



Socio-economic status of seaweed farmers in the Mandapam region of Tamil Nadu

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DOI: <https://doi.org/10.66856/ijbs.2026.11.3.11174>

Abstract

Seaweed farming is a climate-resilient aquaculture practice that provides sustainable livelihoods for coastal communities. However, the socio-economic characteristics of seaweed farmers, including education, income, and access to resources, remain inadequately documented, posing challenges to the sector's sustainable development. This study was undertaken to assess the socio-economic status of seaweed farmers in the Mandapam region of Tamil Nadu. Data were collected from 150 farmers using a structured interview schedule. The findings revealed that the majority of seaweed farmers were women (76%), while men constituted 24% of the workforce, with most (60.67%) belonging to the middle-age group. A considerable proportion had attained primary or secondary education, and 96.67% belonged to the OBC category. Seaweed farming was the primary occupation for 78% of respondents, and 96.67% had received formal training in cultivation. Approximately 36% of farmers had 16–20 years of experience, while 52.67% were indebted, primarily for household or farming purposes. The study underscores the need for targeted interventions and policy measures to improve the socio-economic well-being of all individuals engaged in seaweed farming, particularly women, thereby promoting the sector's sustainable and equitable growth.

Keywords: Socio-economic status, seaweed farming, *Kappaphycus alvarezii*, Mandapam

Introduction

Seaweed farming has emerged as a climate-resilient aquaculture activity that contributes significantly to food security, coastal livelihoods, and environmental sustainability. Seaweeds are large marine macroalgae that occur naturally in shallow coastal, marine, and brackish water ecosystems. Although nearly 12,000 seaweed species have been reported globally, only a limited proportion is cultivated on a commercial scale (FAO, 2022; Chopin, 2017) [8]. Seaweeds serve multiple purposes, including direct consumption, use as organic manure, and as raw materials for industrial products such as agar, alginate, and carrageenan, which are extensively utilized in the food, pharmaceutical, and cosmetic industries (Johnson *et al.* 2023) [12].

Seaweed farming provides regular income and employment opportunities for coastal populations, particularly small-scale fishers and women, and reduces dependence on capture fisheries (Krishnan and Narayanakumar, 2010) [15]. In addition, seaweed cultivation has received increasing attention for its potential environmental benefits, including carbon sequestration under the blue carbon framework, although these benefits are still under scientific assessment (Mendes *et al.* 2024) [18].

Global seaweed production has increased steadily, reaching 37.8 million tonnes (wet weight) in 2022. Asia accounts for

nearly 97% of global production, with China, Indonesia, the Republic of Korea, and the Philippines emerging as the leading producers. The most commonly cultivated species include *Eucheuma*, *Gracilaria*, *Porphyra*, and *Undaria pinnatifida* (FAO, 2024).

India has considerable potential for seaweed farming due to its extensive coastline and rich seaweed biodiversity. A total of 844 seaweed species have been documented from Indian waters, many of which are commercially important, particularly along the Tamil Nadu coast (Banerjee *et al.* 2020) [6]. Tamil Nadu, especially the Gulf of Mannar and Palk Bay regions, is recognised as one of the major seaweed diversity hotspots in the country. Commercial seaweed farming in India was initiated in the late 1990s with the introduction of *Kappaphycus alvarezii* cultivation technology in the Mandapam region of Tamil Nadu (Kaliaperumal and Kalimuthu, 1997) [13]. At present, Mandapam continues to serve as the principal centre for commercial seaweed farming, where farmers predominantly adopt the floating bamboo raft method with a harvest cycle of approximately 45 days (Johnson *et al.* 2017; Anuraj, 2023) [5, 11].

In the Mandapam region, seaweed farming has evolved into an important livelihood activity, engaging a large number of self-help group members with support from government agencies, financial institutions, private enterprises, and non-

governmental organisations (Krishnan and Narayanakumar, 2010) ^[15]. Despite its expansion, seaweed farmers in the region continue to face several socio-economic challenges, particularly with respect to income stability, access to resources, and institutional support.

