Goa, however, maintained relatively stable numbers. Tamil Nadu is the only state that registered an increase, reflecting sustained or growing fishing activity. Overall, the figure shows a gradual decline or stagnation in the fishing workforce in most states.

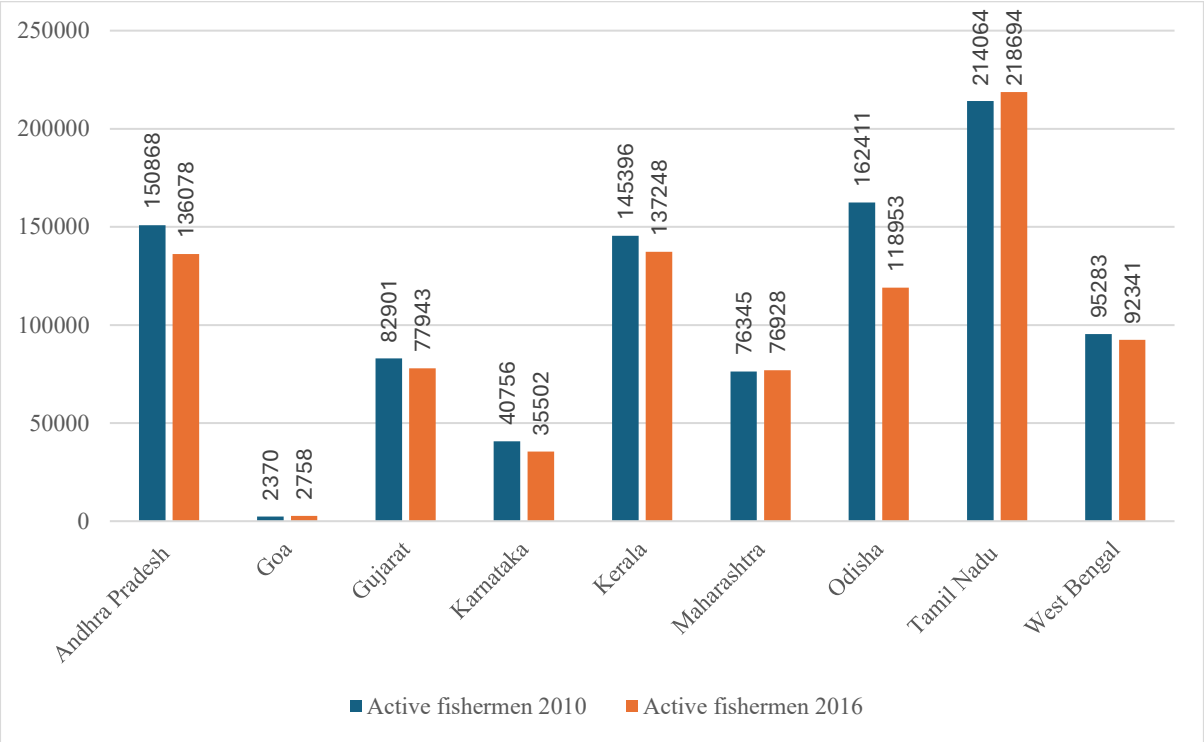


Figure 12: Number of active fishers across states in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

While patterns in the number of active fishers reveal important shifts in the fishing workforce, examining trends in fishers engaged in marketing and other activities provides further insights into the evolving nature of fisheries across Indian states. States such as Andhra Pradesh and Odisha witnessed substantial declines in the number of fishers involved in marketing, suggesting a contraction in market-based livelihoods (Figure 13). Kerala, Tamil Nadu, Karnataka, and West Bengal also experienced moderate reductions, while Maharashtra, followed by Gujarat, stood out for a significant increase in the number of fishers engaged in marketing, suggesting an expansion of the marketing network in these states.

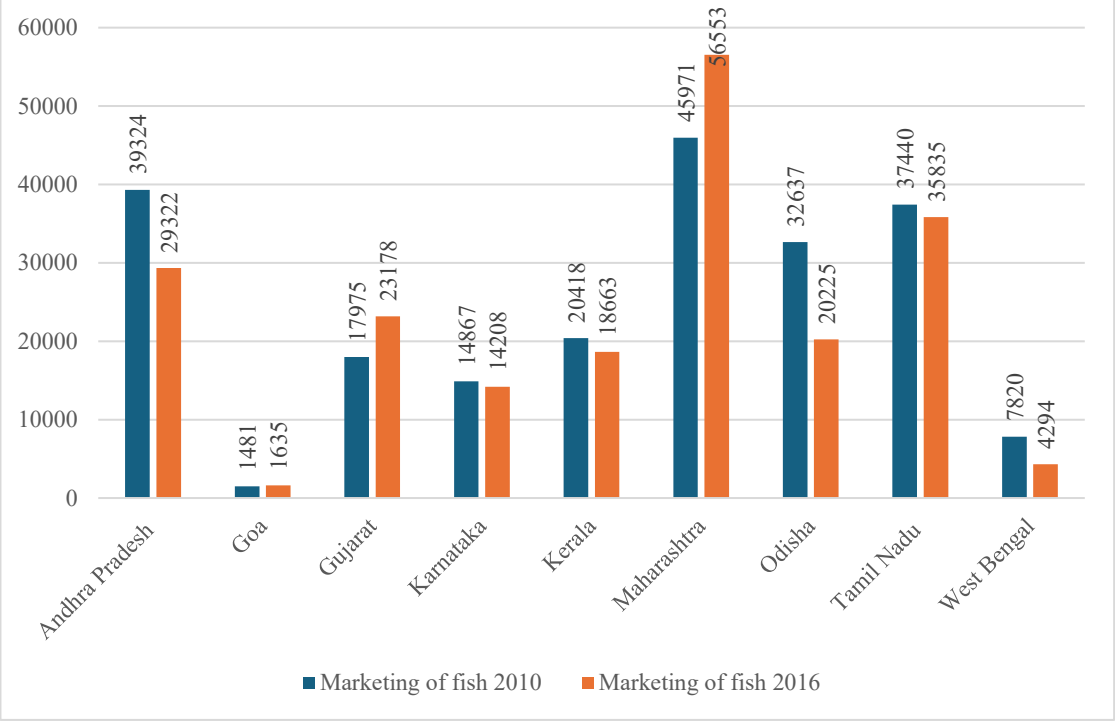


Figure 13: Number of fishers employed in marketing across states in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

Netmaking and repair, which have traditionally provided a significant source of occupation for fishers, have reported substantial declines between 2010 and 2016, as evident in the state-wise figures. Odisha, Maharashtra, Andhra Pradesh, and Gujarat, which had a substantial number of fishers engaged in net making or repair in 2010, witnessed a sharp decline in the activity by 2016 (Figure 14). Similar downward trends were also observed in Kerala and Karnataka, where the number of fishers engaged in net-making and repair decreased significantly. These declines may reflect a shift in fishing practices, including increased mechanization, the use of standardized factory-made nets, and the adoption of modern gear that requires less maintenance. In contrast, West Bengal exhibited relatively stable levels of engagement in this activity across both years, possibly indicating a continued reliance on artisanal gear maintenance practices. Tamil Nadu, meanwhile, recorded a slight increase in the number of fishers engaged in net making and repair, suggesting that local repairs and maintenance of fishing nets may have continued to play a major role in sustaining the

fishery economy there. These trends highlight the complex, regionally diverse dynamics of evolving occupational shifts in India's fisheries sector.

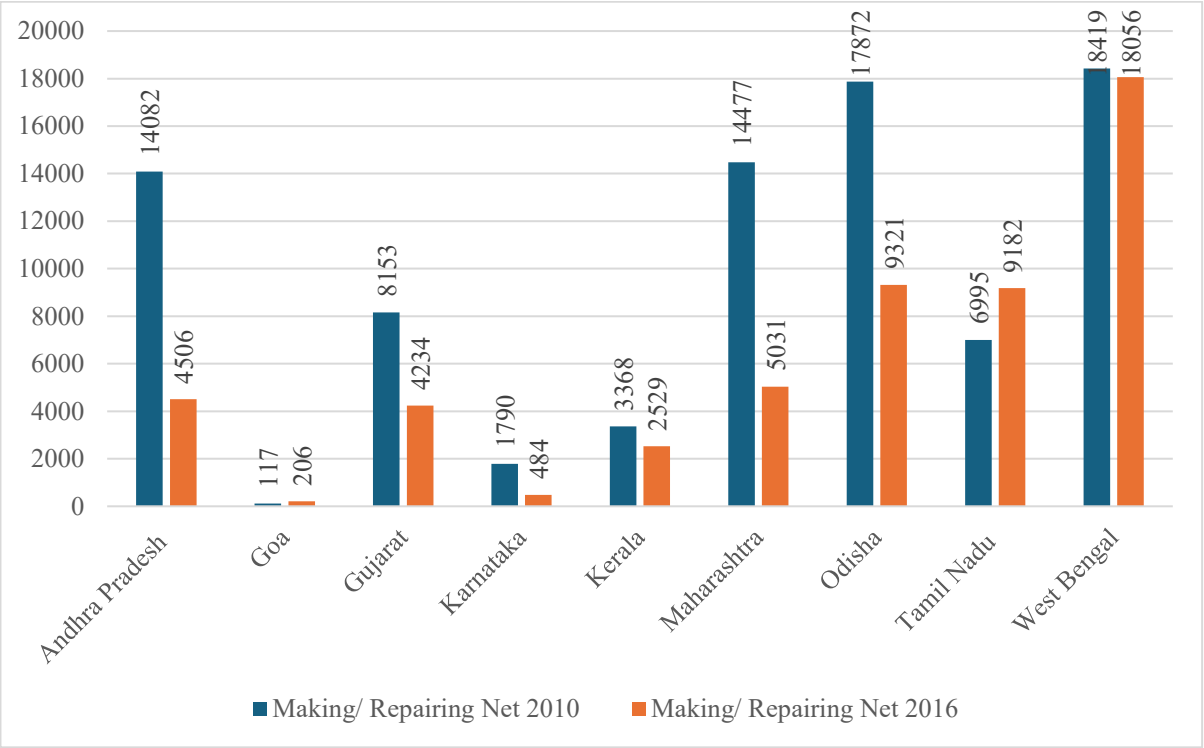


Figure 14: Number of fishers employed in net making and repair across states in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

Curing and processing activities, integral to the fisheries value chain, reveal further shifts in the structure of fisheries employment across states. Andhra Pradesh consistently reported the highest participation in this activity, though numbers declined from about 16,000 in 2010 to 14,000 in 2016 (Figure 15). Most states reported a decline in the number of people engaged in this activity, whereas Kerala reported an increase, possibly indicating the continued importance of traditional fish processing practices in supporting local consumption and export.

A similar sharp increase in the number of people engaged in peeling activities is also observed in Kerala (Figure 16). This surge likely reflects the state's continued emphasis on processing shrimp and prawn for domestic and export markets, supported by strong value chain linkages and local demand. Odisha also recorded a sharp increase in the number of fishers engaged in peeling from 2200 in 2010 to about

16,222 in 2016. Meanwhile, states like Maharashtra reported a decline in the number of persons engaged in peeling, while Tamil Nadu, Andhra Pradesh, Gujarat, and Karnataka reported a modest increase. This shows the growing importance of peeling as a specialized, labor-intensive fishery-related activity in some regions, particularly Kerala and Odisha.

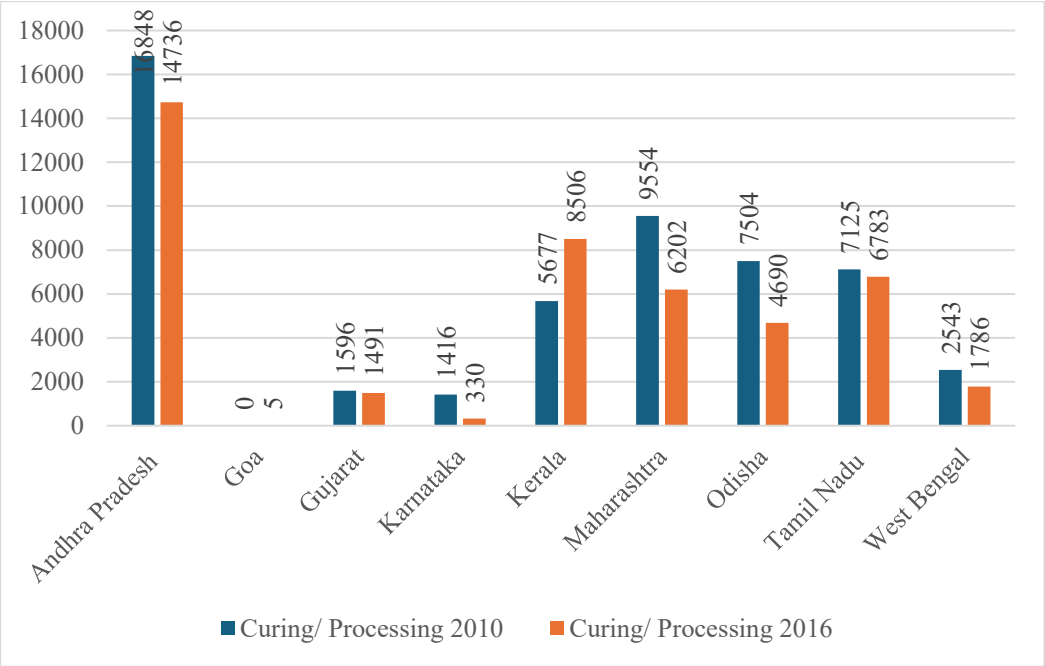


Figure 15: Number of fishers employed in curing or processing across states in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

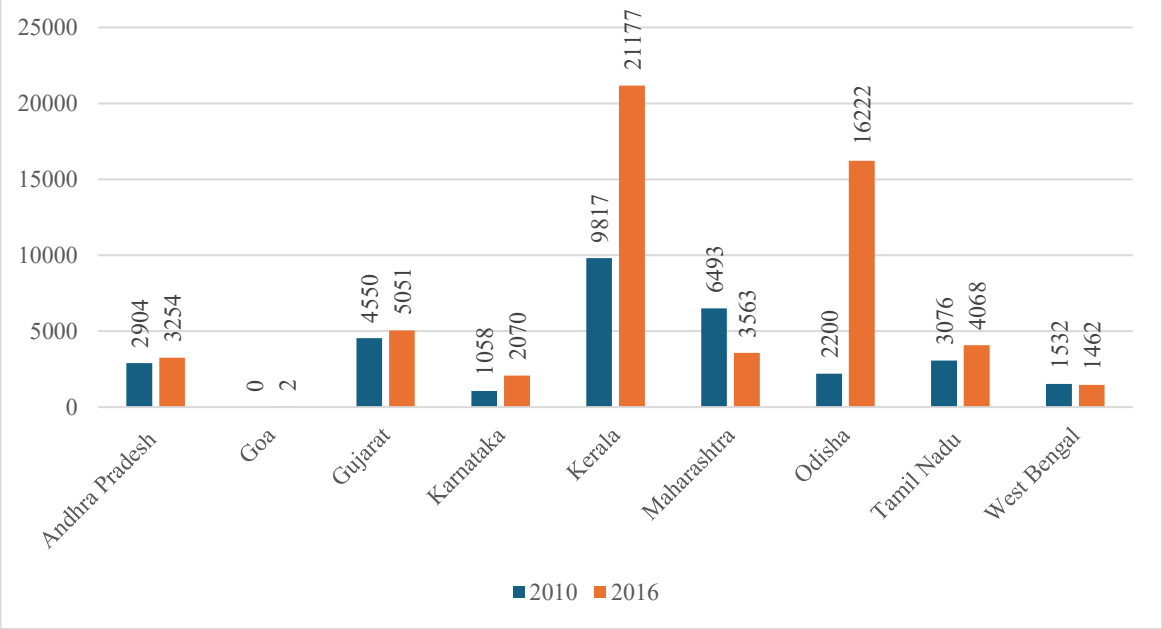


Figure 16: Number of fishers employed in peeling across states in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

A striking feature of the curing/processing and peeling data is the very low participation reported for Gujarat, which contrasts with field observations of the thousands of women and migrant laborers engaged in drying yards, peeling sheds, and industrial processing units along its coast. While the definitional and methodological limitations of the CMFRI census, such as its household-based enumeration leading to exclusion of migrant and factory labor, and reliance on self-reported primary occupations, apply across all maritime states, their impact is more pronounced in Gujarat because of the distinctive nature of fisheries in the state. Gujarat's fisheries sector is highly mechanized or industrialized, export-oriented, and vertically integrated, with a large share of post-harvest work undertaken by migrant laborers and specialized processing units that lie outside fishing households, which CMFRI enumerates. In contrast, in states such as Kerala, Tamil Nadu, Odisha, and Andhra Pradesh, a substantial proportion of curing, drying, and small-scale processing continues to be undertaken within fishing households, making household-based enumeration more reflective of actual participation. CMFRI's occupational category of 'fishers' also only captures those directly involved in harvesting or household-level ancillary work. However, since most active fishers do not engage in vertically integrated processing operations, the

numbers for Gujarat appear low but become plausible when interpreted strictly as household-based fisher participation. These definitional constraints mean that the Gujarat figures, and to a lesser extent those from other states, should be interpreted with caution, with greater emphasis placed on directional trends rather than absolute magnitudes.

Labor in fisheries encompasses a wide range of activities, including direct fishing, shore-based work, and other supporting activities. Before analyzing trends in labor, it is important to note that the CMFRI category of ‘labor’ includes only individuals who belong to marine-fishing households and self-identify labor as their primary occupation. The household-based approach excludes the substantial migrant workforce employed as crew, harbor labor, peeling shed workers, and factory-based processing staff, which constitute a major share of the post-harvest workforce, especially in states like Gujarat, Maharashtra, Andhra Pradesh, and Tamil Nadu. As a result, the labor figures below are best interpreted as shifts within fishing households rather than changes in the total fisheries labor force.

Across most states, the number of fishers reporting labor as their primary occupation declined by more than half between 2010 and 2016, including Andhra Pradesh, Karnataka, Kerala, Odisha, Maharashtra, and West Bengal (Figure 17). Andhra Pradesh, which initially had about 64,141 fishers working as laborers in 2010, saw a significant reduction by half to about 32,489 in 2016. Only Tamil Nadu and Gujarat reported an increase in the number of laborers during this period.

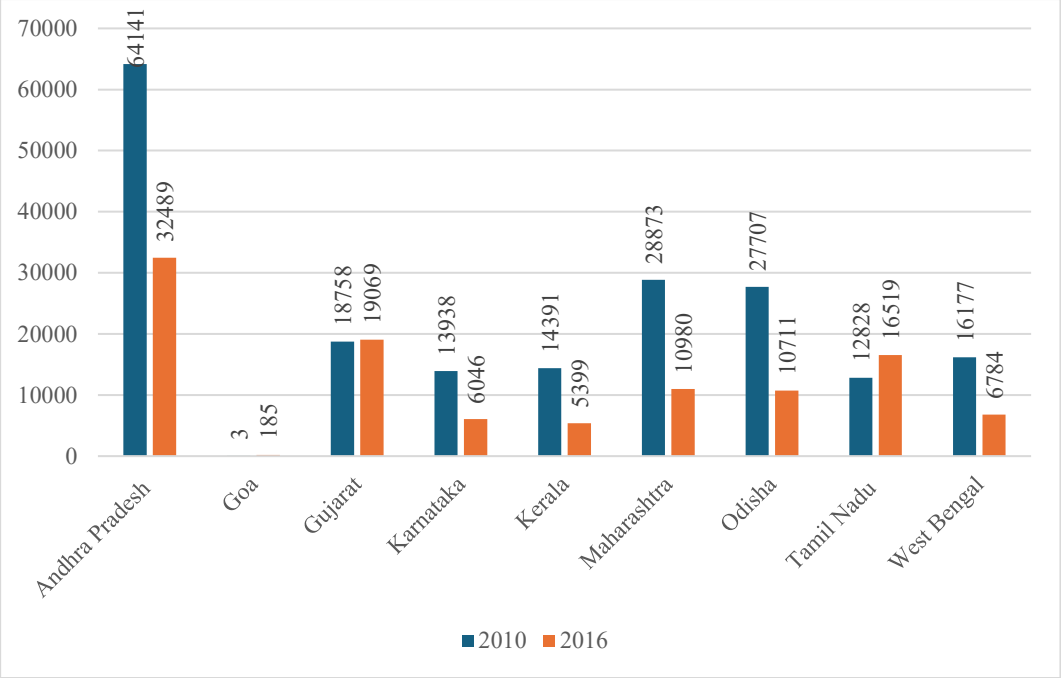


Figure 17: Number of fishers employed as laborers across states in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

The analysis presented above reveals a complex pattern of shifting occupational structures within the fisheries sector. Across states, there is a notable decline in the number of active fishers, as well as those engaged in net making/repair, curing or processing, and general labor, suggesting a gradual erosion of traditional fisheries livelihoods. While mechanization, the emergence of modern value chains, and the availability of alternative employment opportunities are significant drivers of this shift, declining resource availability, worsening ecological conditions, and competing coastal development activities also play a critical role in reshaping livelihood options. These pressures have constrained access to fishing grounds, reduced catch predictability, and intensified economic uncertainty, further pushing households away from traditional occupations. It is also important to note that the analysis does not capture the gender dimension of these occupational changes, a critical aspect given the significant role of women in fisheries processing, marketing, and related activities. Incorporating a gender perspective is crucial for understanding the occupational shifts happening in the sector, which is attempted below.

3.5. Trends in women's participation in marine fisheries

This section analyses changes in the occupation roles of women in India's marine sector in five core categories where women have traditionally been active: marketing, netmaking/repair, curing/processing, peeling, and labor. It is important to note that the CMFRI census captures women's participation only within marine fishing households and records household-based primary and secondary occupations. As such, the data exclude a substantial proportion of women engaged in fisheries, particularly migrant workers, factory-based processing, and peeling jobs, as well as women participating in market-linked value chain activities outside fishing households. Therefore, the trends presented below reflect shifts within household-based fishers' work rather than the full extent of women's labor in the sector, and the absolute magnitudes should be interpreted as conservative measures.

(i) Women's participation in marketing

Women have historically played a crucial role in fish marketing in coastal states, serving as key actors in the value chain and contributing to household incomes and local economies. At the national level, the percentage of women engaged in marketing activities increased slightly from 44.82 per cent in 2010 to 47.05 per cent in 2016 (Figure 18). This marginal rise indicates a continued, and possibly growing, reliance on women in the distribution and retail end of the fisheries value chain, especially in local and informal markets. However, a closer look at state-level data reveals divergent trends. Notable increases in women's participation were observed in Karnataka (from 53.81 per cent to 74.96 per cent), Maharashtra (from 50.23 per cent to 70.59 per cent), Gujarat (from 44.32 per cent to 51.70 per cent), and Andhra Pradesh (from 33.53 per cent to 34.63 per cent).

In contrast, several states recorded significant declines. Goa, which had the highest proportion of women in fish marketing in 2010 at 99.79 per cent, saw this figure drop to 77 per cent in 2016. Similarly, Tamil Nadu declined from 65.28 per cent to 59.89 per cent, Kerala from 44.40 per cent to 30.57 per cent, Odisha from 44.62 per cent to 29.27 per cent, and West Bengal from 13.43 per cent to 9.32 per cent. A recent study by Gopal and Hapke (forthcoming) also observed a similar decline in women's participation in fish marketing in Kerala. These reductions may reflect a complex interplay of factors, including increasing male participation in retail due to

mechanization and modernization, consolidation of market access through private agents, and changes in women's overall work participation. These reductions may reflect both structural shifts, such as an increase in male participation in retailing, consolidation of market access through private agents, and modernization of distribution chains, as well as CMFRI's methodological constraint, which undercounts women engaged in outside household-based fish marketing.

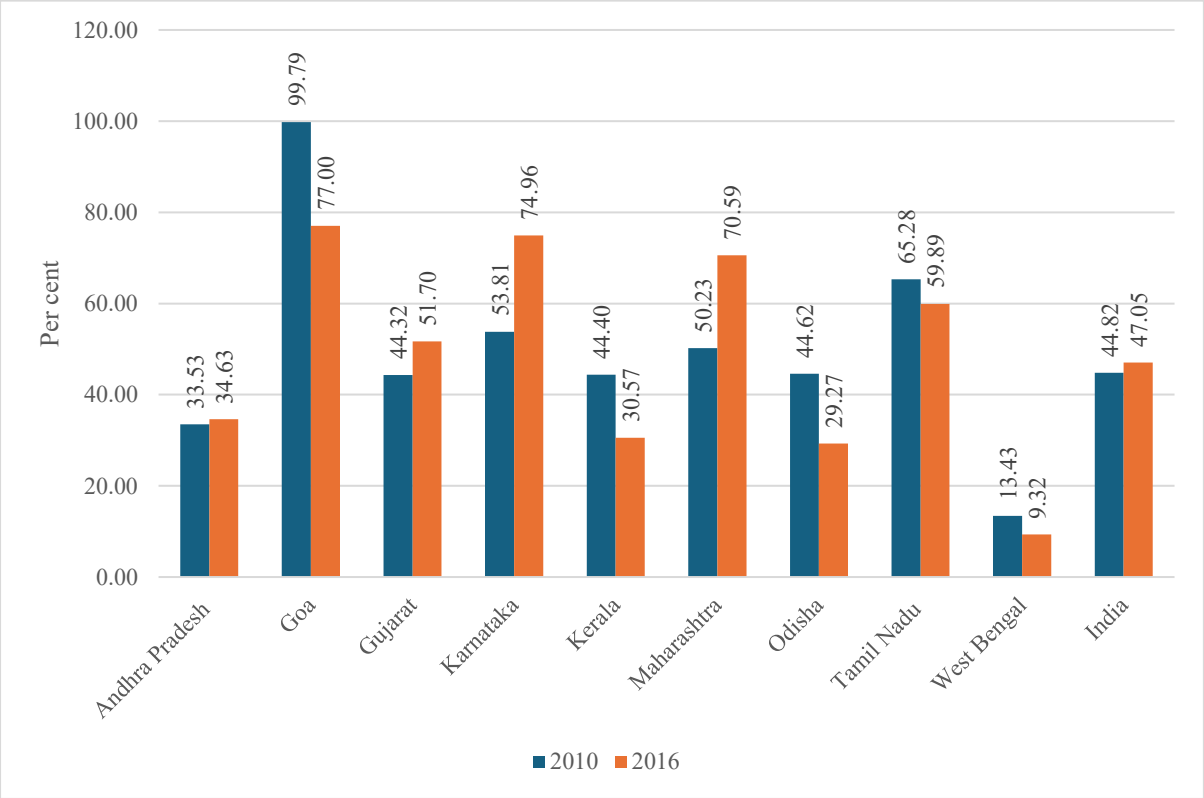


Figure 18: Changes in the percentage of women engaged in marketing across states in India in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

(ii) Women's participation in netmaking / repair

Net making and repair has been traditionally one of the domains within fisheries where women have had a consistent presence, particularly in artisanal and small-scale fishing communities. However, national-level trends from the Marine Fisheries Census show a decline in the percentage of women engaged in this activity. The participation of women declined from 9.41 per cent in 2010 to 7.39 per cent in 2016, indicating a

slow but consistent reduction in women's presence in this specialized support activity (Figure 19). A state-wise analysis shows clear variations in trends. West Bengal stands out as the dominant contributor to women's participation in net making and repair, with figures increasing from 57.64 per cent in 2010 to 66.71 per cent in 2016. Although the absolute number of gillnets and dolnets has declined, the state's fisheries rely heavily on them (CMFRI-FSI-DoF (2020), both of which require frequent, labor-intensive mending. These nets are easily damaged in strong tidal waters and need continuous upkeep, much of which is traditionally carried out by women within fishing households. Since this work takes place at home rather than in commercial facilities, it is more fully captured in the CMFRI's household-based census, resulting in high and rising shares observed in West Bengal. This suggests a strong continuation and possibly intensification of these traditional roles in the region.

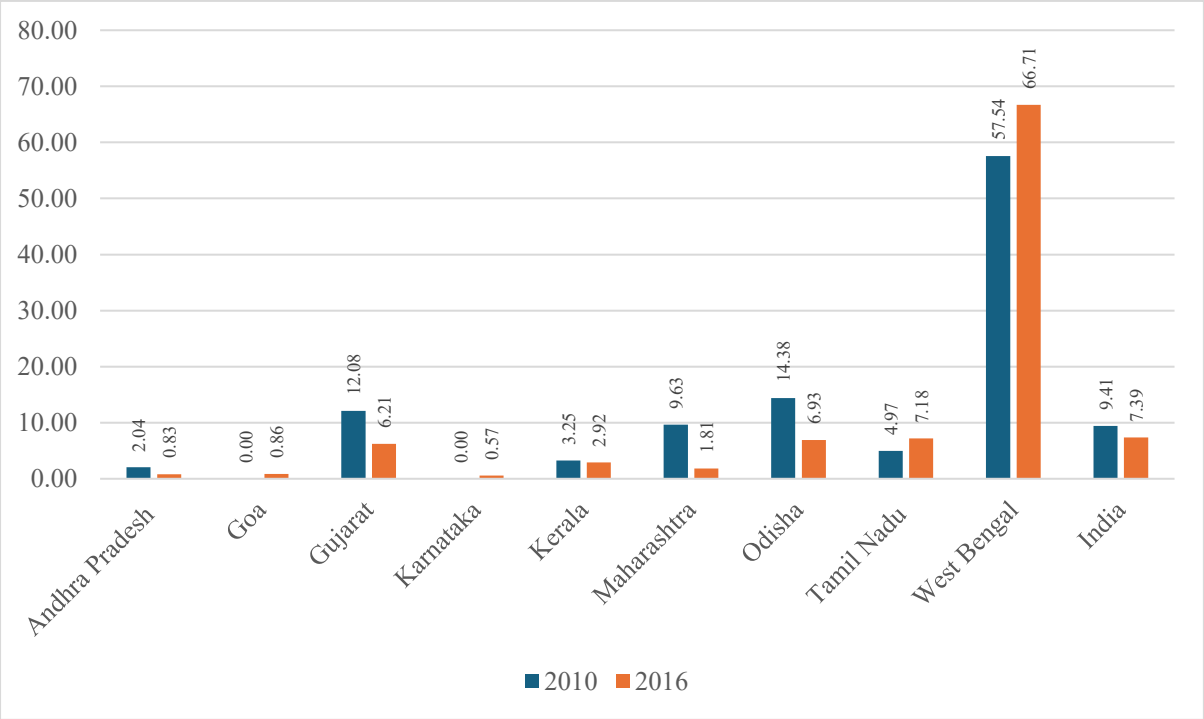


Figure 19: Changes in the percentage of women engaged in net making/ repair across states in India in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

In contrast, several states reported significant declines in women's engagement in these tasks. Gujarat saw a drop from 12.08 per cent to 6.21 per cent, Maharashtra

from 9.63 per cent to 1.81 per cent, and Odisha from 14.38 per cent to 6.93 per cent. Other states, such as Andhra Pradesh (2.04 per cent to 0.83 per cent), Tamil Nadu (4.97 per cent to 7.18 per cent), Kerala (3.25 per cent to 2.92 per cent), and Karnataka, show very low overall percentages with only marginal changes. Tamil Nadu is the only state other than West Bengal that recorded a marginal increase, although its overall share remains modest. These patterns suggest a shift in the structure of fisheries-related work, in which women's participation in net making or repair, once an essential and skilled livelihood activity, is either undervalued or replaced by a more commercially driven, male-dominated system.

(iii) Women's participation in fish curing and processing

Traditionally, women's involvement in curing and processing as post-harvest activities has been significant. It may be noted that women engaged in curing and processing activities in this data set include only those household members directly engaged in curing or processing as home-based or self-employment activities. Women in the household who work in external drying yards, peeling sheds, or processing units are classified under 'labor' and not counted in this category. As a result, the figures reflect household-level enterprise participation rather than the much larger workforce involved in wage-based post-harvest processing. At the national level, the proportion of women engaged in curing and processing remained relatively stable, moving marginally from 11.56 per cent in 2010 to 11.30 per cent in 2016 (Figure 20). However, this national average conceals important state-level differences, reflecting divergent trends in women's roles in the post-harvest activities. It is worth noting that Andhra Pradesh recorded the highest increase in women's participation in curing/processing, rising from 14.93 per cent in 2010 to 19.01 per cent in 2016. Kerala saw a rise, from 13.09 per cent to 15.99 per cent, reinforcing the continued reliance on women in fish preservation and drying activities in these states. Odisha registered a marginal increase from 14.30 per cent to 15.53 per cent, indicating a steady increase in women's engagement in these activities. In Andhra Pradesh, the rise in women's participation in curing and processing reflects contributions from both the non-mechanized and mechanized sectors. While large, mechanized harbors supply substantial quantities of low-value fish suitable for drying, districts such as Srikakulam and Vizianagaram, despite operating at smaller scales, have many non-mechanized units that collectively generate significant volumes for household-based processing.

The modest increase in Kerala and Odisha could be due to the persistence of traditional preservation practices, availability of catch, and continued reliance on women's labor in small-scale, home-based processing activities.

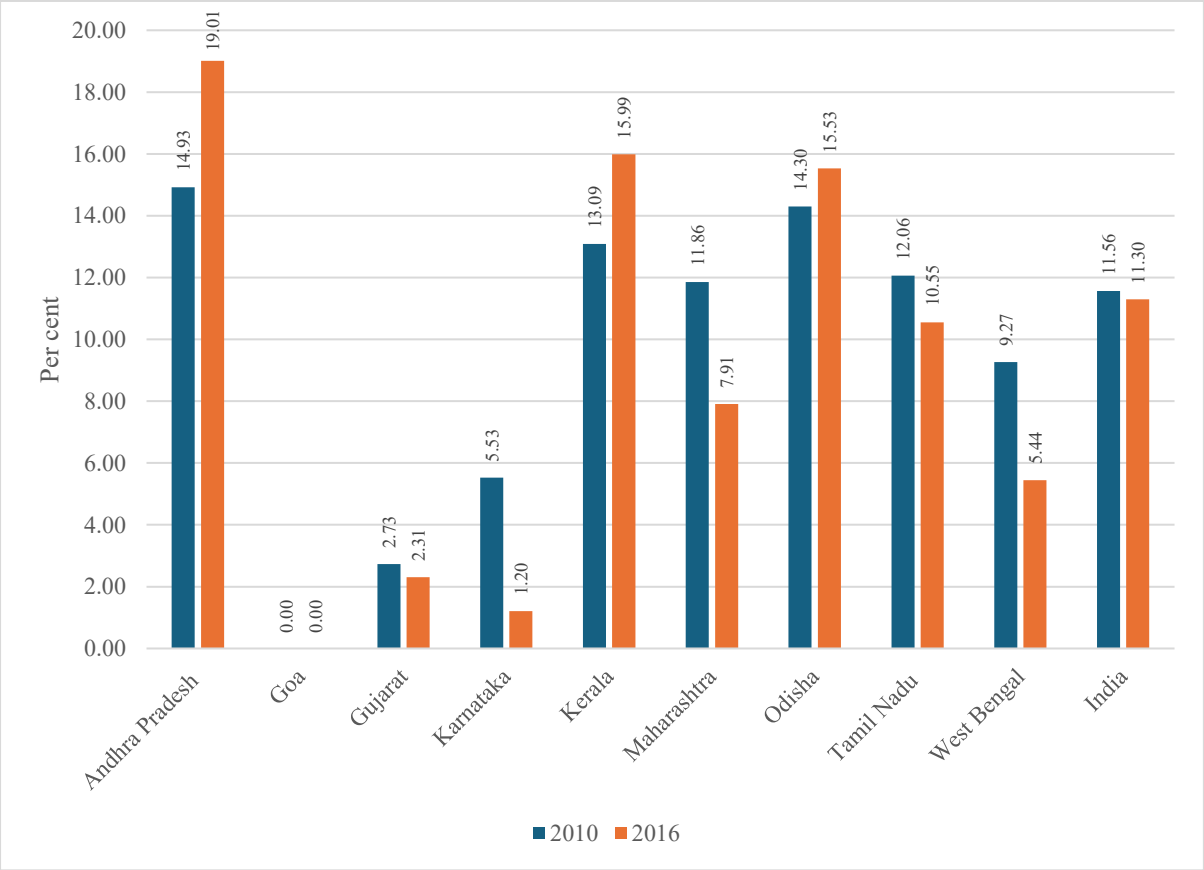


Figure 20: Changes in the percentage of women engaged in curing/processing across states in India in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

In contrast, significant declines were recorded in several states, such as Karnataka, where the share dropped from 5.53 per cent to just 1.20 per cent; Maharashtra, where it fell from 11.86 per cent to 7.91 per cent; and West Bengal, where it fell from 9.27 per cent to 5.44 per cent. These reductions may indicate the displacement of women due to mechanization, increased private sector involvement, or broader shifts in labor-market dynamics. Tamil Nadu also reported a reduction from 12.06 per cent to 10.55 per cent, although it continues to maintain a high absolute share. Gujarat recorded a modest decline from 2.73 per cent to 2.31 per cent with relatively low levels of involvement in both years. Goa reported no women's participation in curing,

processing, or peeling activities in both 2010 and 2016, reflecting negligible overall engagement, including men, in these activities, possibly due to the limited presence of traditional post-harvest practices in the state.

Overall, while states like Andhra Pradesh and Kerala show resilience and even growth in women's engagement in curing and processing, others indicate displacement or diminishing roles. These changes may be attributed to shifts in processing technologies, value chain formalization, and emerging market standards that increasingly favor commercial processing facilities over small-scale, household-based production.

(iv) Women's participation in fish peeling

Peeling, primarily of shrimp and prawns, is a labor-intensive activity in which women are engaged. Our data indicate a modest increase in women's engagement in peeling activities nationally, rising from 6.97 per cent in 2010 to 11.30 per cent in 2016 (Figure 21). This trend highlights the growing demand for skilled female labor in post-harvest seafood processing, especially in regions where peeling is linked to export-oriented value chains.

Kerala has recorded a significant increase in women's involvement, jumping from 25.96 per cent to 40.92 per cent between the two census years. The increase likely corresponds to Kerala's well-developed shrimp export infrastructure and peeling units concentrated in some of the coastal districts like Alappuzha, Kochi, etc. Odisha also reported a sharp increase from 3.42 per cent to 10.07 per cent, indicating greater women's engagement in this activity. Tamil Nadu, Andhra Pradesh, Gujarat, and Karnataka reported more modest increases, while West Bengal remained stable (Figure 21). In contrast, Maharashtra recorded a slight decline from 7.83 per cent in 2010 to 4.40 per cent in 2016.

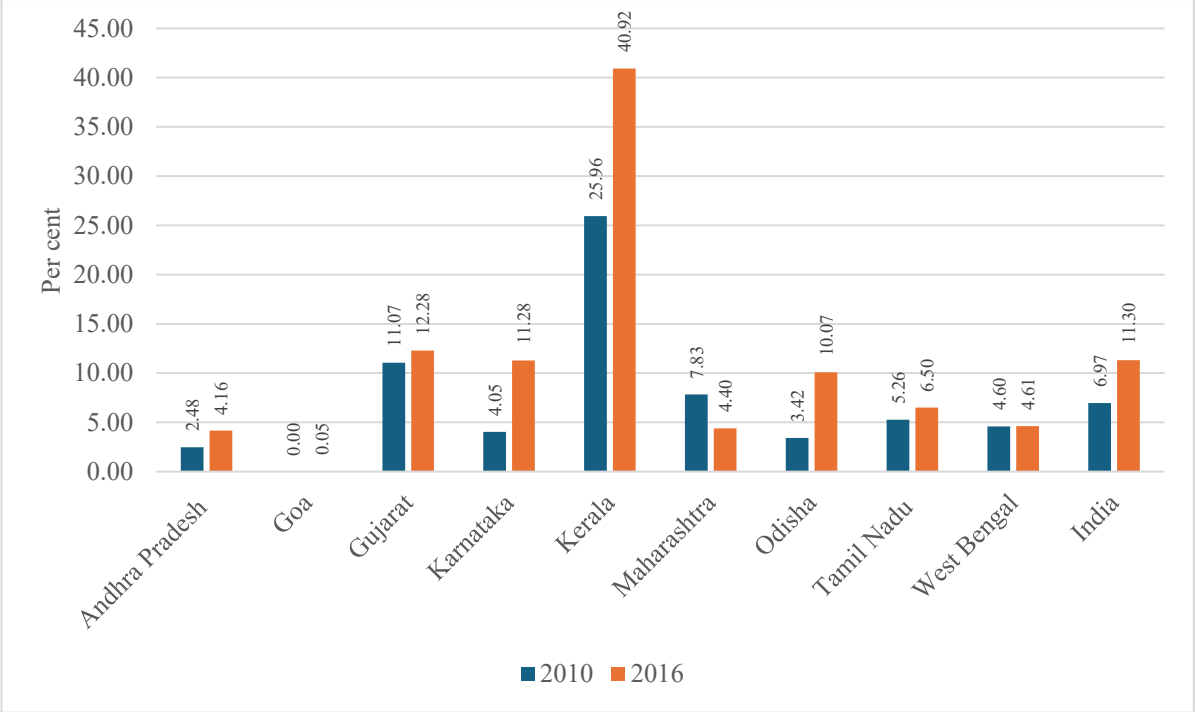


Figure 21: Changes in the percentage of women engaged in peeling across states in India in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

(v) Women's participation as laborers in marine fisheries

The percentage of women reported as laborers declined considerably between 2010 and 2016. At the national level, women's participation in these roles dropped from 24.77 per cent to 16.19 per cent, reflecting a significant reduction of over 8 percentage points (Figure 22).

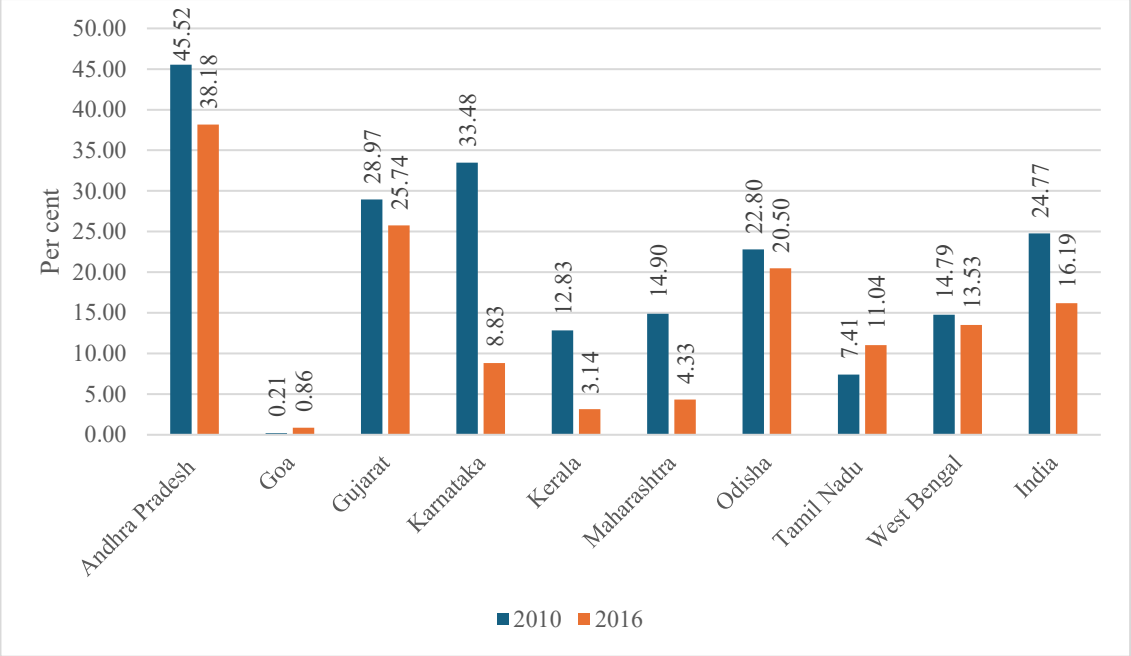


Figure 22: Changes in the percentage of women engaged as laborers across states in India in 2010 and 2016

Source: CMFRI (2012); CMFRI-DoF (2020)

State-level patterns reveal that this decline is widespread. Andhra Pradesh, which had the highest share of women at 45.52 per cent in 2010, fell to 38.18 per cent in 2016, though it still retains the highest proportional representation (Figure 22). Karnataka saw a sharp decline from 33.48 per cent to 8.63 per cent, marking one of the most significant reductions in women's labor force engagement within fisheries. States like Gujarat, Odisha, and West Bengal also saw a decline in women's participation in fisheries as laborers. In Maharashtra, women's participation fell from 14.90 per cent to 4.33 per cent, whereas a similar decline was observed in Kerala from 12.83 per cent to 3.14 per cent. Only Andhra Pradesh, Gujarat, and Odisha maintained relatively high shares despite declines, suggesting that in these states, women continue to play a significant role in fisheries labor, perhaps due to the persistence of traditional labor arrangements or the structure of local value chains. Overall, this declining trend points towards increasing male dominance in labor roles and the crowding out of women from traditional fishing-related occupations. It also raises concerns about the invisibility of women's labor, particularly when it is casual, unpaid, or seasonal, and about their contributions to the fisheries sector (Harper et al., 2013; Chambon et al., 2024).