Socio-economic status refers to the social and economic position of individuals or households and is commonly assessed using indicators such as age, education, occupation, income, assets, and social participation. These indicators play a crucial role in influencing livelihood outcomes and the adoption of improved technologies. An understanding of the socio-economic status of seaweed farmers is therefore essential for the formulation of effective extension strategies and policy interventions. In this context, the present study was undertaken to assess the socio-economic status and constraints of seaweed farmers in the Mandapam region of Tamil Nadu.

Materials and Methods

The study was conducted in the Mandapam region of Tamil Nadu, situated along the south-eastern coast of India, between 9°20'03.4" N latitude and 79°00'46.2" E longitude and 9°18'33.0" N latitude and 79°20'05.3" E longitude. For the purpose of the study, eight villages were selected from the Mandapam region, namely Munaikadu, Mandapam, Vedalai, Thonithurai, Mangadu, Sambai, Olaikuda, and Ariyangundu.

Within each selected village, seaweed farmers were identified based on the relative intensity of seaweed farming activities, accessibility, and their willingness to participate in the study. Consequently, the number of respondents varied across villages owing to differences in farming intensity and field feasibility. A total sample of 150 seaweed farmers was selected using purposive and convenience sampling techniques, as suggested by Kothari (2004) ^[14].

Primary data were collected using a pre-tested interview schedule comprising structured questions to ensure uniformity and reliability in data collection. Information was gathered on variables relevant to the objectives of the study, including gender, age, education, religion, social category, marital status, occupation, family type, family size, experience in seaweed farming, training received, participation in government schemes, and annual income.

Additional information was collected on housing characteristics (type of house and ownership), membership in cooperative societies, level of indebtedness, type of seaweed species cultivated, number of rafts owned, and number of crops cultivated per year. The collected data were systematically tabulated and analysed for interpretation. Descriptive statistical tools such as frequencies and percentages were used for data analysis.

Results and Discussion

The socio-economic characteristics of seaweed farmers in the Mandapam region of Tamil Nadu were analyzed, and the findings are presented in Table 1.

Table 1: Socio-economic characteristics of seaweed farmers in the Mandapam region

Variables	Categories	Frequency	Percentage (%)
Gender	Male	36	24.00
	Female	114	76.00
Age	Young (<30 years)	21	14.00
	Middle (30-50 years)	91	60.67
	Old (>50 years)	38	25.33
Educational level	Illiterate	12	8.00
	Primary	55	36.67
	Secondary	64	42.67
	Higher secondary	19	12.66
Religion	Hindu	118	78.67
	Muslim	16	10.67
	Christian	16	10.66
Category	OBC	145	96.67
	SC	5	3.33
Marital status	Married	144	96.00
	Unmarried	3	2.00
	Widow	3	2.00
Primary occupation	Seaweed farming	117	78.00
	Fishing	27	18.00
	Natural collection	6	4.00
Family type	Nuclear	127	84.67
	Joint	23	15.33
Family size	Up to 3	42	28.00
	4-6	102	68.00
	7 and above	6	4.00
Experience in seaweed farming	1-5	31	20.67
	6-10	22	14.67
	11-15	29	18.33
	16-20	54	36.00
	21-25	14	9.33
Training in seaweed farming	Received	145	96.67
	Not received	5	3.33
Beneficiary of government schemes	Yes	148	98.67