3.6 Ownership of crafts and gears

There are three predominant types of fishing crafts used in Indian fisheries. These include:

1. Mechanized crafts, which have engines permanently fitted to the hull. These use machine power for propulsion or for fishing operations, such as casting and pulling the net, operating lines, etc. These include trawlers, gillnetters, dolnetters, liners, ring seiners, and carrier boats.
2. Motorized crafts, which have engines fitted temporarily outside the craft. These engines are used for propulsion, not for fishing operations. There are motorized crafts with both inboard and outboard fitted engines. Outboard crafts include catamaran, dugout canoe, plank-built boat, plywood boat, fiber-glass boat, ferro-cement boat, carrier boat, and *teppa* (small traditional plank-built canoe), whereas inboard types include wooden-built, iron-built, and wood-fiber-type boats.
3. Non-motorized crafts, which do not use any engine for propulsion or fishing operations. Dugout canoe, catamaran, plank-built boat, plywood boat, fiberglass boat, ferro cement boat, carrier boat, and *teppa* (CMFRI, 2012).

Understanding the distribution of these fishing crafts offers valuable insights into the broader shifts in fishing practices and technology adoption. According to the Marine Fisheries Census, the total number of fishing crafts declined from 194,490 to 166,333 between 2010 and 2016. This reduction was accompanied by a marked shift in the composition of craft types.

In 2010, mechanized (37 per cent) and motorized crafts (37 per cent) accounted for 74 per cent of the total fishing crafts, while non-motorized crafts accounted for the remaining 26 per cent. By 2016, this distribution had shifted significantly: the share of mechanized crafts declined to 26 per cent, and non-motorized crafts dropped further to just 15 per cent. In contrast, motorized crafts saw a sharp increase, constituting nearly 59 per cent of the total fishing crafts (Figure 23).

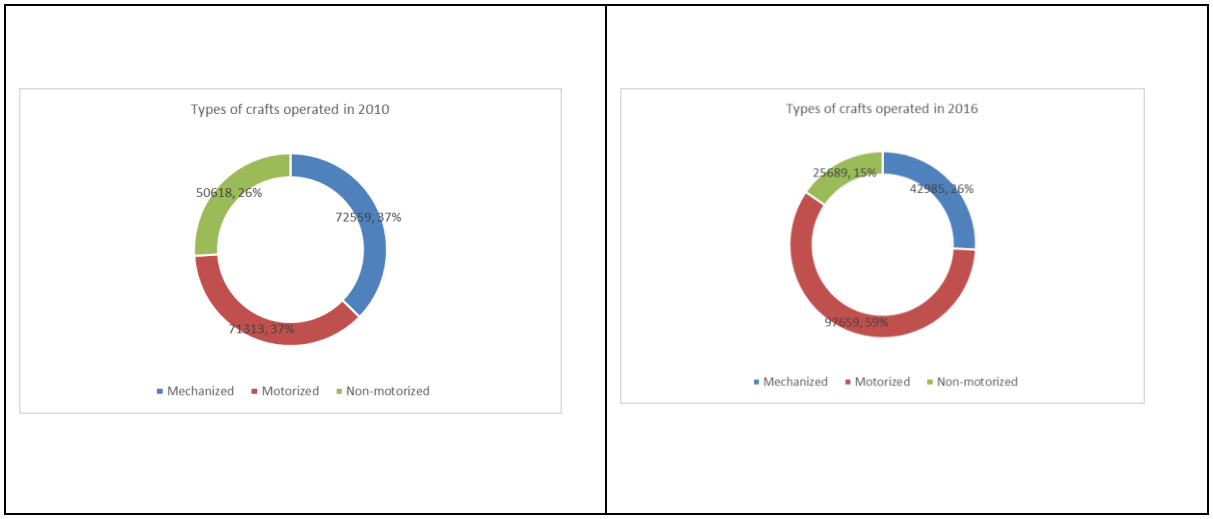


Figure 23: Type of fishing crafts owned by the fishers in India

Source: CMFRI (2012); CMFRI-DoF (2020)

The state-wise distribution of mechanized, motorized, and non-motorized boats in India between 2010 and 2016 highlights important structural changes in the marine fisheries sector across states. The data indicate a decline in the number of mechanized boats across major fishing states (Figure 24). For instance, Gujarat, Maharashtra, Tamil Nadu, and West Bengal, which had large, mechanized fleets in 2010, registered significant reductions by 2016. Gujarat saw a drop from 18,278 to 14,061 mechanized boats, Maharashtra from 13,016 to 5,867, and Tamil Nadu from 10,692 to 4,014. Only Karnataka showed a marginal increase in the number of mechanized boats.

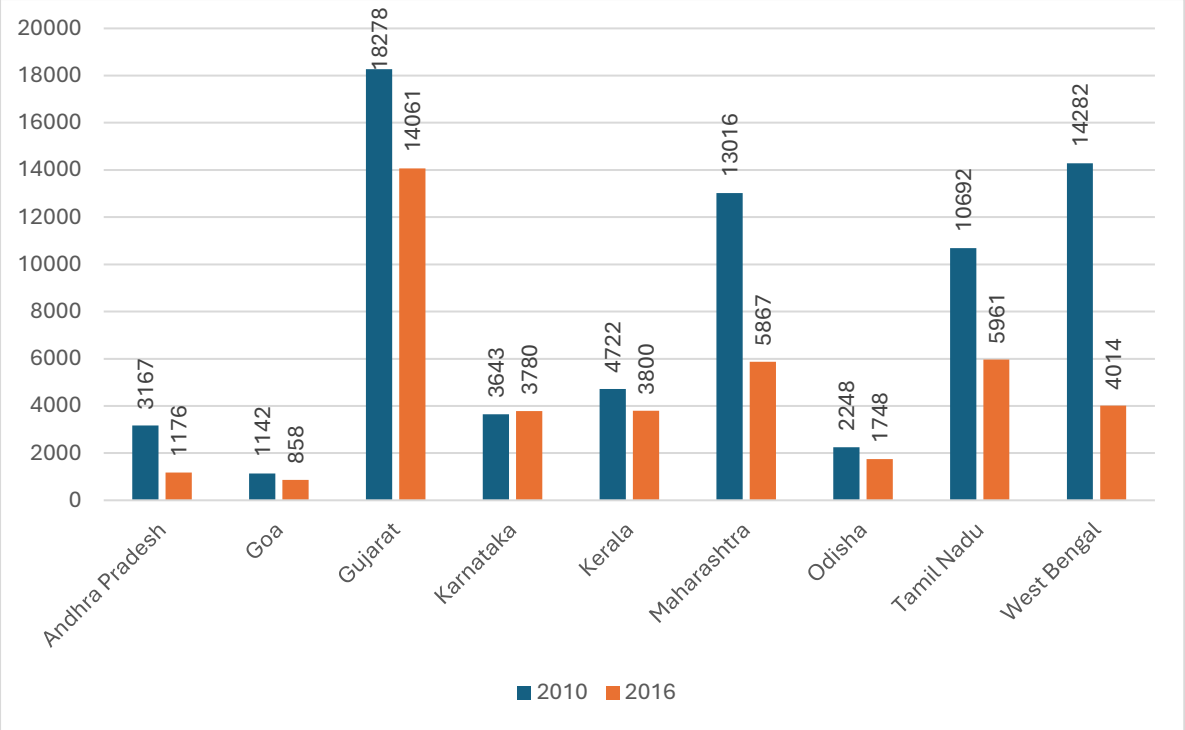


Figure 24: Number of mechanized crafts owned by the fishers in India

Source: CMFRI (2012); CMFRI-DoF (2020)

Despite the reduced number of mechanized vessels, they continue to dominate marine fish production. As per FRAEED (CMFRI, 2023), mechanized crafts contributed approximately 82 per cent of the total marine landings, followed by 17 per cent from motorized crafts and a negligible share from non-motorized crafts in 2022. This divergence between fleet composition and production contribution reflects the intensive fishing capabilities and extended range of mechanized vessels and highlights a growing concentration of catch and economic returns in the mechanized sector. This, in turn, raises concerns about the sustainability of the resource system, equity in resource access, and the long-term viability of small-scale fisheries.

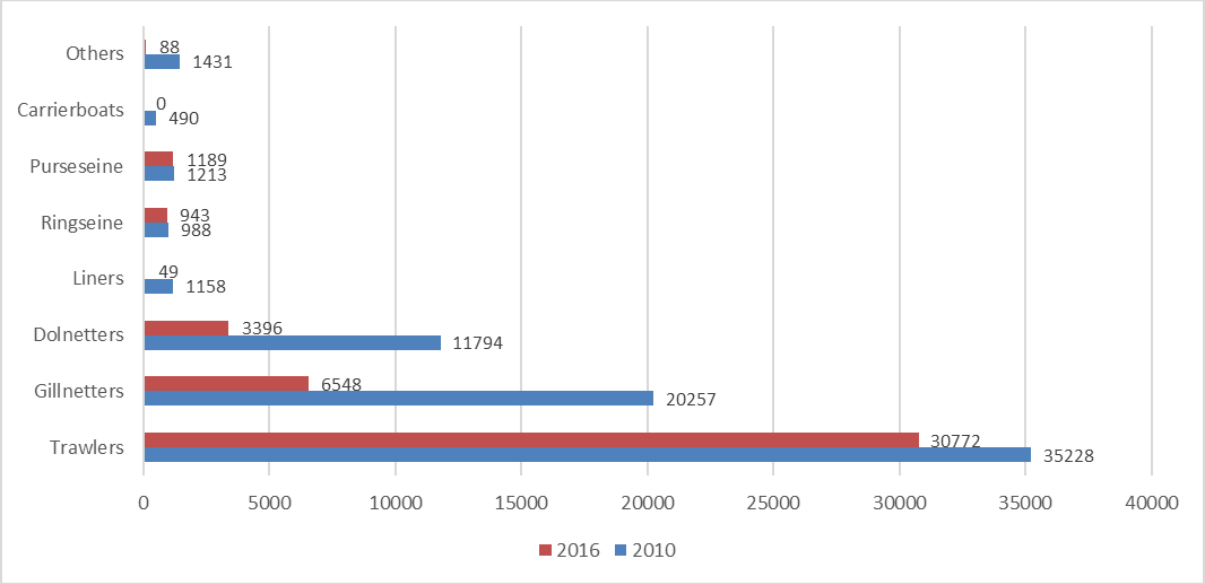


Figure 25: Number of different types of mechanized boats in India

Source: CMFRI (2012); CMFRI-DoF (2020)

A look at the types of mechanized vessels used in India shows that trawlers remain the dominant type of mechanized gear used by fishers, though their numbers decreased slightly from 35,228 in 2010 to 30,772 in 2016 (Figure 25). However, a sharp decline in the gillnetters and dolnetters is observed. The sharp decline in gillnetters at the all-India level from 20,257 to 6,548 also corresponds with state-level declines (Figure 26), possibly driven by stricter enforcement of mesh size regulations to curb bycatch of juvenile pelagic species. Dol netters (stationary bag nets), traditionally important in Maharashtra and Gujarat for targeting Bombay duck and ribbonfish, saw a marked decrease nationwide from 11,794 to 3,396, suggesting displacement due to trawler expansion or area closures intended to protect nursery habitats[4]. Meanwhile, purse seiners, ring seiners, and liners also registered declines, aligning with regulatory measures aimed at curbing encroachment into artisanal fishing zones.

4 https://www.cmfri.org.in/uploads/files/Attachment%201.%20Major%20Research%20Achievemnt_Mumbai.pdf

Although some gillnetters and dolnetters were found to be upgraded or reclassified as trawlers, a much larger number of trawlers seem to have exited the fishery, leading to a net decline across all three categories. It may be noted that across India's maritime states, except Gujarat[5], fisheries are governed by state-specific Marine Fishing Regulation Acts that define spatial fishing zones, closed seasons, mesh-size standards, and licensing conditions. These regulatory frameworks may have reduced the operational viability of traditional gear types such as gillnetters and dolnetters, especially in nearshore waters where most restrictions apply. Although the specific regulations and their enforcement vary across states and over time, the overall regulatory regime appears to have increased pressure on these gear types, contributing to their decline.

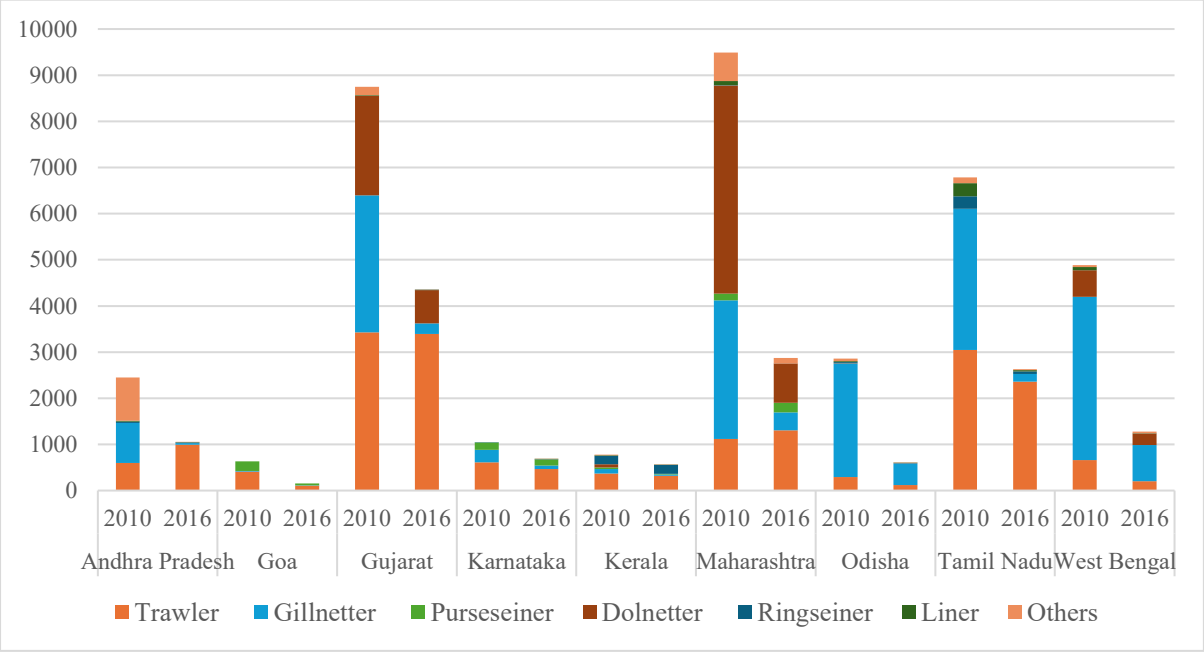


Figure 26: Number of different types of mechanized boats owned by fishers in India

Source: CMFRI (2012); CMFRI-DoF (2020)

[5] Gujarat fisheries are governed according to the Gujarat Fisheries Act, 2003, which was further strengthened Gujarat Fisheries (Amendment) Act, 2020.

The decline of gillnetters and dolnetters observed in the CMFRI data is broadly consistent with field observations. Many fishers note that these gear types have become less viable due to rising operational costs, declining catches of target species, and increasing gear damage from mechanized fleets operating close to shore. Field accounts also indicate that the decline in gillnetters is partly linked to increasing competition from purse seiners, which can harvest entire pelagic shoals, such as sardine, mackerel, before gillnetters reach the ground. This reduces catch viability, creates frequent gear conflicts, making gillnet operations unviable. Scientific assessments echo these concerns: purse seining, introduced along the southwest coast in the late 1950s as a highly efficient method for harvesting shoaling species, is capable of rapidly removing large volumes of pelagic fish and has been associated with stock depletion in several parts of the world, including Californian sardine fishery and the herring and mackerel fisheries of the North Sea (Praveen and Meenakumari, 2016; Silas, et al., 1980). In several locations, gillnetters have shifted to multi-gear operations or joined trawlers as crew, and dolnetters report changes in tidal patterns and coastal development affecting their fixed-net operations. At the same time, vessels that once operated exclusively have been modernized or re-registered as trawlers or liners, resulting in a numerical decline of the gillnetter category. The decline in gillnetters reflects both increased competition from purse seiners and the modernization or reclassification of many boats into trawl or multi-gear categories. In contrast, the reduction in dolnetters is more closely tied to environmental changes in marine and coastal areas, spatial conflicts with mechanized boats, and regulatory restrictions on fixed-net operations rather than vessel reclassification.

The distribution of motorized fishing boats across India between 2010 and 2016 shows a strong overall trend of rapid motorization, with most states showing substantial growth in these crafts (Figure 27). States such as Andhra Pradesh (10,737 to 12,078), Gujarat (8,238 to 12,825), Kerala (11,175 to 13,686), Maharashtra (1,563 to 6,788), Odisha (3,922 to 5,678), Tamil Nadu (24,942 to 31,279), and West Bengal (6,564 in 2016) show marked increases, reflecting a widespread shift from traditional non-motorized crafts to engine fitted boats. This expansion indicates rising fishing effort in nearshore waters, greater reliance on faster, more versatile crafts, and competitive pressures from the mechanized fleet. In contrast, states like Goa (1,297 to 942) and

Karnataka (7,518 to 5,879) show declines in motorized boats, which may be linked to local factors such as coastal development pressures or a shift towards mechanized or alternative livelihoods. Overall, the pattern points to a structural change, characterized primarily by intensification of motorized artisanal fishing across most of India's coastline.

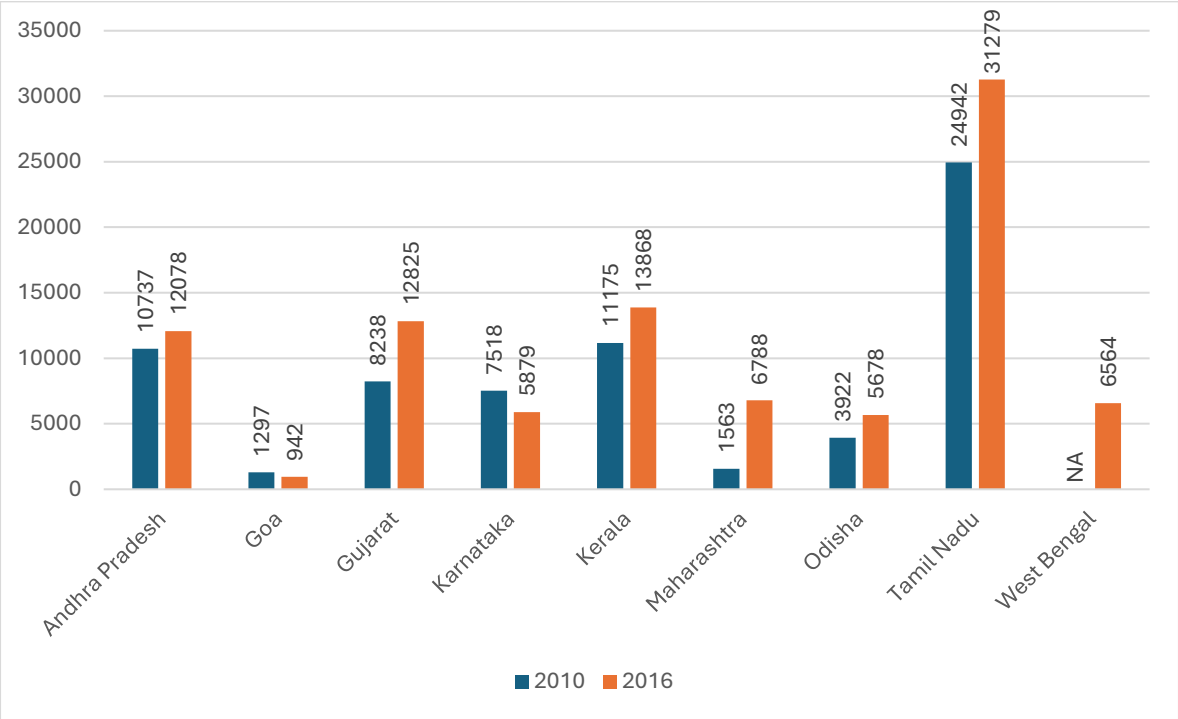


Figure 27: Number of motorized crafts owned by the fishers in India

Source: CMFRI (2012); CMFRI-DoF (2020)

The 2016 distribution of motorized fishing boats shows a strong predominance of outboard-engine craft across most maritime states. Out of the 97,659 motorized boats reported in India in 2016, about 66,250 (67.8 per cent) were outboard, and 31,409 (32.2 per cent) were inboard motorized boats (CMFRI-DoF, 2020). While detailed information on the number of inboard and outboard motorized boats in 2010 was not separately available, a total of 71,313 motorized boats were reported that year. Inboard-engine boats are generally more capital-intensive, larger, and operate in offshore waters for several days, targeting demersal and pelagic species such as prawns, cuttlefish, and tuna. Outboard-engine boats are smaller, used for nearshore fishing trips, and focus on species such as sardines, mackerel, and anchovies.

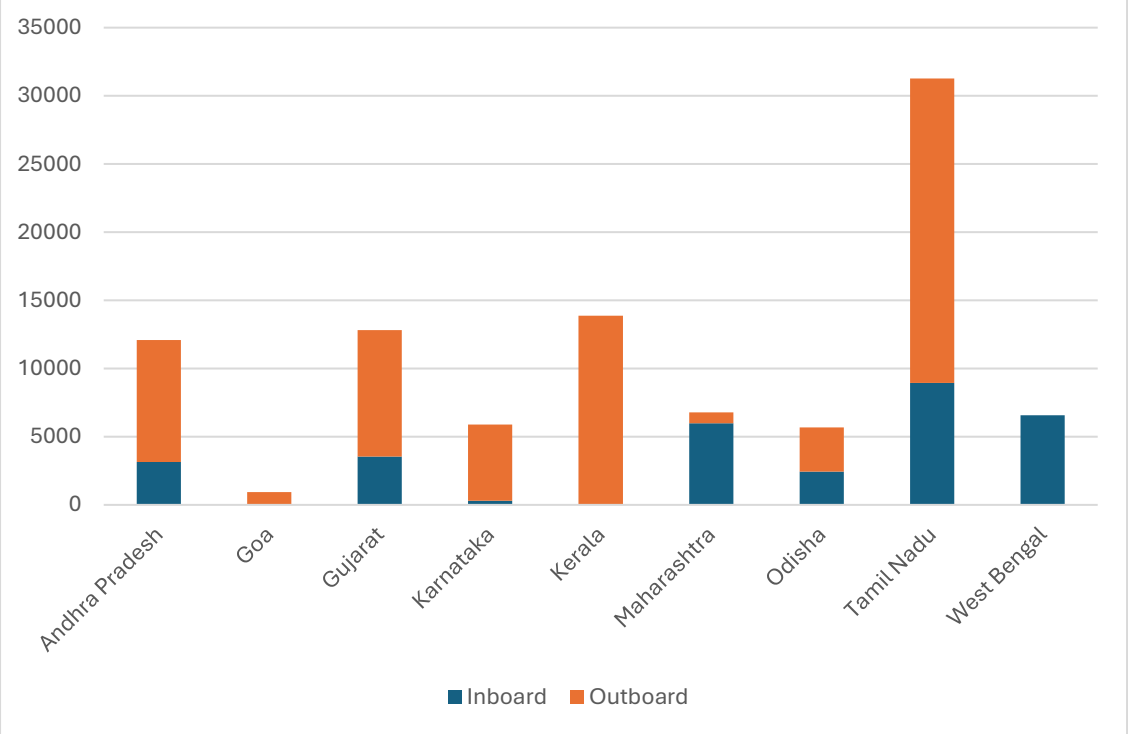


Figure 28: Number of different types of motorized boats owned by fishers across states in India

Source: CMFRI (2012); CMFRI-DoF (2020)

Figure 28 shows the state-wise distribution of inboard and outboard motorized boats. States such as Tamil Nadu, Kerala, Andhra Pradesh, and Gujarat report a higher proportion of outboard-engine boats, with Tamil Nadu standing out as the country's largest motorized fleet. In contrast, inboard-engine boats, which generally indicate higher investment and greater operational range, are concentrated in a few states, most notably, in Maharashtra, Tamil Nadu, West Bengal, Gujarat, Andhra Pradesh, and Odisha. The dominance of outboard-engine boats in many states suggests that nearshore, day-trip fishing continues to be central to livelihoods, while the presence of inboard-engine boats in states such as Tamil Nadu, West Bengal, Odisha, Andhra Pradesh, Maharashtra, and Gujarat indicates a parallel trend towards semi-mechanized or longer-distance operations within the motorized sector. Overall, the figure highlights a dual structure within the motorized sector: an expansive, outboard-dominated fleet alongside a smaller but strategically important inboard segment,

shaped by differences in capital investment, ecological conditions, and fishing practices across states.

To better understand these contrasts, it is useful to analyze the specific types of inboard- and outboard-engine-powered craft, as their materials and engine systems reveal important differences in operational capacity and fishing practices.

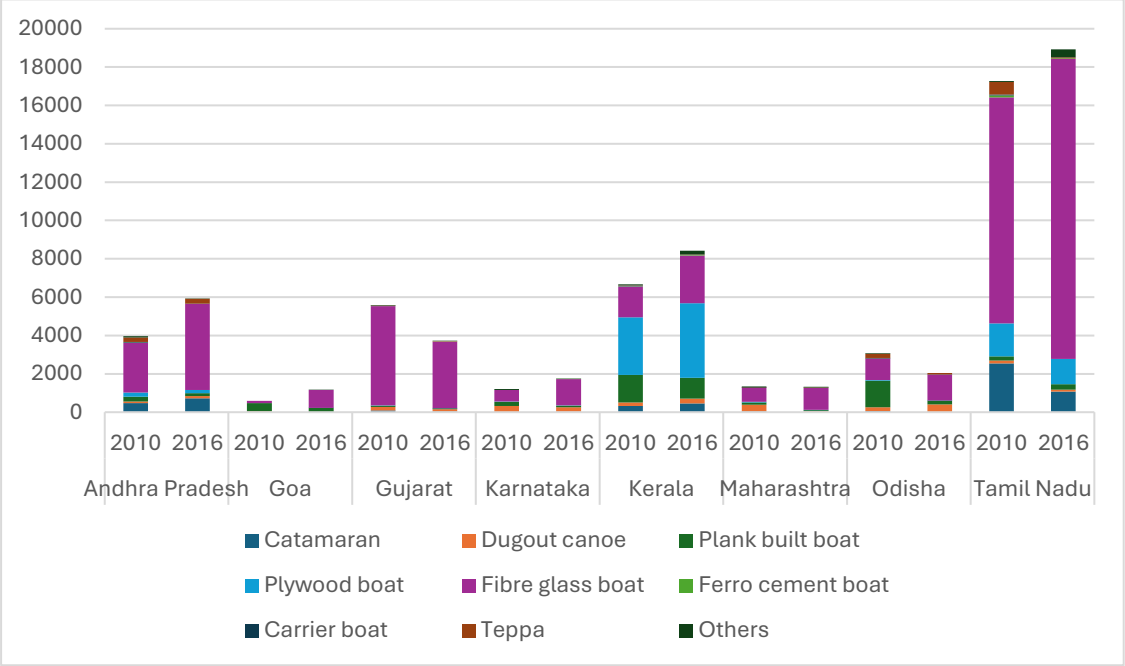


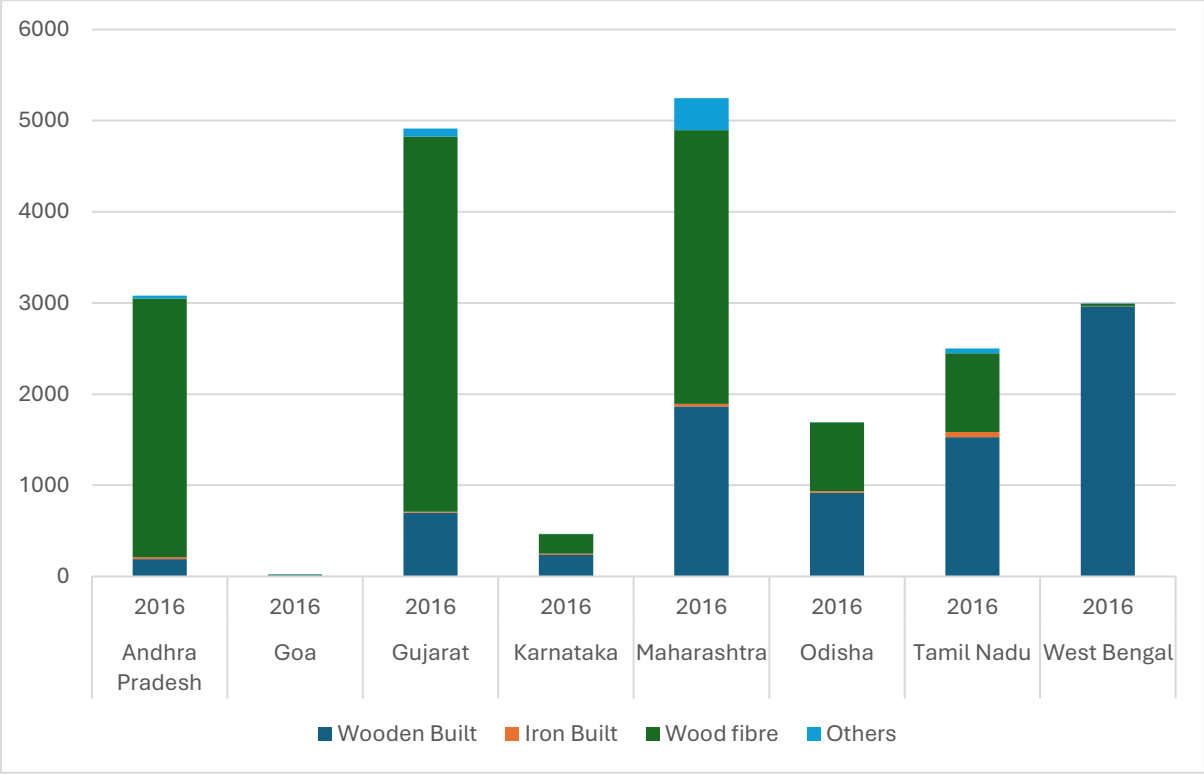
Figure 29: Number of different types of outboard engine boats owned by fishers in India

Source: CMFRI (2012); CMFRI-DoF (2020)

Figure 29 shows a clear shift in the composition of outboard engine-motorized boats across states between 2010 and 2016, reflecting the dominance of fiberglass and plywood boats. The increase in fiberglass boats fitted with outboard engines is most pronounced in Tamil Nadu, Kerala, and Andhra Pradesh, indicating rapid motorization and greater dependence on capital-intensive artisanal fishing. Kerala also shows a marked increase in plywood boats, highlighting a growing preference for boats that offer lower costs and higher capacity. Fibreglass boats, which are relatively more expensive, are suitable for gillnetting, and plywood boats, comprising both decked and open boats, are suitable for gillnetting, ring seine, and hook-and-line operations (Edwin, 2008). States such as Goa, Maharashtra, and Karnataka show only modest

growth. Across states, traditional crafts such as dugout canoes and plank-built wooden boats either stagnate or decline, signaling a gradual phase-out of low-investment artisanal fishing.

While the CMFRI census did not report any inboard-engine boats in the 2010 census due to either their negligible presence or lack of enumeration, by 2016, inboard engines appeared prominently in several states. It clearly reflects a structural shift towards larger, more powerful fishing craft. Figure 30 shows that Maharashtra and Gujarat have the highest number of inboard engine boats, dominated by wood-fibre boats, followed by a smaller but notable share of wooden-built boats. This pattern seems to suggest intensification within the motorized fleet, with inboard boats becoming larger and more powerful. Andhra Pradesh, Tamil Nadu, and West Bengal also record substantial growth in inboard-engine craft, reflecting higher capital investment and a transition toward motorized boats designed for longer trips and higher harvest capacity.



Note: No outboard engine boats were reported in Kerala

Figure 30: Number of different types of inboard engine boats owned by fishers in India

Source: CMFRI (2012); CMFRI-DoF (2020)

Meanwhile, the data show a pronounced nationwide decline in non-motorized boats between 2010 and 2016, reflecting a steady erosion of traditional artisanal fishing practices across coastal India. The sharpest reductions occurred in Andhra Pradesh (from 17,837 to 6,965), Tamil Nadu (from 10,436 to 4616), Kerala (from 5,884 to 4,016), and especially West Bengal, where numbers fell dramatically from 3,066 to just 476 (Figure 31). These states relied heavily on non-motorized boats, but rapid motorization, declining nearshore resources, competition from mechanized crafts, and shrinking artisanal fishing spaces seem to have accelerated the shift to motorized boats. Moderate declines are also visible in Gujarat, Odisha, and Karnataka, while Goa continues to have a very small non-motorized fleet. The trends indicate a structural shift away from labor-intensive, non-motorized fishing toward motorized and mechanized fishing. This trend seems to be driven by economic pressures, changing labor availability, and ecological factors that are reducing the viability of nearshore fishing for livelihood security.

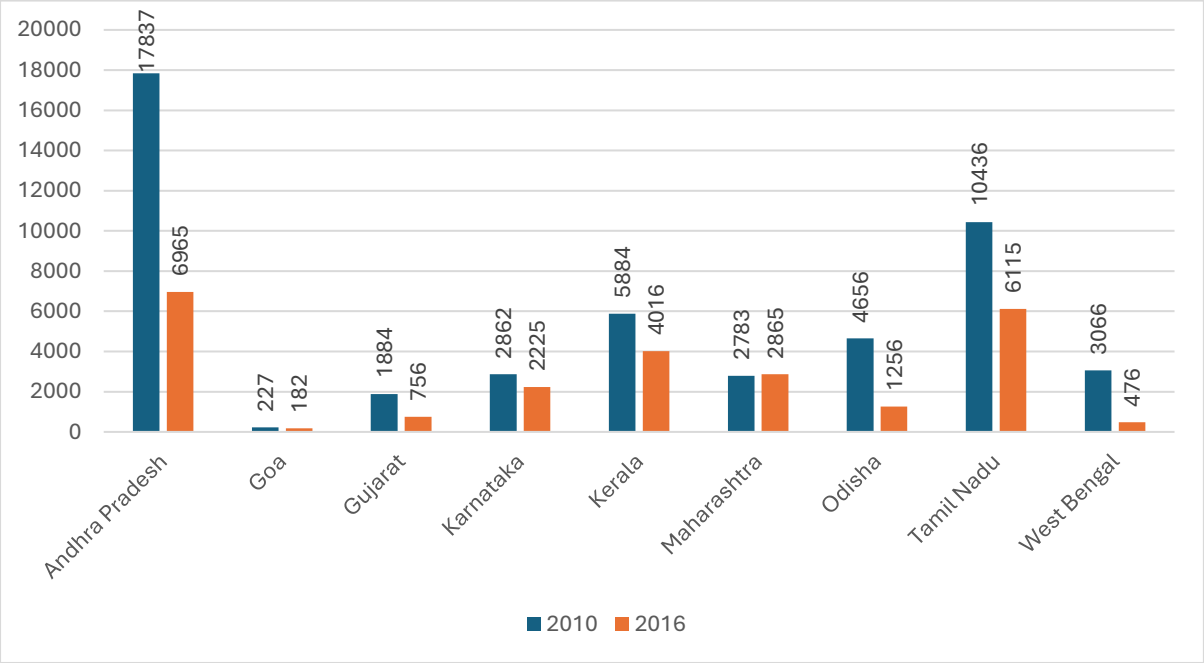
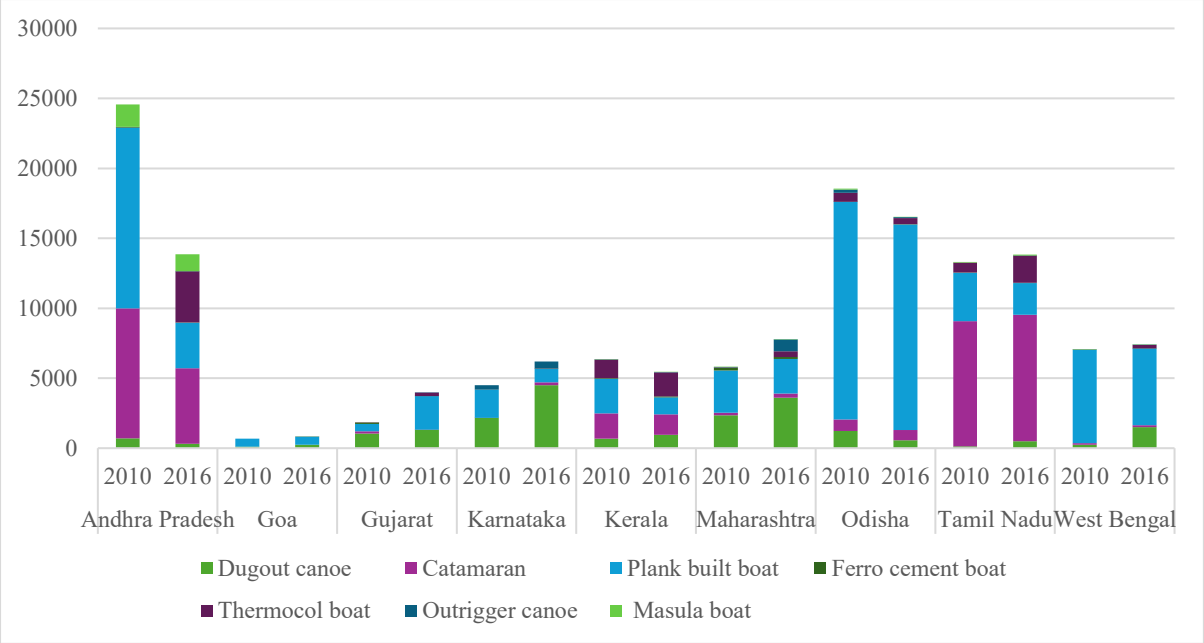


Figure 31: Number of non-motorized crafts owned by the fishers in India

Source: CMFRI (2012); CMFRI-DoF (2020)

Across states, the highest number of non-motorized boats was reported from Andhra Pradesh, Odisha, and Tamil Nadu in 2010 (Figure 31). The predominant types of non-motorized boats operated varied across states. In Andhra Pradesh and Tamil Nadu, catamarans were dominant. However, a considerable presence of plank-built boats was also observed in these states. In Kerala, both plank-built boats, catamarans, and thermocol boats were common, while in Karnataka, Maharashtra, and Gujarat, it was dugout canoes and plank-built boats. This distribution reflects regional preferences and local fishery practices.



Note: The Masula boat is a traditional, non-rigid Indian surfboat used for fishing and transportation along the Chennai and Coromandel coast.

Figure 32: Number of different types of non-motorized boats owned by fishers across states in India

Source: CMFRI (2012); CMFRI-DoF (2020)

Between 2010 and 2016, the predominant types of non-motorized boats across states displayed some shifts. In Andhra Pradesh, catamarans and plank-built boats remained important, but their numbers decreased, while thermocol boats increasingly appeared (Figure 32). Tamil Nadu continued to rely on catamarans, while plank-built boats

remained significant, though their numbers declined slightly. In Kerala, the dominance of plank-built boats decreased, and thermocol boats increased in number, while catamarans also remained prevalent. Karnataka saw an upward trend in the number of non-motorized boats, with dugout canoes increasing in numbers. Here, the number of plank-built boats declined considerably. Gujarat, Maharashtra, and West Bengal showed an increase in the number of non-motorized boats, most of which were contributed by dugout canoes and plank-built boats.

The analysis of the changes in the number of motorized and non-motorized crafts between 2010 and 2016 reveals a major structural transformation in India's traditional fishing fleet. The structural transformation is marked by rapid motorization, technological upgrading of artisanal craft, and the gradual erosion of traditional non-motorized crafts. Outboard-engine motorboats show the strongest growth during this period, especially in Tamil Nadu, Kerala, and Andhra Pradesh, where fiberglass and plywood boats dominate. This reflects a shift towards capital-intensive artisanal fishing, suitable for longer fishing ranges, and towards gear diversification, such as gillnets, hook-and-lines, and ring seines. The decline of dugout canoes and plank-built wooden boats alongside the rise in fiberglass and plywood boats points to the replacement of labor-intensive artisanal boats with more efficient, motorized alternatives.

Further, inboard-engine motorized boats, though smaller in number, represent a parallel shift towards larger, more powerful vessels within the motorized segment. States such as Maharashtra, Gujarat, Andhra Pradesh, Tamil Nadu, and West Bengal show considerable growth in wood fiber and wooden-built inboard motorboats. It suggests a consolidation of medium-scale motorized operations rather than full mechanization.

In contrast, the non-motorized sector shows a marked nationwide decline, with the sharpest reductions in Andhra Pradesh, Tamil Nadu, Kerala, and West Bengal. Catamarans, plank-built boats, and dugout canoes, once central to traditional artisanal fisheries, declined substantially. The decline of the non-motorized segment has been widely documented (CMFRI, 2012; Salagrama, 2006; Bavinck, 2001), driven by declining nearshore resources (Vivekanandan et al, 2016; Bhathal and Pauly, 2008), increased competition from motorized and mechanized fleets (Bhat and Bhatta, 2006), shrinking artisanal spaces (Menon and Bavinck, 2018), labor shortages (Salagrama,

2012), and the economic compulsion to motorize for viable livelihoods (Kurien, 1985; Salagrama, 2006).

These transformations show how economic pressures, technological change, and ecological constraints are reshaping the composition of India's fishing fleet.

3.7. Craft density[6] per km of coastline

Calculating the number of mechanized, motorized, and non-motorized crafts per kilometer of coastline provides a spatially grounded measure of how fishing effort is distributed along India's coast, offering insights into settlement pressure, fleet composition, and the intensity of resource dependence that absolute craft counts cannot reveal.