	No	2	1.33
Annual income	Below Rs.1 lakhs	29	19.33
	Rs.1-2 lakhs	47	31.34
	Rs.2-3 lakhs	26	17.33
	Rs.3-4 lakhs	33	22.00
	4-5 lakhs	12	8.00
	Above 5 lakhs	3	2.00
House ownership	Own house	150	100.00
House type	Tiled house	37	24.67
	Pucca	107	71.33
	Hut	6	4.00
Indebtedness	Indebted	79	52.67
	Non-indebted	71	47.33
Membership	Fishermen cooperative society	35	23.33
	Fisherwomen cooperative society	104	69.34
	Retired members	5	3.33
	No membership	6	4.00
Type of cultured method	Bamboo raft method	150	100.00
Type of species cultivated	<i>Kappaphycus alverazii</i>	150	100.00
Number of rafts	1–25	72	48.00
	26–50	64	42.67
	51–100	10	6.67
	Above 100	4	2.67
Number of crops per year	Four	3	2.00
	Five	125	83.33
	Six	22	14.67

Gender

The results indicate that women predominated in seaweed farming in the Mandapam region of Tamil Nadu, constituting approximately 76% of the workforce, while men accounted for only 24%. This clearly reflects the significant role of women in seaweed cultivation activities in the study area. Similar patterns have been reported in earlier studies by San Juan *et al.* (2024) ^[21] and Akhtar *et al.* (2021). Likewise, Mateo *et al.* (2021) ^[16] observed a pronounced female dominance in seaweed farming, with women comprising 93% of farmers and men accounting for only 7%.

Age

The findings reveal that a majority of the seaweed farmers (60.67%) belonged to the middle-age group, followed by the older age group (25.33%) and the younger age group (14%). This distribution indicates that middle-aged individuals are more actively engaged in seaweed farming, likely due to their experience, economic responsibilities, and physical capacity to undertake farming activities. The relatively lower participation of younger individuals suggests the need for targeted interventions to encourage youth involvement in the sector. Comparable results were reported by Sindhu Kavi *et al.* (2024) ^[23], who found that 70% of respondents belonged to the middle-age group (33–54 years), 17.5% were in the older age group (>54 years), and 12.5% were in the younger age group (<33 years).

Educational level

The findings indicate that the majority of seaweed farmers (42.67%) had completed education up to the secondary level, followed by primary education (36.67%) and higher secondary education (12.66%). Only a small proportion of respondents (8%) were illiterate. This educational distribution suggests a moderate level of formal education among seaweed farmers in the study area. Comparable results were reported by Mateo *et al.* (2021) ^[16], who observed that 46% of respondents had attained secondary

education, 37% had completed primary education, and 17% possessed a diploma. Similar trends have been documented in other studies, which reported that nearly half of the respondents had attained secondary education, while the remainder had either primary education or no formal schooling (Hamad and Mtae 2012; Seif 2013) ^[10, 22].

Religion

The results show that the majority of seaweed farmers in the Mandapam region were Hindus (78.67%), followed by Muslims and Christians, each accounting for 10.67% of the respondents. This religious composition reflects the general demographic pattern of coastal communities in the region. Similar observations were reported by Ahila *et al.* (2024) ^[2], who found that seaweed harvesters were predominantly Hindus. Likewise, Angela and Sharma (2023) ^[4] reported that 91.46% of respondents were Hindus, followed by Christians (7.28%) and Muslims (1.27%).

Category

It was observed that a large majority of the seaweed farmers belonged to the Other Backward Classes (OBC) category (96.67%), while only a small proportion (3.33%) belonged to the Scheduled Caste (SC) category. These findings indicate that seaweed farming in the study area is predominantly practiced by individuals from the OBC category. Comparable results were reported by Biswal *et al.* (2024) ^[7] in their study on the socio-economic status of gillnet operators in the Ratnagiri block of Maharashtra, where 70.80% of respondents belonged to the OBC category and 29.20% to the Special Backward Classes (SBC). Similar socio-economic patterns among aquaculture-based livelihoods were also noted by Angela and Sharma (2023) ^[4] in their study on shrimp farmers in Tamil Nadu.

Marital Status

The study revealed that the vast majority of seaweed farmers (96%) were married, while only 2% were unmarried and another 2% were widows. This distribution suggests

that seaweed farming is largely undertaken by individuals with family responsibilities and household commitments. Similar findings were reported by Mbunda *et al.* (2024)^[17], who observed that 69% of respondents were married, followed by divorced (14%), single (11%), and widowed (6%) respondents.