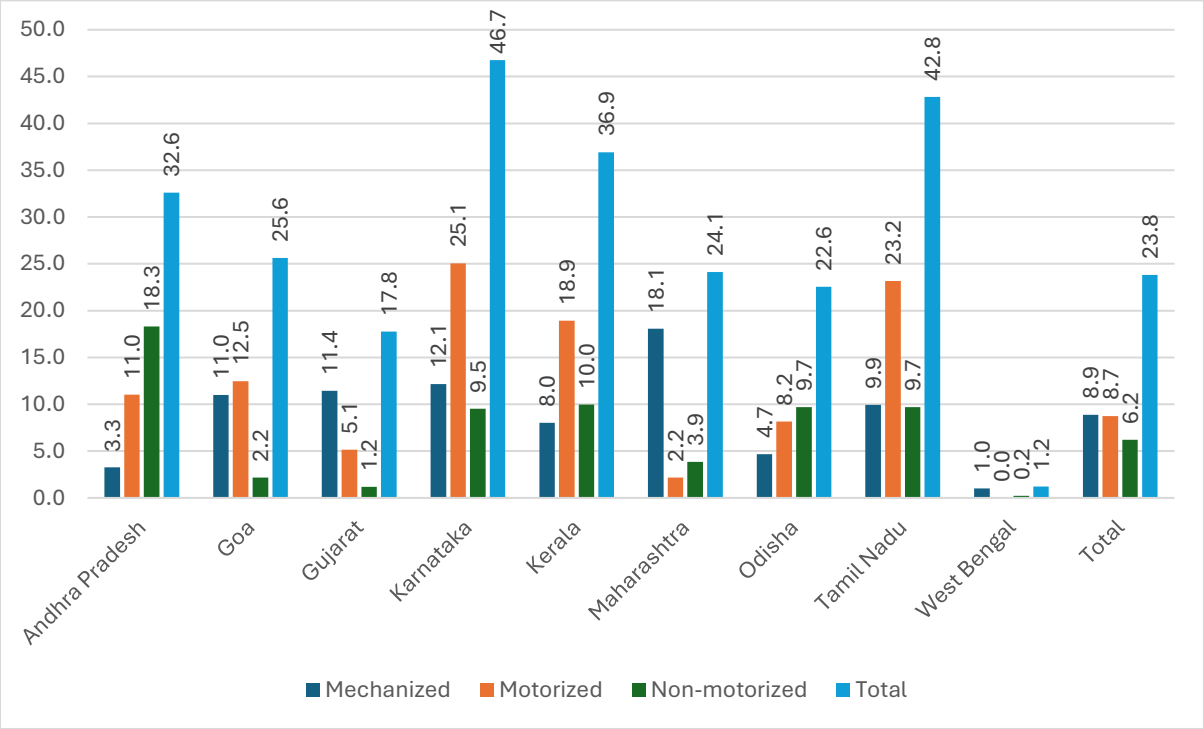


Figure 33: Number of crafts per kilometer of coastline in 2010

Source: CMFRI (2012)

[6] The craft numbers reported in the CMFRI Marine Fisheries Census are based on household-reported ownership of fishing crafts, rather than a physical or administrative count of all vessels operating along the coastline. As such, these figures may not fully capture boats registered at harbours, jointly owned vessels, migrant fishing units, or crafts operated by non-residents. The density estimates presented here should therefore be interpreted as reflecting the distribution of household-owned fishing assets, not the total number of operational boats along the coast.

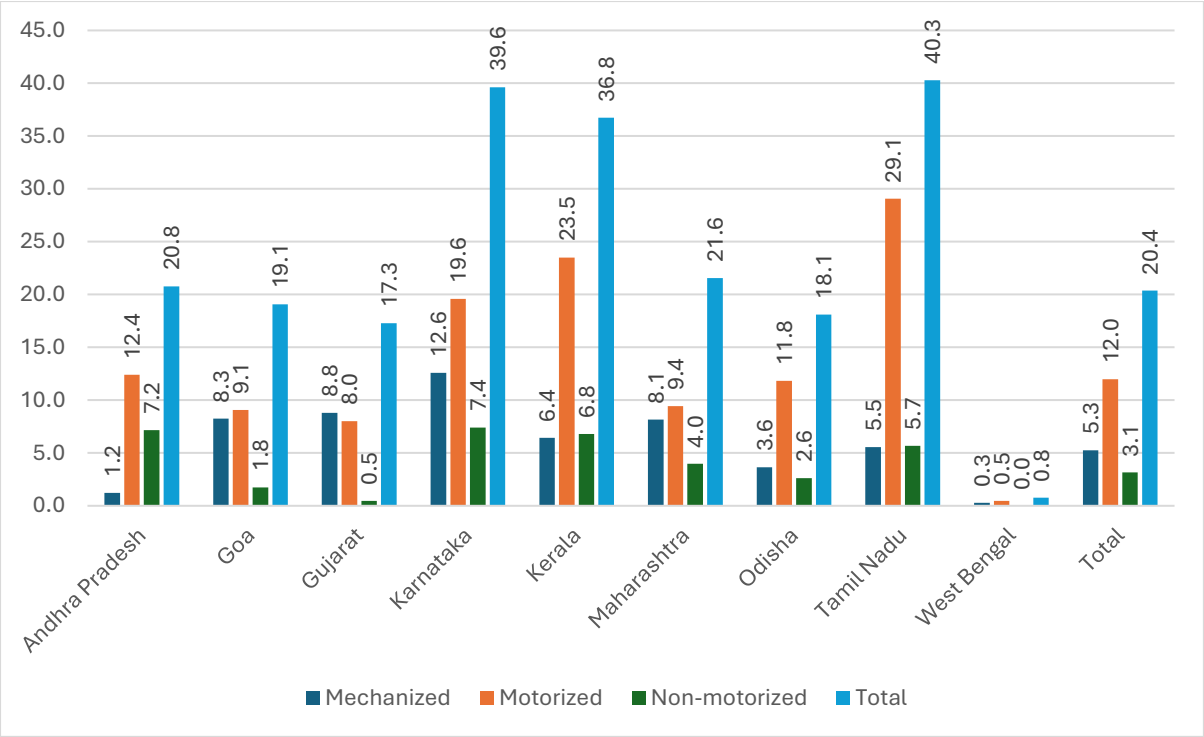


Figure 34: Number of crafts per kilometer of coastline in 2016

Source: CMFRI-DoF (2020)

Figures 33 and 34 show a clear decline in total crafts per km of coastline between 2010 and 2016 in most states, indicating that India's marine fisheries sector is undergoing structural consolidation. States like Tamil Nadu, Kerala, Karnataka, and Andhra Pradesh, which had relatively high craft density in 2010, continued to show relatively high values in 2016, though with a downward trend. West Bengal and Gujarat remain low-density outliers.

Across states, the most pronounced change is a sharp decline in non-motorized craft density, which fell steeply between 2010 and 2016 in almost all regions, especially in Andhra Pradesh, Tamil Nadu, Gujarat, and West Bengal. This reflects the decline of low-investment artisanal fishing and the rapid replacement of traditional boats by motorized units. Non-motorized boats remain important for subsistence fishers, but their declining viability owing to resource depletion, competition in near-shore waters, and generational shifts away from labor-intensive practices has pushed many operators toward motorization or out of fishing entirely.

In contrast, motorized craft density remains stable or increases in states such as Karnataka, Kerala, Tamil Nadu, and Gujarat. This indicates that artisanal fleets are not disappearing but upgrading, with fishers investing in outboard motors, more efficient gear, and longer fishing ranges. Motorization allows small-scale fishers to cope with declining near-shore productivity, making short-distance fishing more competitive. Thus, even as total artisanal boat numbers fall, the capacity of the artisanal sector seems to have increased.

Mechanized craft density shows a moderate decline, especially in Tamil Nadu, Maharashtra, and Gujarat. However, this decline does not reflect a reduction in mechanized fishing pressure. Rather, it points to fleet consolidation, where fewer but more powerful vessels dominate landings. Multi-day trawlers and advanced ring-seiners have replaced older gillnetters and dolnetters, as discussed earlier. At the same time, higher-horsepower trawlers and multi-gear vessels seem to have expanded offshore operations. In other words, more boats seem to have moved out of mechanized fishing than moved into it, but those that remain are significantly larger and more efficient, as is evident in the share of total catch from this sector.

Taken together, the density trends reveal a structural shift in Indian fisheries. Many small, low-capacity boats are being replaced by fewer, higher-capacity boats. Artisanal fleets are upgrading through motorization. Mechanized fleets are consolidating into technologically advanced units. Improvements in engine power, gear upgrades, fish-finding technologies, and the ability of these boats to fish farther offshore allow these mechanized vessels to maintain, or even increase, overall fishing effort despite a shrinking fleet. The number of mobile phone users increased from 279232 to 595561; GPS users from 18,539 to 27760 between 2010 and 2016. In addition, 5899 radio phone users and 5427 echo sound users who were non-existent in 2010 were reported in the 2016 census (CMFRI-DoF, 2020). Tamil Nadu, Kerala, and Gujarat were ahead of other states in the use of these electronic gadgets. All these reflect that fishing effort is intensifying even though craft density declines.

Moreover, the analysis helps identify regions where resource pressure per kilometer of coast remains extremely high (Tamil Nadu, Kerala, and Karnataka), areas where artisanal livelihood dependence is declining (Andhra Pradesh, Maharashtra, and Odisha), and states where modernization is reshaping fleet structures (Gujarat and West Bengal). The density indicators reveal that India’s marine fisheries are moving

towards capital-intensive, high-effort, technologically advanced fishing systems, with important implications for sustainability, equity, and livelihoods.

4. Trends and patterns in marine fisheries: A district-level analysis of Andhra Pradesh

The preceding section provided a macro-level understanding of changes in India's fisheries sector and offered a brief context for examining marine fisheries at more localized scales. As one of the largest coastal states on the east coast of India, Andhra Pradesh, with a 974 km coastline, supports a dynamic fisheries economy vital to the livelihoods of coastal communities. According to 2016 CMFRI data, the state hosted 20,219 fishing vessels. Of this total, 1176 were mechanized boats that berthed at the major and minor fishing harbors in Visakhapatnam (59 per cent), and the remaining at the three minor fishing harbors at Kakinada, Machilipatnam, and Nizampatnam, along with 12,078 motorized and 6,965 14,799 traditional fishing crafts. Fishers employ diverse gear types, including trawl nets, drag nets, gill nets, cast nets, hook & line, and other gear (CMFRI, 2016). In 2021-22, the state's total marine fish production stood at 594,000 tonnes, representing 14 per cent of India's total marine fish production (GoI, 2022). Fish processing and drying remain major economic and livelihood activities in coastal Andhra Pradesh, particularly for women, although comprehensive data on dried-fish production are lacking. This section analyses district-wise patterns of the key characteristics of the fisheries sector in the state using data from the Marine Fisheries Census 2010 and 2016, and primary data, with an aim to understand the trends and directions in which the fisheries sector is moving.

The analysis of the number of landing centers across districts in Andhra Pradesh between 2010 and 2016 reveals a significant decline in most districts. Districts such as Nellore and Visakhapatnam reported the highest number of landing centers in 2010. By 2016, most of the districts had experienced a sharp decline in the number of landing centers (Figure 35). Visakhapatnam, which had 66 landing centers in 2010, reported a decline to 22 by 2016. Similar declines were reported in Nellore and Krishna as well. While the precise reason for the decline in the number of landing centers is unclear, consolidation and modernization may be among them. There may have been efforts to consolidate landing centers into fewer but better-equipped facilities, driven by modernization initiatives to enhance operational efficiency and

improve the management of fish landings. Coastal erosion, sedimentation, reduced fish catch due to overfishing, or changes in marine conditions could also have rendered some traditional landing sites inaccessible or economically unviable, leading to their decline. Moreover, expansion of urban areas and industrial facilities, particularly in coastal districts like Visakhapatnam, might have displaced traditional landing centers or restricted access for fishing communities.

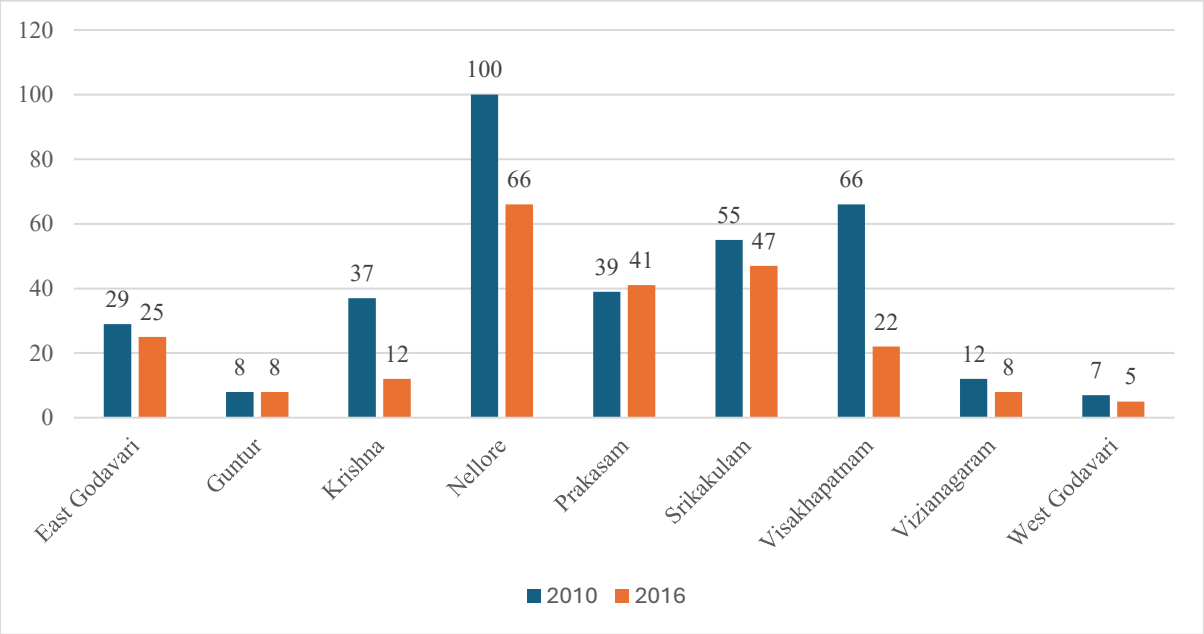


Figure 35: Number of landing centers across districts in Andhra Pradesh

Source: CMFRI (2012b); CMFRI-DoF (2020b)

Similarly, the analysis of the number of fishing villages across districts between 2010 and 2016 reveals mixed trends, with some districts experiencing decreases and others showing slight growth or stability. East Godavari saw a significant decline from 97 to 79 fishing villages during this period (Figure 36). Nellore, Srikakulam, Krishna, and Prakasam also showed a marginal decrease in the number of fishing villages. In contrast, Guntur and West Godavari showed a minor increase, whereas Visakhapatnam and Vizianagaram showed stable figures, suggesting the persistence of traditional fishing communities.

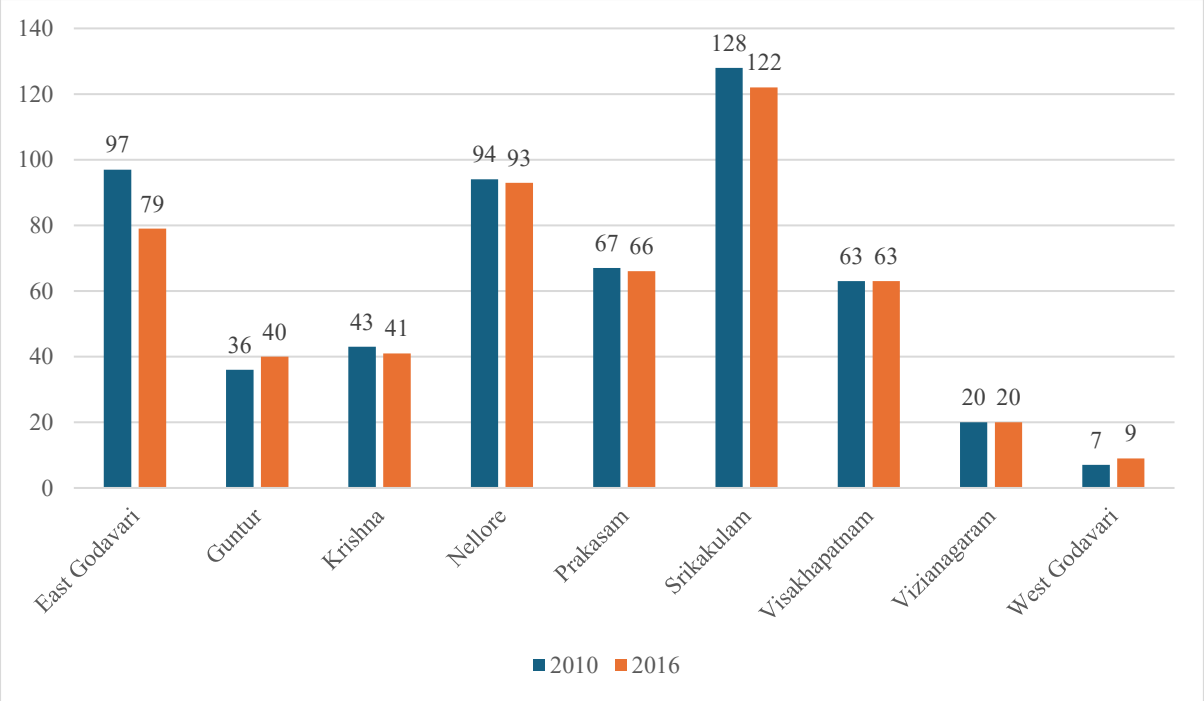


Figure 36: Number of fishing villages across districts in Andhra Pradesh
Source: CMFRI (2012b); CMFRI-DoF (2020b)

East Godavari consistently recorded the highest number of fisher families among all districts in both the 2010 and 2016 censuses, showing a slight increase over time (Figure 37). While Visakhapatnam, Nellore, Krishna, and Guntur showed some decrease in the number of families, it remained almost stable in other districts.

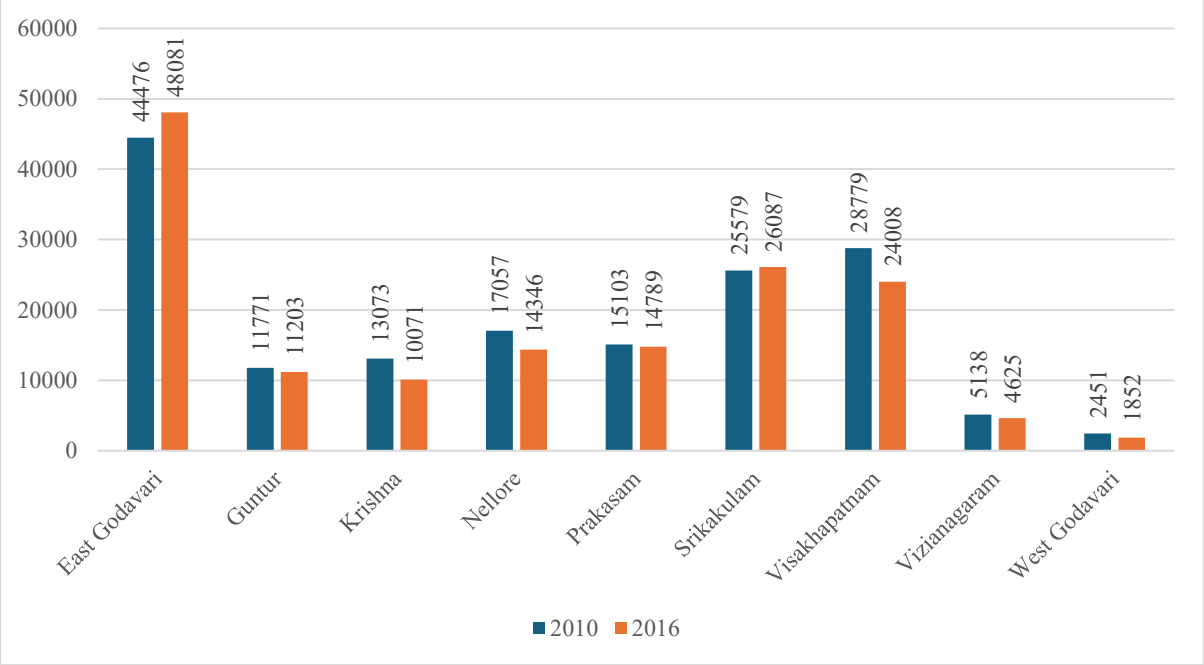


Figure 37: Number of fisher families across districts in Andhra Pradesh
Source: CMFRI (2012b); CMFRI-DoF (2020b)

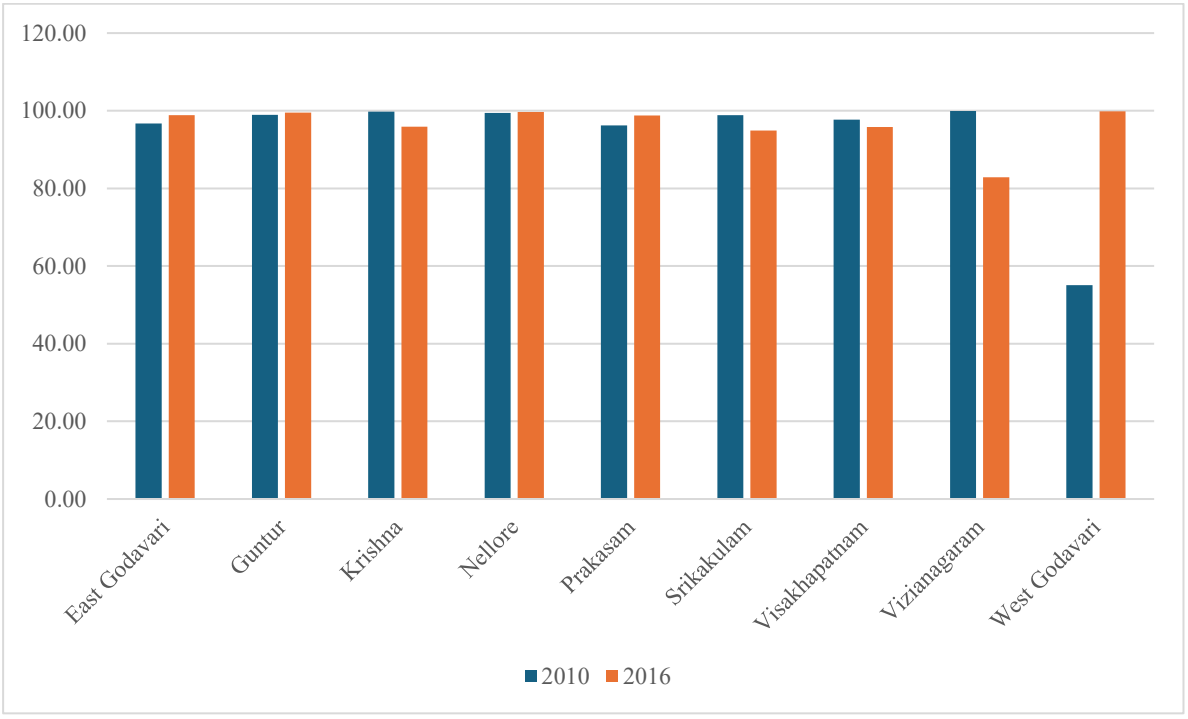


Figure 38: Percentage of fisher families below the poverty line across districts in Andhra Pradesh
Source: CMFRI (2012b); CMFRI-DoF (2020b)

The percentage of fisher families below the poverty line remains high, close to or at 100 per cent for both years in many places, indicating persistent poverty challenges among fisher communities. West Godavari, which initially showed lower levels of poverty among fishers, experienced a sharp increase by 2016, potentially due to factors such as improved reporting or a real socio-economic decline (Figure 38). In other districts, such as East Godavari, Krishna, Guntur, and Visakhapatnam, poverty levels remain consistently high, underscoring the limited progress in poverty alleviation among fisher families over this period.