Primary Occupation

The results indicate that seaweed farming served as the primary occupation for a majority of the respondents (78%), while 18% were engaged in fishing and 4% in wild seaweed collection. This pattern reflects the growing dependence on seaweed cultivation as a stable and reliable income-generating activity in coastal areas. In contrast, Agyarko (2017)^[1] reported that fishing remained the dominant occupation, with 60% of respondents engaged in fishing, followed by farming (26.7%) and seaweed production (13.3%), suggesting regional variations in livelihood dependence.

Family Type

The study revealed that most seaweed farmers (84.67%) belonged to nuclear families, while only 15.33% lived in joint families. This trend indicates a shift towards nuclear family structures among coastal households engaged in seaweed farming. Similar findings were reported by Sindhu Kavi *et al.* (2024) and Ahila *et al.* (2024)^[23], who also observed that the majority of seaweed farmers resided in nuclear families.

Family Size

With respect to family size, the findings show that 28% of seaweed farmers had households comprising up to three members, 68% had between four and six members, and only 4% had seven or more members. This indicates that most households were of moderate size. Comparable results were reported by Mbunda *et al.* (2024)^[17], who observed that 65% of respondents had family sizes ranging from four to six members, followed by households with seven to ten members (25%) and one to three members (9%).

Experience in Seaweed Farming

The results reveal that a substantial proportion of seaweed farmers (36%) had 16–20 years of experience in seaweed farming, followed by 20.67% with 1–5 years of experience and 19.33% with 11–15 years of experience. Only 14.67% of farmers had 6–10 years of experience, while 9.33% had 21–25 years of experience. These findings indicate strong long-term engagement in seaweed farming among respondents. Similar trends were reported by Sindhu Kavi *et al.* (2024)^[23], who found that 75% of seaweed farmers had more than 10 years of experience, further supporting sustained participation in the sector.

Training in Seaweed Farming

The study revealed that a high proportion of seaweed farmers (96.67%) had received training in seaweed farming, while only 3.33% had not undergone any formal training. This reflects the effectiveness of training and extension efforts in the study area. In contrast, Syam *et al.* (2018)^[24], in their study of seaweed farmers in Jeneponto Regency, Indonesia, reported that 70% of farmers had not received

any training, while only 30% had undergone training. Ahila *et al.* (2024)^[2], in a gender analysis of wild seaweed harvesting in Tamil Nadu, reported that 51.67% of women had received training in seaweed farming, indicating variation in training coverage across regions and activities.

Beneficiary of Government Schemes

The study revealed that a large majority of seaweed farmers (98.67%) were beneficiaries of government schemes, while only 1.33% had not received such benefits. This high level of participation reflects the active role of government agencies in promoting seaweed farming through financial assistance, training programmes, and institutional support. Similar findings were reported by Hamad and Mtae (2012)^[10], who observed that government support plays an important role in encouraging participation in seaweed farming, although the level of support varies across regions.

Annual Income

Analysis of annual income revealed that 31.34% of seaweed farmers earned between Rs.1 lakh and Rs.2 lakh, followed by 22% earning Rs.3–4 lakh, and 19.33% earning less than Rs.1 lakh. Around 17.33% reported incomes between Rs.2–3 lakh, 8% earned Rs.4–5 lakh, and only 2% had an income above Rs.5 lakh. These results indicate a moderate but varied income range among the farmers. Comparable observations were reported by Narayanakumar and Krishnan (2013)^[19], who noted that in Mandapam, most respondents earned between Rs.20,001 and Rs.30,000, while 33% earned between Rs.10,001 and Rs.20,000. Sindhu Kavi *et al.* (2024)^[23] observed that 70.83% of marine fisherwomen engaged in seaweed cultivation earned between Rs.66,260 and Rs.132,198, highlighting regional differences in income levels.