The number of active fishers across the state shows that East Godavari consistently had the highest number of active fishers in both years, although there was a slight decline from around 45,000 in 2010 to approximately 41,000 in 2016, probably indicating a movement away from fishing as a primary livelihood in that district (Figure 39). Several districts, including Guntur, Prakasam, Visakhapatnam, and Krishna, also show moderate declines in the number of active fishers between 2010 and 2016. In some other districts, the numbers remained stable, which might indicate sustained engagement in fisheries, possibly due to limited alternative livelihoods or the steady availability of fishery resources and related activities.

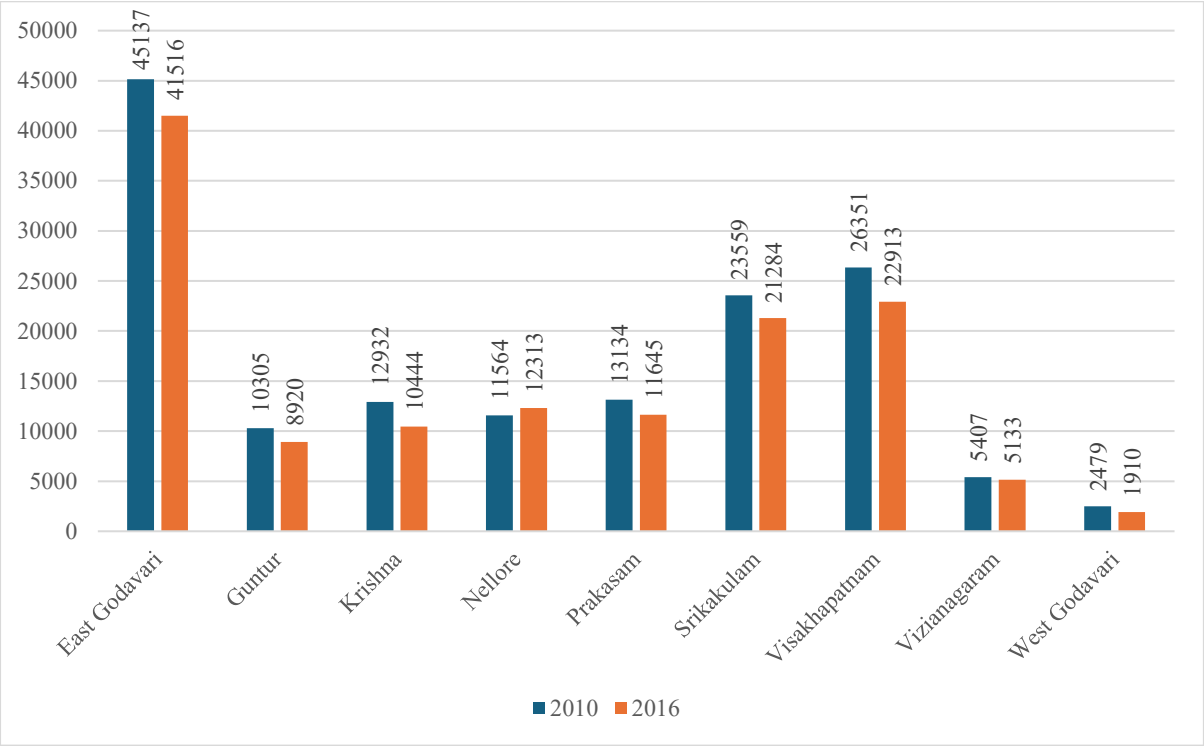


Figure 39: Number of active fishers across districts in Andhra Pradesh
Source: CMFRI (2012b); CMFRI-DoF (2020b)

A gender-wise look into the distribution of fishers engaged in various activities, such as marketing, curing, processing, and as laborers, shows interesting results. The gender-wise data on fishers engaged in marketing shows that women overwhelmingly dominate in nearly all districts and across both years (Figure 40). Visakhapatnam, Srikakulam, and East Godavari emerge as districts with the highest female participation in marketing. In contrast, male participation is significantly lower, though East Godavari and Srikakulam show a noticeable increase from 2010 to 2016. Overall, the trend highlights the gendered nature of fisheries marketing, where women's involvement is substantial but decreasing.

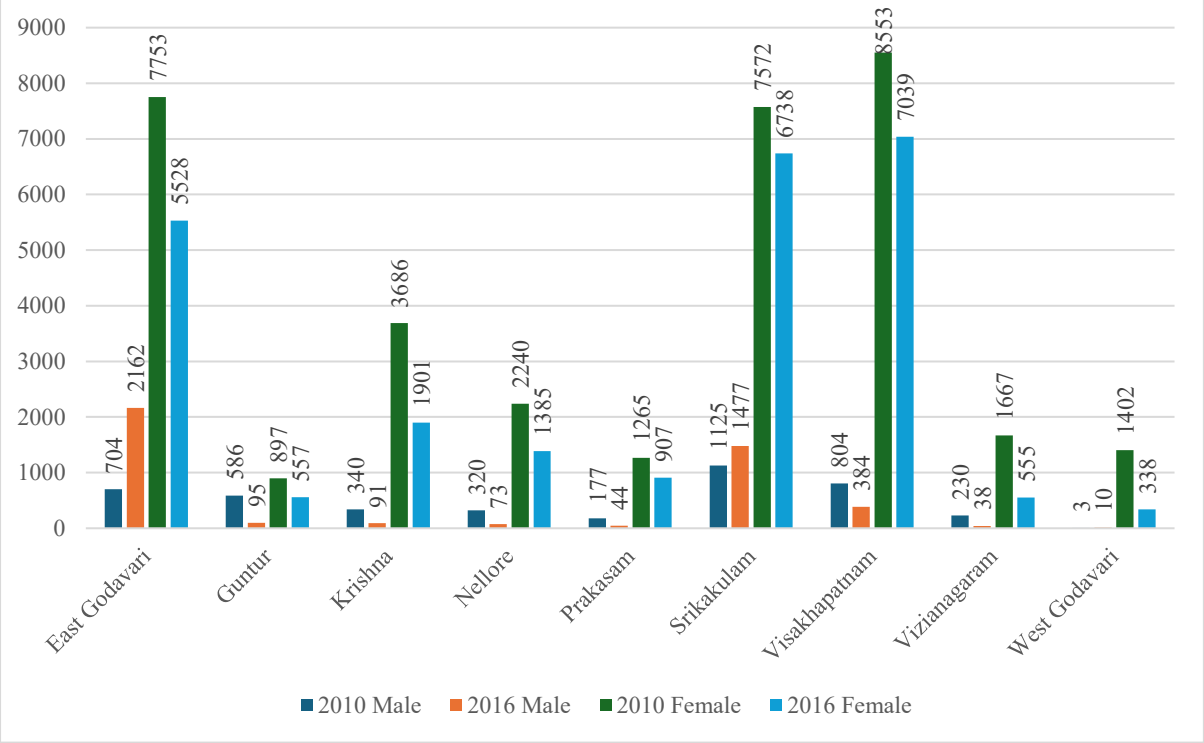


Figure 40: District and gender-wise distribution of fishers engaged in marketing in Andhra Pradesh

Source: CMFRI (2012b); CMFRI-DoF (2020b)

Similarly, a striking pattern in the number of fishers involved in curing and processing shows a predominance of female workers (Figure 41). This is evident in all districts across both years. Districts such as Visakhapatnam, East Godavari, Krishna, Vizianagaram, and West Godavari also show that the number of women fishers engaged in curing and processing is increasing. Male participation, on the other hand, remains very low, with only marginal increases or even decreases between 2010 and 2016. This gendered division of labor highlights the crucial role of women in the post-harvest sector, emphasizing their contribution to household income and food security.

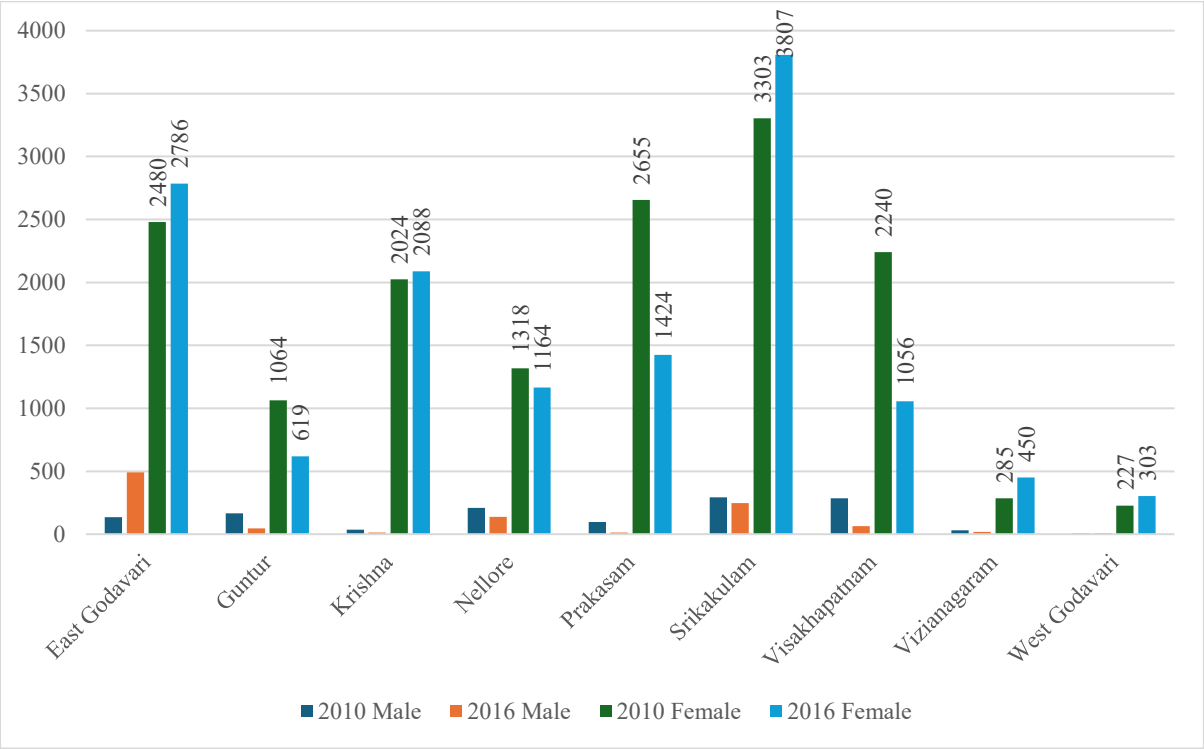


Figure 41: District and gender-wise distribution of fishers engaged in curing and processing in Andhra Pradesh

Source: CMFRI (2012b); CMFRI-DoF (2020b)

Another important aspect is the number of fishers engaged as laborers. Figure 42 reveals a strong female dominance here as well. Districts such as East Godavari, Guntur, Srikakulam, and Visakhapatnam show the highest overall participation, with female fishers consistently outnumbering male counterparts by significant margins. This suggests that wage labor in fisheries-related activities is a major source of livelihood for women. It is also important to note that male labor participation is declining in most districts between 2010 and 2016.

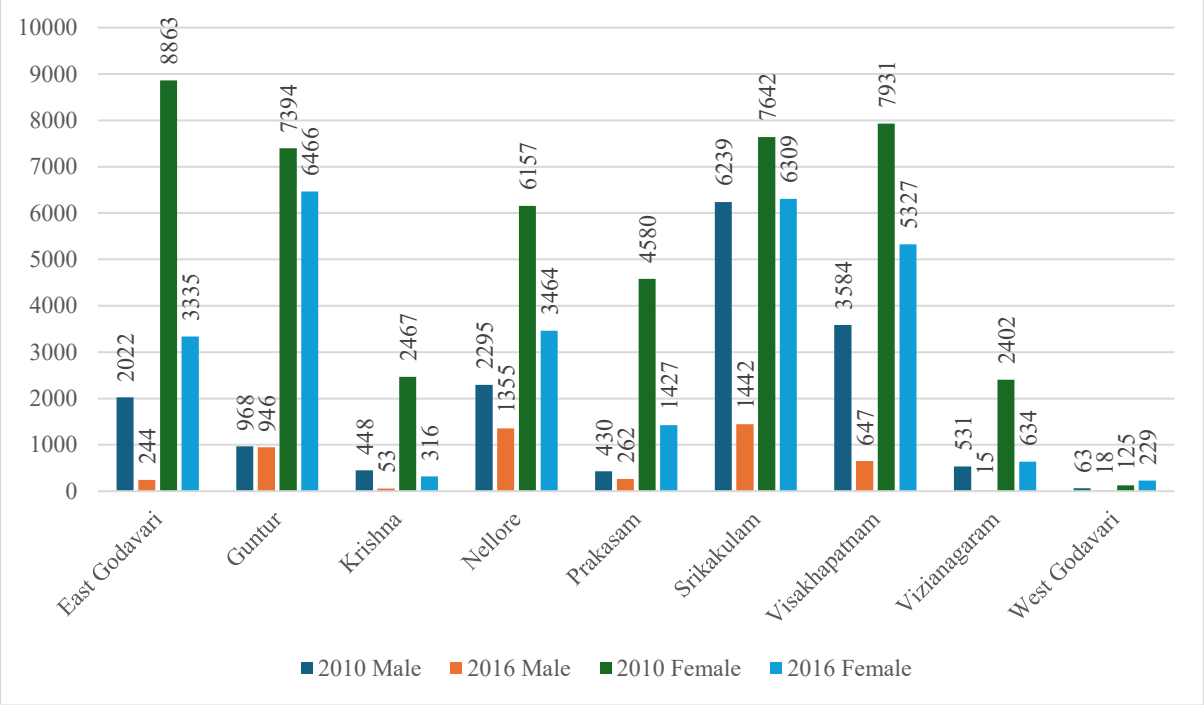


Figure 42: District and gender-wise distribution of fishers engaged as laborers in Andhra Pradesh

Source: CMFRI (2012b); CMFRI-DoF (2020b)

Thus, the gender-wise distribution of fishers engaged in marketing, curing, and processing roles underscores the critical role that women play in fisheries in Andhra Pradesh. Despite sectoral challenges, women dominate marketing activities. Similarly, in curing and processing, women constitute a significant majority, reflecting their centrality in the post-harvest value chain. In the labor sector, too, women are highly engaged, performing essential but often unrecognized roles in the fisheries economy. While men tend to be concentrated in direct fishing activities, women's participation in marketing, curing, and processing, as well as in labor, underscores the interconnectedness of their work in sustaining fisheries. However, the persistence of these gendered patterns over time indicates structural factors, such as limited alternative employment opportunities for women in coastal areas and social norms around the division of labor, that sustain this status quo.

5. Marine fisheries production in Andhra Pradesh: Evidence from field data

Building on the insights derived from district-level analysis of Marine Fisheries Census data, this section draws on field-based primary data to provide a more nuanced understanding of production trends and operational aspects of marine fisheries in Andhra Pradesh. It explores key aspects, including district-wise marine production, seasonal variations, fishing practices, and disposition. The findings shed light on the operational characteristics of the marine fisheries sector, identifying critical factors like regional variations in resource availability and market dynamics. These insights are crucial for situating the dried fish sector within the broader marine fisheries context, highlighting important linkages related to production, processing, and trade.

Table 2: District-wise Distribution of Sampled Fishing Boats by Season in Andhra Pradesh

Districts	Types of boat	Monsoon	Winter	Summer	Ban Period	Total
Srikakulam	Motorized	21	21	21	0	63
	Traditional	106	108	106	80	400
	Total	127	129	127	80	463
Vizianagaram	Motorized	16	16	16	9	57
	Traditional	16	16	16	16	64
	Total	32	32	32	25	121
Visakhapatnam	Mechanized	129	127	129	0	385
	Motorized	60	62	60	53	235
	Traditional	105	105	102	77	389
	Total	294	294	291	130	1009
East Godavari	Mechanized	106	109	109	0	324
	Motorized	65	60	59	38	222
	Traditional	61	48	46	5	160
	Total	232	217	214	43	706
West Godavari	Traditional	16	16	16	16	64
	Total	16	16	16	16	64
Krishna	Mechanized	19	19	20	0	58
	Motorized	31	31	30	0	92
	Traditional	32	32	32	32	128
	Total	82	82	82	32	278
Guntur	Mechanized	33	34	33		100
	Motorized	11	10	11		32
	Total	44	44	44		132
Prakasam	Mechanized	9	9	9	0	27
	Motorized	47	48	46	20	161
	Traditional	25	24	26	40	115
	Total	81	81	81	60	303
Nellore	Motorized	108	107	111	59	385
	Traditional	45	46	42	36	169
	Total	153	153	153	95	554
All	Mechanized	296	298	300	0	894

Districts	Types of boat	Monsoon	Winter	Summer	Ban Period	Total
	Motorized	359	355	354	179	1247
	Traditional	406	395	386	302	1489
	Total	1061	1048	1040	481	3630

Source: Sathyapalan (2014); Srinivasan and Sathyapalan (2023)

The analysis is based on primary data collected through a comprehensive survey of fishing units conducted in 2013-14 by the Centre for Economic and Social Studies, Hyderabad,[7] and a qualitative field survey conducted in 2021-22. The 2013-14 survey was part of a study reviewing the rates and ratios used to compile the Gross State Domestic Product (GSDP) of the fisheries sector. This study estimated the quantity and value of landings across seasons for various types of fishing boats in Andhra Pradesh. Fish species were classified according to the market value using the classification system proposed by Kumar (2004). The study included mechanized, motorized, and non-motorized crafts sampled from across each coastal district in Andhra Pradesh.

The survey was conducted over four seasons, accounting for inter-annual variations: Monsoon (June-September), Winter (October-January), Summer (February-March), and the Ban Period (April-May), during which fishing is restricted due to species spawning, and in which trawlers and motorized boats are prohibited from operating. A total of 3,630 fishing units were surveyed across all seasons. Data were collected using a structured interview schedule, and fish landings were recorded for boats arriving at different times of the day. The number of trips made by each boat was determined through recall. Table 2 gives the sample details.

As mentioned earlier, detailed information on fish catch, covering species and quantities, was collected from different types of boats across various fishing seasons to understand the landing patterns. The catches were classified into several groups: pelagic (high- and low-value), demersal (high- and low-value), shrimp, crustaceans, and others. Before analyzing the production composition and disposal of marine

[7] Refer to Sathyapalan (2014) and Srinivasan and Sathyapalan (2023) for details of sampling procedure.

harvest in Andhra Pradesh, this section provides an overview of the key characteristics of fishing in the study region.

5.1 Major types of gears operated by different types of boats and crew size

The survey reported that the major types of gears operated by mechanized boats included trawl net, purse seine, ring seine, gill net, drag net, cast net, prawn/shrimp net, shore seine, etc. Fishers often use multiple gears during their fishing trips. On average, a mechanized boat operates approximately 2.36 gears, increasing slightly during the monsoon season to 2.67 gears. Among mechanized boats, those in Visakhapatnam (2.48) and East Godavari (2.46) reported the highest number of gears. In contrast, mechanized boats in Krishna District exclusively used trawl nets.

Major types of motorized and non-motorized boats included fiberglass, plank-built, and plywood boats, among others. These boats operated an average of 2.27 and 1.78 gears, respectively. Notably, in the Nellore district, the averages were higher: motorized boats averaged 2.97 gears, and traditional boats averaged 2.41 gears.

The major types of gears operated by motorized boards included gill nets, ring seines, cast nets, *joka vala* (scoop net), disco net (also known as starlight net, which uses light to attract fish during night fishing), shore seine net, barrier or trap net, among various other types of nets used for catching certain species. The non-motorized boats, on the other hand, operated fewer types of gears. Their gear included disco nets, scoop nets, net rope, cast nets, prawn/shrimp nets, and longlines.

The average size of a mechanized boat operated in Andhra Pradesh was 36 feet, and the average sizes of motorized and non-motorized boats were 27 and 18 feet, respectively. Regarding crew size, mechanized boats employ an average of eight crew members, while motorized and traditional crafts typically employ around five and three members, respectively. District-level variations were observed: Visakhapatnam, East Godavari, and Krishna districts each reported an average of eight crew members per mechanized boat, while Guntur averaged slightly lower at 6.8. In the motorized sector, East Godavari reported an average of 6.9 crew members, followed by Visakhapatnam with 6.4 and Krishna district at 5. In the traditional sector, Vizianagaram reported the highest average crew size at 4.21, whereas Krishna district reported the lowest at 1.96.

5.2. Primary species targeted by the boats

Across seasons, pelagic species, both high-value and low-value, are the primary target of all boat types. High-value species include seer fish, oceanic tunas, carangids, pomfrets, sharks, and mullets. Low-value pelagic fishes comprise sardines, mackerel, anchovies, Bombay duck, coastal tuna, scads, and barracudas. Some mechanized boats also target shrimp, particularly during the winter and monsoon seasons. Demersal species are mainly targeted by motorized boats during winter and by traditional boats year-round, although the primary focus remains on pelagic species.

5.3. Seasonal variations in fishing trips

As expected, the number of fishing trips per month and the duration of each trip vary by boat type. On average, fishing units in the study area reported approximately 14 fishing trips per month, each lasting around 2.5 days. Mechanized boats tend to make longer fishing trips compared to motorized and traditional boats, which usually make more frequent but shorter trips. During the monsoon and winter seasons, traditional crafts undertake around 21 single-day trips per month. However, during the ban period, when fishing is restricted, traditional crafts average only 12 trips per month. (Figure 43).

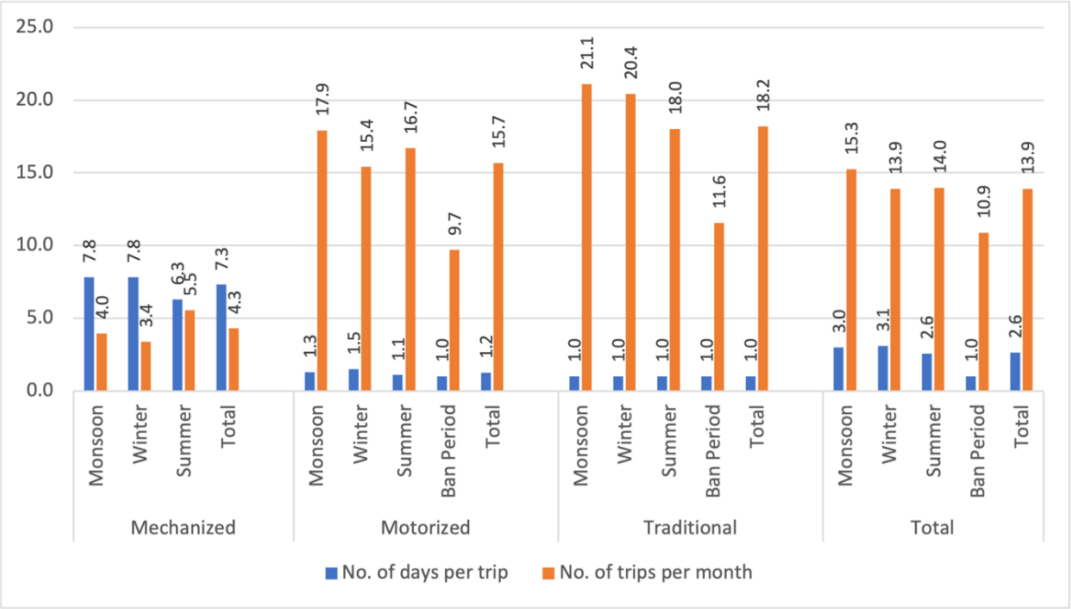


Figure 43. Number of fishing trips and days spent on each trip in Andhra Pradesh

Source: Field survey

5.4. Depth and distance of fishing

The distance from the shore and the depth at which fishing occurs are key indicators of the state of fisheries. As fish stocks decline, boats tend to travel farther and fish at greater depths to maintain their catch levels. Mechanized boats operate at distances of approximately 200 to 350 km (100-200 nautical miles) from the shore, while motorized and traditional boats fish closer, within 50 km (less than 25 nautical miles) and 25 km (less than 12 nautical miles), respectively (Figure 44). Mechanized boats travel the greatest distances during the winter season and fish at deeper depths during the summer. These boats can reach depths of 90-100 feet in summer, compared to around 30 feet for motorized boats and less than 15 feet for traditional boats. Traditional and motorized boats fish at slightly greater depths during the monsoon season.

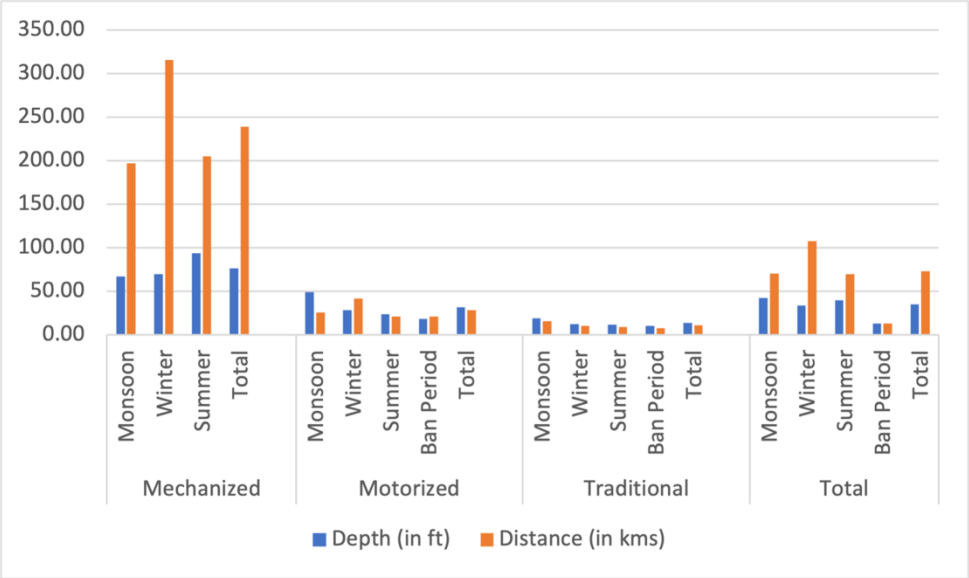


Figure 44. Depth and distance at which the sample boats fish in Andhra Pradesh

Source: Field survey

5.5. Fisher's perception of catch

Fishers classify daily catches as small, medium, or large ("good"), with variations by seasons and boat type. Overall, the largest catches are reported during the winter for all boat types. For mechanized boats, a winter catch exceeding 3,000 kg is considered 'good', substantially higher than in the monsoon and summer seasons (Figure 45). This increase may be due to favorable environmental conditions, such as cooler water temperatures and seasonal fish migrations, which enhance fish availability, particularly in mechanized boats that can reach deeper, more distant waters. A medium catch in winter is comparable to a good catch in the summer and monsoon months. In terms of value, a good winter catch for mechanized boats exceeds ₹2,50,000, while a small catch is valued at over ₹1,16,000, like a medium catch during the monsoon season, based on 2013-14 prices (Figure 46). For motorized and traditional boats, the distinction between small, medium, and large catches is less pronounced across seasons.

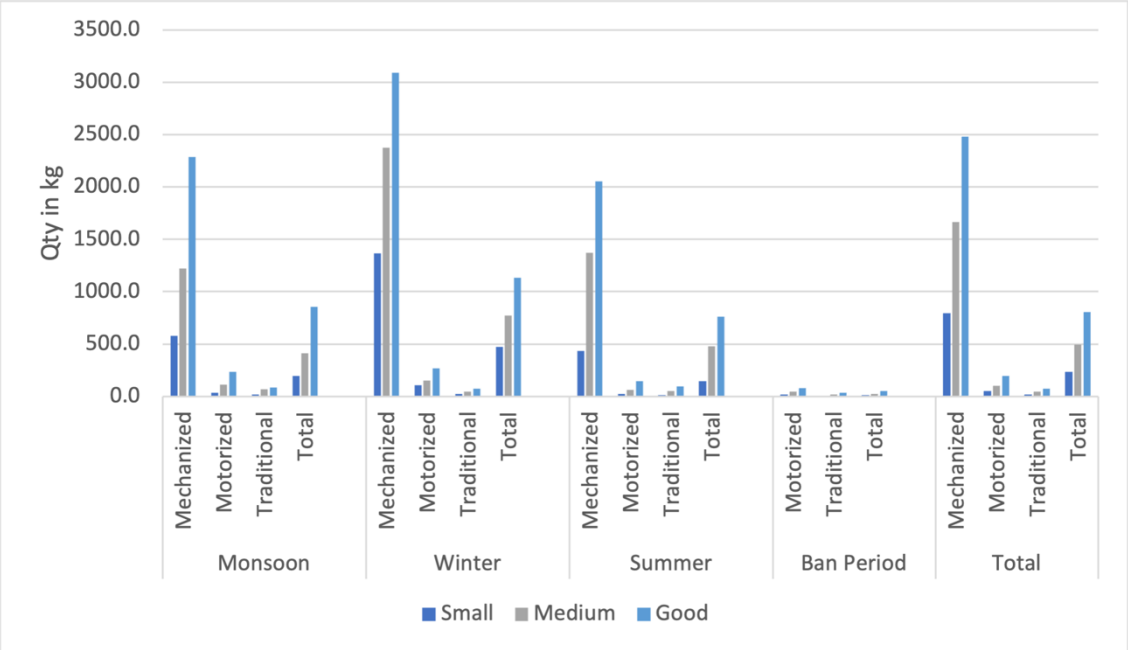


Figure 45. Perception of catch in quantitative terms as reported by the fishers across seasons

Source: Field survey

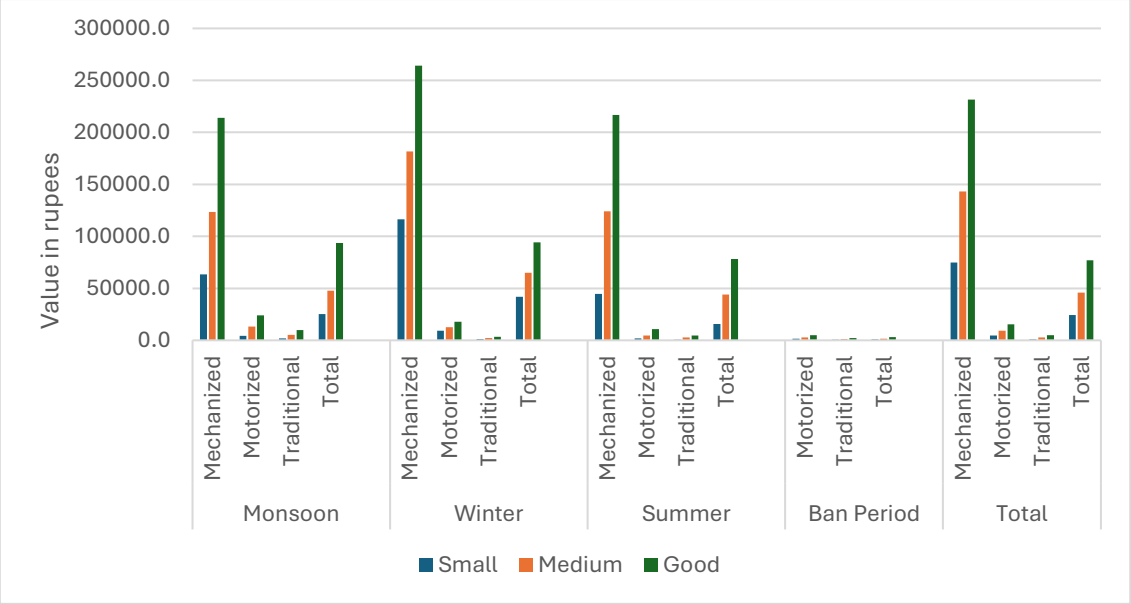


Figure 46. Perception of catch in terms of value as reported by the fishers across seasons

Source: Field survey

5.6. Key species caught on the Andhra Pradesh coast

As noted earlier, fishers along the Andhra Pradesh coast primarily target high-value and low-value pelagic species. The main high-value pelagic species include seer fish, oceanic tunas, pomfrets, pelagic sharks, and mullets. The key low-value pelagic species comprise sardines, mackerel, anchovies, Bombay ducks, coastal tunas, scads, horse mackerel, and barracudas. Among these, mackerel and sardines are especially significant low-value pelagic species harvested by all boat types throughout the year (Figures 47 and 48). However, some seasonal differences are observed. For example, sardines are harvested by all boat types during the winter, while mackerel is more commonly harvested in the monsoon and summer seasons. Anchovy catches are higher during the winter, particularly for mechanized boats. Ribbonfish are mainly caught in summer, followed by winter and monsoon seasons.

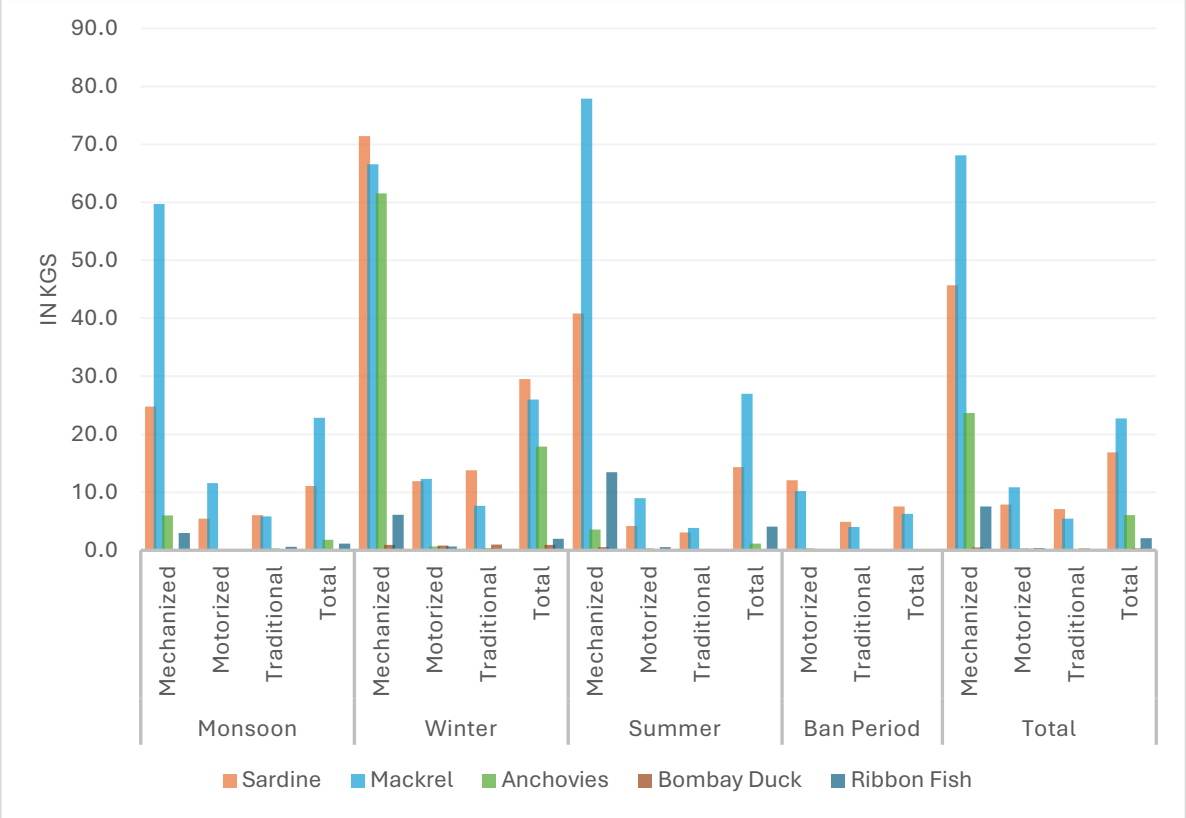


Figure 47. Season-wise catch of low-value pelagic species per boat from Andhra Pradesh (in quantity)

Source: Field survey

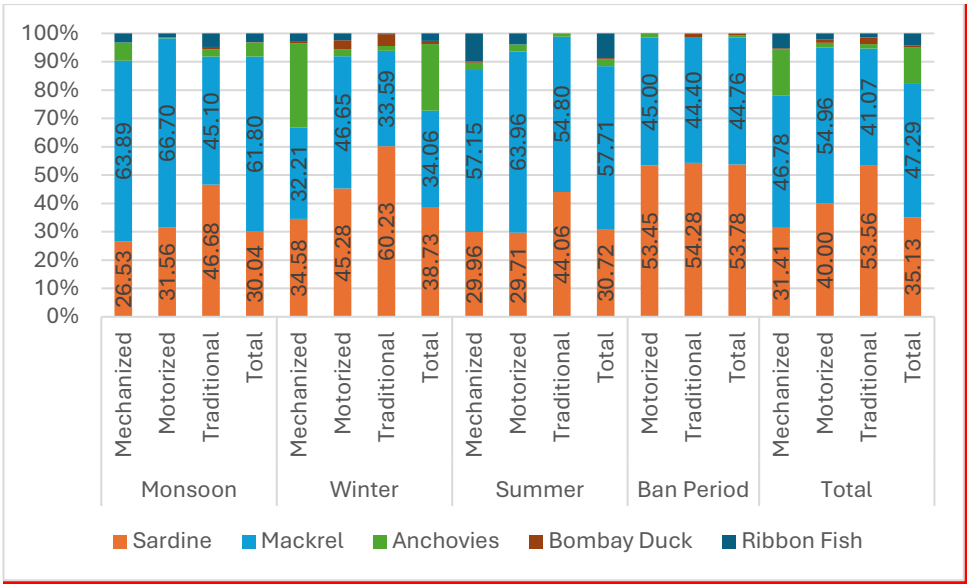


Figure 48. Season-wise catch of low-value pelagic species per boat from Andhra Pradesh (in per cent)

Source: Field survey

Figures 45 and 46 show differences in the composition of low-value pelagic species across boat types and fishing seasons, highlighting the seasonal and operational shifts in fishing practices. For example, the share of mackerel in the mechanized boats' total catch is about half in the winter as in the monsoon season. Anchovies are more commonly harvested by mechanized boats in winter, while the share of sardines in the low-value pelagic catches is higher for motorized and traditional boats during the ban period, reflecting species availability and fishing restrictions.

During winter, mechanized boats primarily catch sharks, seer fish, pomfrets, tuna, and mullets, while in the monsoon season, pomfrets become the dominant catch, followed by seer fish, tuna, and sharks. Traditional boats primarily target seer fish throughout most fishing seasons (Figures 49 and 50).

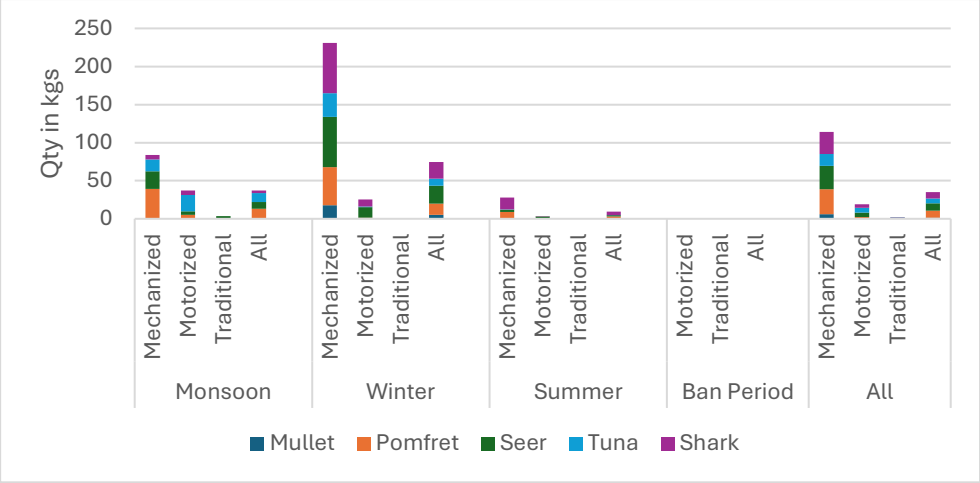


Figure 49. Season-wise and boat-wise catch of high-value pelagic species in Andhra Pradesh (in quantity)

Source: Field survey

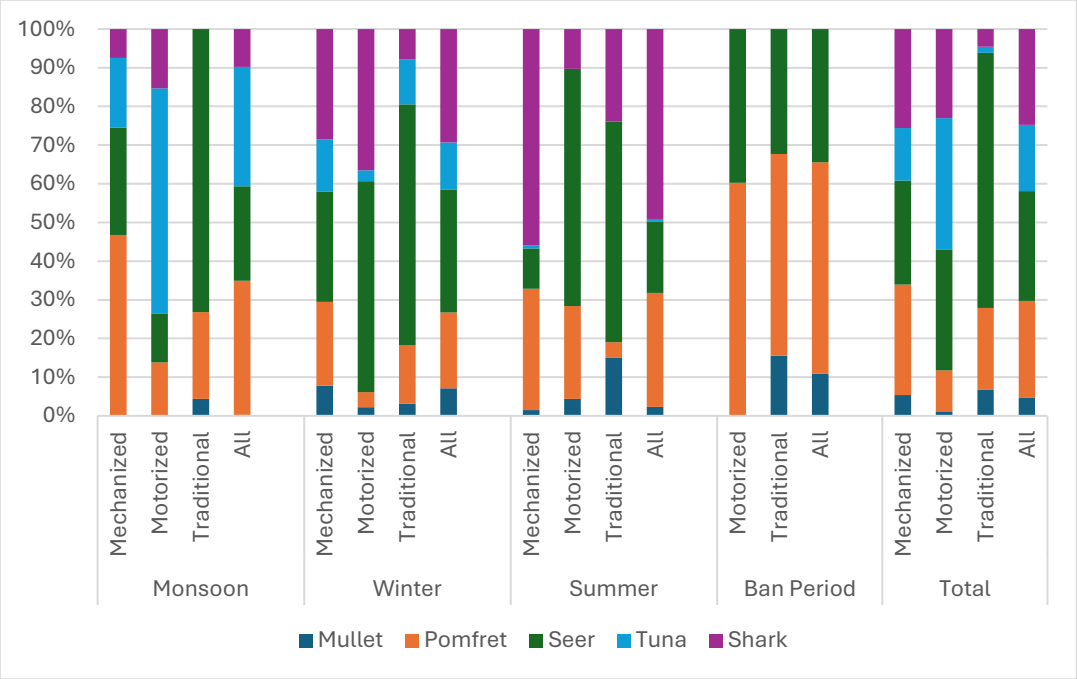


Figure 50. Season-wise and boat-wise catch of high-value pelagic species in Andhra Pradesh (in per cent)

Source: Field survey

5.7. Disposition of catch

Analysis of the disposition of catch reveals that over 70 per cent of the annual catch is sold fresh, followed by sun drying and salting (Figure 51). Motorized and traditional boats also retain a small portion of their total catch for home consumption. Our field observations show that the disposition of catch for home consumption on mechanized boats is more complex and varies substantially across seasons and species. Because these boats undertake multiday trips and land much larger volumes, the quantity set aside for home use can be considerable. In most harbors, crew members receive a small portion of the catch, typically 1 to 3 kg, as part of their share in addition to wages, with the amount depending on species value. Bycatch is also commonly divided among the crew, and with the emergence of dedicated bycatch markets, this portion increasingly functions as a component of remuneration. It is also significant to note that mechanized boats contribute to the processing of fish through salting and sun drying. Approximately 30 per cent of the total catch by mechanized boats during winter is processed in this manner (Figure 51 and 52).

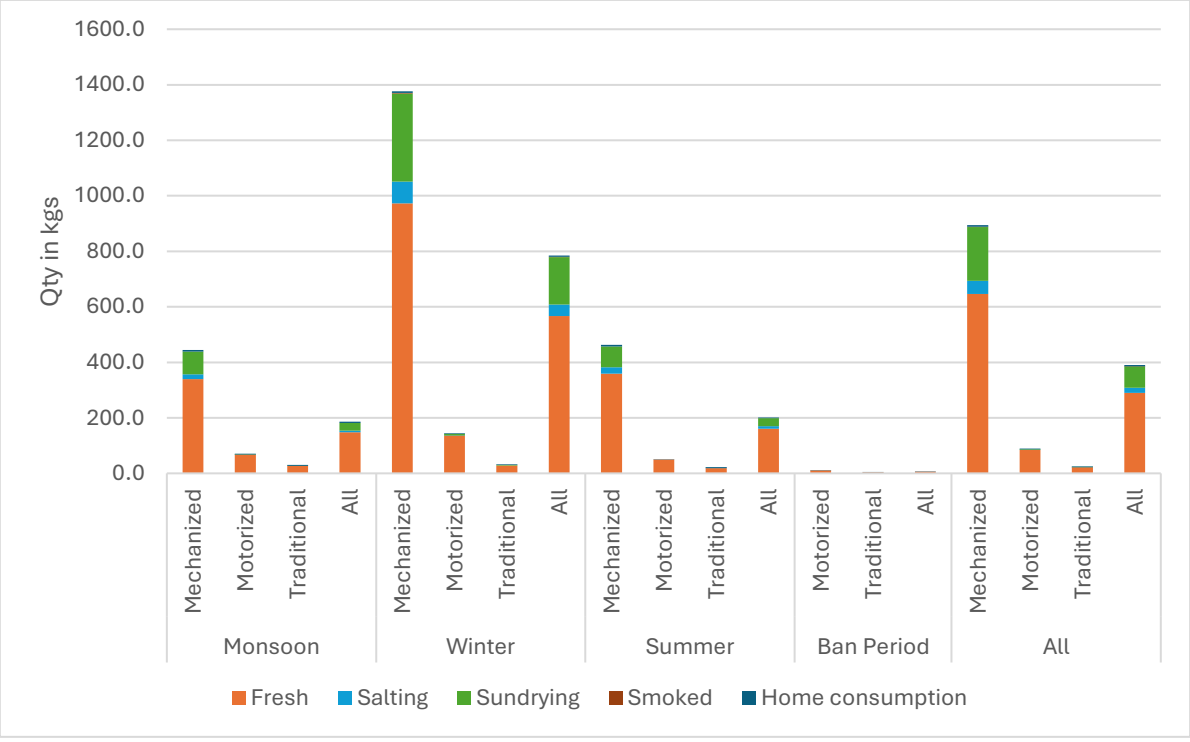


Figure 51. Season-wise and boat-wise disposition of catch in Andhra Pradesh (in Quantity)

Source: Field survey

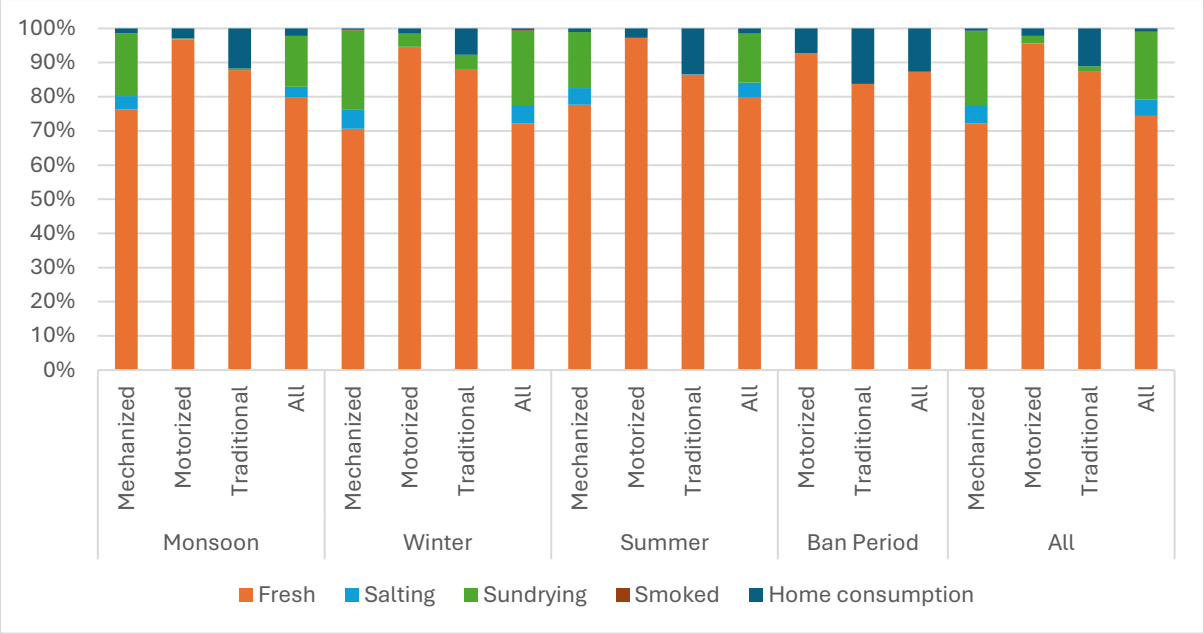


Figure 52. Season-wise and boat-wise disposition of catch in Andhra Pradesh (in per cent)

Source: Field survey

A district-wise analysis, as depicted in Figure 53, shows that Visakhapatnam, East Godavari, Krishna, and Guntur are the primary contributors to marine fish production in the state. Among these, Visakhapatnam and East Godavari stand out for their role in the production of dried fish. While Krishna and Guntur contribute less to dried fish production, they remain key players in the overall fisheries sector. Variations in the total catch per boat and its disposition across districts reflect the regional differences in fishing practices, fleet capacity, and species availability in regional waters.

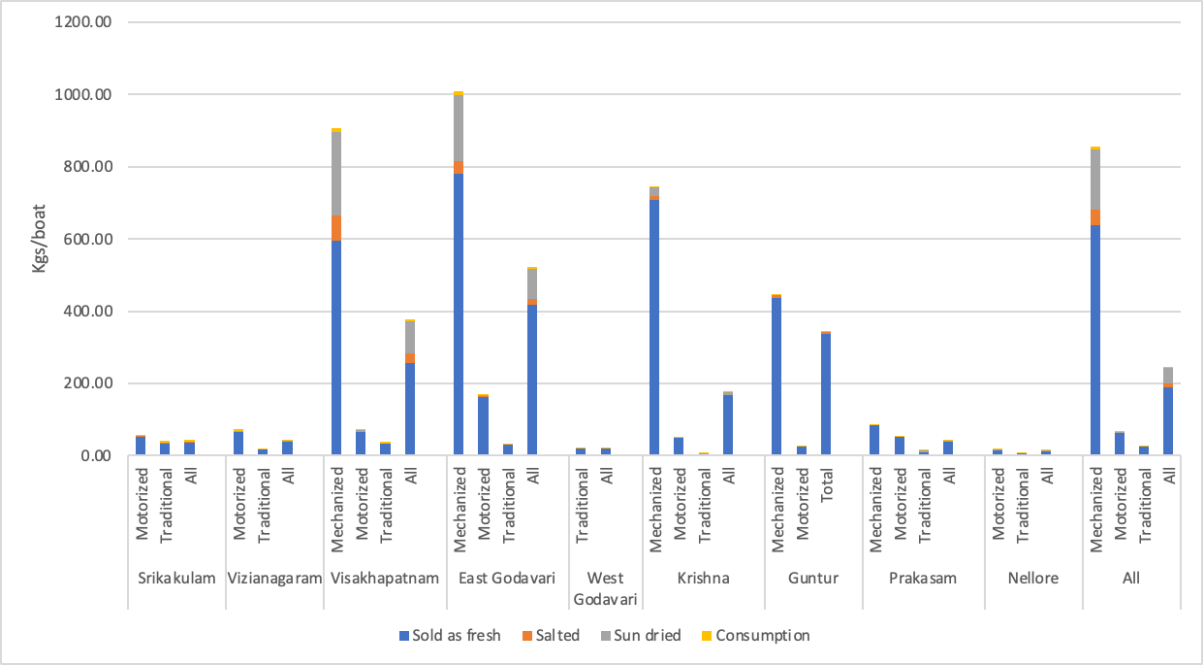


Figure 53. District-wise total catch per boat and its disposition

Source: Field survey

6. Concluding observations

The analysis of the fisheries sector in India underscores its vital role in the national economy, contributing approximately 1.24 per cent to gross value added (GVA) and supporting the livelihoods of around 28 million people. In 2019-20, India produced 14.16 million metric tons (MMT) of fish, ranking second globally and accounting for 7.58 per cent of global fish production. Over time, notable shifts have occurred in the composition of fish production. The share of fish marketed fresh increased from 65 per cent in 1980-81 to 77 per cent in 2020-21, while the contribution of marine fisheries declined from 63 per cent to 35 per cent during the same period. These trends highlight the dual pressures of overfishing and ecological stresses in the marine sector, alongside the rapid growth of inland fisheries and aquaculture as a compensatory source of fish production.

The structural transformation of marine fisheries is further evidenced by the 2010 and 2016 Marine Fisheries Censuses, which offer important insights from Andhra Pradesh and other coastal states. The data reveal a paradoxical trend: while the number of fishing villages increased, landing centers and mechanized fishing crafts declined,

indicating contraction in certain infrastructural and operational domains. At the same time, the number of fishing families rose, but the total fisher population declined, suggesting outmigration, aging of the fisher workforce, a shift away from traditional occupations, or possibly changes in household structure, such as a decline in extended-family living arrangements. The rising incidence of poverty among fisher families, particularly in Tamil Nadu and Andhra Pradesh, further reflects the increasing economic vulnerability in the sector. The occupational structure also shows transition, with a decline in labor-intensive fishing activities and a rise in marketing-related roles, highlighting changes in livelihood strategies.

Craft composition and spatial craft density provide critical evidence of structural change. Across states, there is a clear decline in non-motorized craft, especially catamarans, dugout canoes, and plan-built boats, accompanied by a substantial rise in motorized craft. The transition from traditional non-motorized boats to more powerful outboard and inboard engines highlight a structural intensification of fishing effort, driven by economic necessity, technological change, and declining nearshore resources. Mechanized craft remain dominant in terms of output, but their numbers also drop in several states. Density indicators further confirm this transformation: crafts per kilometer of coastline decline nationally from 23.8 to 20.4 between 2010 and 2016, with a steep reduction in states with historically dense artisanal fleets such as Andhra Pradesh, Odisha, and Maharashtra. Kerala and Tamil Nadu continue to show high craft density, but with a significant shift from non-motorized to motorized units. These patterns suggest consolidation, capacity expansion, and a gradual decline of small-scale artisanal fleets, reflecting rising operational costs, a decline in stock in nearshore waters, and the overall intensification of fishing effort among remaining operators.

The district-level analysis of marine fisheries in Andhra Pradesh reflects these national trends: significant declines in landing centers and major contractions in non-motorized craft pointing toward technological upgrading, consolidation into fewer landing points, and the declining viability of low-capital artisanal fisheries. While the number of fishing villages and fisher families showed mixed patterns, poverty levels among fisher families remain persistently high, particularly in traditional fishing districts such as East Godavari and Visakhapatnam.

There is a modest but steady decline in active fishers, suggesting a gradual withdrawal from traditional fishing occupations likely influenced by a mix of economic, ecological,

and social factors. Although mechanized boats continue to dominate total landings, a visible shift towards motorized boats is emerging, reflecting adjustments in fishing strategies in response to factors such as rising operational costs, regulatory constraints, and declining marine stocks. This shift aligns with the broader trend of “effort efficiency” with fewer but larger or better-equipped units responsible for a growing share of catches, while smaller units survive through adaptation.

Primary survey from Andhra Pradesh further illustrates the differentiated operational strategies within the fleet. Mechanized boats target high-value species such as sharks, seer fish, pomfrets, tuna, and mullets, operating 200-250 km offshore at depths of 90-100 feet. They use an average of 2.36 gear types, increasing during the monsoon, undertake longer fishing trips (8-person crew, 15 trips per month, approximately 2.5 days each). Motorized and traditional boats operate closer to shore, focusing on species such as seer fish and sardines, particularly during ban periods. These differences reflect stratification in capital investment, resource access, and risk-bearing capacity across boat categories.

Disposition patterns reinforce the continued importance of both fresh and processed fish within the state’s food system. While over 70 per cent of the fish catch in Andhra Pradesh is marketed fresh, salting and sun drying also remain significant, especially in winter months, when over 30 percent of the mechanized catches are processed for the dried fish value chain, sustaining employment for marginalized groups, especially women and landless workers, and contributing to food and nutritional security.

Overall, the findings point to the sector undergoing a multidimensional transition, shaped by ecological constraints, economic vulnerabilities, regulatory pressures, and technological changes. The combined evidence from declining non-motorized craft, rising motorization, changes in craft density, and shifts in occupational roles suggests differentiated pathways emerging within marine fisheries. They include consolidation and intensification among mechanized and large motorized operators, adaptation among smaller fishers, and withdrawal or marginalization among the most vulnerable groups. The primary survey insights from Andhra Pradesh reinforce these broader patterns: mechanized boats operate farther offshore, use multiple gears, larger crews, and longer trips, while motorized and traditional boats operate nearshore zones, with shorter, low-cost trips and species-specific targeting. These local patterns mirror the structural reorganization indicated in the national data, where technological upgrading,

spatial expansion of effort, and declining viability of traditional operations coexist. The census trends and AP field evidence together point to a fisheries sector in transition, with consolidated mechanized operations at one end and increasingly constrained artisanal livelihoods at the other, underscoring the need for regionally grounded, socially inclusive policy responses.

References

Bavinck, M. (2001). *Marine resource management: Conflict and regulation in the fisheries of the Coromandel Coast*. New Delhi, India: Sage Publications.

Bhat, M. G., & Bhatta, R. (2006). Mechanization and technical interactions in multi-species Indian fisheries: Implications for economic and biological sustainability. *Marine Policy, 30*(3), 237–248. https://doi.org/10.1016/j.marpol.2005.06.006

Bhathal, B., & Pauly, D. (2008). Fishing down marine food webs and spatial expansion of coastal fisheries in India, 1950–2000. *Fisheries Research, 91*(1), 26–34. https://doi.org/10.1016/j.fishres.2007.10.022

Central Marine Fisheries Research Institute (CMFRI), Indian Council of Agricultural Research (ICAR), & Department of Animal Husbandry, Dairying & Fisheries, Government of India. (2012b). *Marine Fisheries Census 2010: Andhra Pradesh – Part II*. CMFRI. https://eprints.cmfri.org.in/8999/1/AP_report_full.pdf

Central Marine Fisheries Research Institute *CMFRI (2012): "Marine Fisheries Census 2010," Part I,* Department of Animal Husbandry, Dairying and Fisheries," Ministry of Agriculture, Government of India, Cochin. CMFRI Booklet Series No. 31/2023. ICAR-Central Marine Fisheries Research Institute, Kochi. https://eprints.cmfri.org.in/8998/

Chambon, M., Miñarro, S., Alvarez Fernandez, S., Porcher, V., Reyes-Garcia, V., Drouet, H. T., & Ziveri, P. (2024). A synthesis of women's participation in small-scale fisheries management: Why women's voices matter. *Reviews in Fish Biology and Fisheries, 34*, 43–63. https://doi.org/10.1007/s11160-023-09806-2.

CMFRI-DoF (2020b). Marine Fisheries Census 2016 - Andhra Pradesh. Central Marine Fisheries Research Institute, Indian Council of Agricultural Research, Ministry of Agriculture and Farmers Welfare; Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. 286p. https://eprints.cmfri.org.in/17499/

CMFRI-FSI-DoF (2020). Marine Fisheries Census 2016 - India. Central Marine Fisheries Research Institute, Indian Council of Agricultural Research, Ministry of Agriculture and Farmers Welfare; Fishery Survey of India and Department of

Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India. 116p. https://eprints.cmfri.org.in/17490/

Edwin, L. (2008). *An overview of fishing vessels*. In Handbook of Fishing Technology (pp. 65–82). Central Institute of Fisheries Technology (CIFT), Indian Council of Agricultural Research.

Fisheries Resource Assessment Economics and Extension Division (FRAEED), CMFRI. (2023). *Marine fish landings in India – 2022* (CMFRI Booklet Series No. 31/2023). ICAR–Central Marine Fisheries Research Institute.

Government of India, Department of Fisheries. (2022). *Handbook on fisheries statistics 2022*. Ministry of Fisheries, Animal Husbandry & Dairying. (Various Issues).

Gopal, Nikita, and Holly M Hapke. (forthcoming). Report of the Scoping Study on Dried Fish Value Chains in Kerala, India. Scoping field research report. Cochin: Dried Fish Matters. University of Manitoba, Canada.

Harper S, Zeller D, Hauzer M, Pauly D, Sumaila UR (2013) Women and fisheries: contribution to food security and local economies. Mar Policy 39:56–63. https:// doi. org/ 10. 1016/j. marpol. 2012. 10. 018.

Kurien, J. (1985). Technical assistance projects and socio-economic change: Norwegian intervention in Kerala's fisheries development. *Economic and Political Weekly, 20*(25/26), A70–A88.

Kumar, P. (2004). Analysis of demand and supply projections for the fisheries sector in India. In Mruthyunjaya (Ed.), *Strategies and options for increasing and sustaining fisheries and aquaculture production to benefit poor households in India*. National Centre for Agricultural Economics and Policy Research.

Menon, A., Sowman, M., & Bavinck, M. (2018). Rethinking capitalist transformation of fisheries in South Africa and India. *Ecology and Society, 23*(4), 27. https://doi.org/10.5751/ES-10461-230427

Pravin, P., & Meenakumari, B. (2016). Purse seining in India – A review. *Indian Journal of Fisheries*, 63(3), 162–174. https://doi.org/10.21077/ijf.2016.63.3.50404-25

Salagrama, V. (2006). *Trends in poverty and livelihoods in coastal fishing communities of Orissa State, India*. FAO Fisheries Technical Paper No. 490. Rome: Food and Agriculture Organization of the United Nations.

Salagrama, V. (2012). *Climate change and fisheries: Perspectives from small-scale fishing communities in India on measures to protect life and livelihood*. Samudra Monograph. Chennai: International Collective in Support of Fishworkers and Heinrich Böll Stiftung–India.

Sathyapalan, J. (2014). *Rates and ratios for income accounting from fisheries sector of proposed Andhra Pradesh* (Report submitted to the Directorate of Economics and Statistics, Government of Andhra Pradesh). Centre for Economic and Social Studies.

Silas, E. G., Pillai, P. P., Dhulked, M. H., Muthiah, C., & Syda Rao, G. (1980). *Purse seine fishery: Imperative need for regulation* (Technical and Extension Series No. 24). Central Marine Fisheries Research Institute (CMFRI).

Srinivasan, J. T. (2023). India's fish and dried fish trade: An overview. In E. Thrift, M. Galappaththi, R. Chuenpagdee, R. Ghosh, W. W. Khaing, M. Rahman, A. Akter, & D. Johnson (Eds.), *Dried fish matters: Exploring the social economy of dried fish* (pp. 252–267). TBTI Global Publication Series. ISBN: 978-1-7773202-6-3. https://tbtiglobal.net/wp-content/uploads/2023/11/FINAL_Dried-Fish-Matters_e-book.smaller-file.pdf

Srinivasan, J. T., & Sathyapalan, J. (2023). Targeted versus non-targeted catch: A study of marine fisheries in Andhra Pradesh. *Economic and Political Weekly, 58*(2), 52–59. https://www.epw.in/journal/2023/2/special-articles/targeted-versus-non-targeted-catch.html

Vivekanandan, E., Hermes, R., & O'Brien, C. (2016). Climate change effects in the Bay of Bengal large marine ecosystem. *Environmental Development, 17*, 46–56. https://doi.org/10.1016/j.envdev.2015.07.002