Housing details

The study revealed that all the seaweed farmers (100%) owned their houses, indicating a high level of residential stability among the respondents. The majority (71.33%) resided in pucca houses, 24.67% in tiled houses, and only 4% in huts. These findings indicate relatively stable living conditions among seaweed farmers. Earlier assessments by Narayanakumar and Krishnan (2013)^[19] reported similar trends, although with greater variation in housing types, while Akhtar *et al.* (2022)^[3] noted that in Bangladesh, the majority of seaweed farmers' homes were constructed from bamboo, mud, and corrugated sheets. Ahila *et al.* (2024)^[2] reported that 63.34% of respondents in Tamil Nadu lived in pucca houses, 18.33% in kutchha houses, and 18.33% in semi-pucca houses.

Indebtedness

The study observed that 52.67% of seaweed farmers were indebted, while 47.33% were not. This indicates a notable reliance on credit to sustain livelihoods and farming operations. Ramakrishnan *et al.* (2023)^[20] similarly reported that 77.3% of respondents had obtained bank loans.

Cooperative Membership

Most farmers (69.34%) were members of fisherwomen cooperative societies, while 23.33% belonged to fishermen cooperative societies. Retired members (above 60 years)

accounted for 3.33%, and 4% had no cooperative affiliation. These results highlight the importance of cooperatives in supporting seaweed farmers. Ahila *et al.* (2024)^[2] reported that men and women aged 18–60 actively participated in cooperative societies, while Biswal *et al.* (2024)^[7] found that 99% of gillnet operators in Maharashtra were cooperative members.

Cultivated Species and Method

All farmers (100%) cultivated *Kappaphycus alvarezii* using the bamboo raft method, demonstrating uniformity in species and cultivation technique in the Mandapam region. By comparison, San Juan *et al.* (2024)^[21] reported that seaweed farmers in Palawan, Philippines, cultivated multiple species, including *E. denticulatum* (69.5%), *K. striatus* (63.6%), and *K. alvarezii* (48.1%). Hamad and Mtae (2012)^[10] found that 75% of Zanzibar farmers produced *Spinosa*, 7% *Cottonii*, and 18% cultivated both types.

Number of Rafts

The study revealed that 48% of seaweed farmers owned fewer than 26 rafts, 42.67% had between 26 and 50 rafts, and only 9.33% possessed more than 50 rafts. Johnson *et al.* (2017)^[11] reported similar findings in Ramanathapuram, Tamil Nadu, where most farmers utilized 25–45 rafts, indicating comparable farm scales.

Number of Crops per Year

It was observed that the majority of farmers (83.33%) harvested five crops per year, 14.67% harvested six crops, and only 2% harvested four crops annually. The average number of crops per year was five, aligning with Johnson *et al.* (2017)^[11], who reported four to six harvests annually in the Ramanathapuram district.

Conclusion

The study offers comprehensive insights into the socio-economic characteristics of seaweed farmers in the Mandapam region of Tamil Nadu. The findings highlight seaweed farming as a vital livelihood activity for coastal communities, particularly for women, who constitute 76% of the workforce. A majority of the farmers (60.67%) belonged to the middle-age group, 78.67% were Hindus, and 42.67% had attained education up to the secondary level. Most respondents (96%) were married, underscoring the family-oriented nature of the occupation. With respect to income, 31.34% of the farmers reported an annual income ranging from ₹1 lakh to ₹2 lakh. A substantial proportion of respondents (36.00%) had 16–20 years of experience in seaweed farming, reflecting long-term involvement in the sector. Most farmers (84.67%) lived in nuclear families, and 71.33% resided in pucca houses, indicating relatively stable living conditions. Seaweed farming served as the primary occupation for 78% of the respondents, and a high proportion (96.67%) had received formal training in seaweed cultivation. Cultivation predominantly involved *Kappaphycus alvarezii* using the bamboo raft method. Despite these socio-economic gains, more than half of the farmers (52.67%) were indebted, pointing to persistent financial vulnerabilities. The findings provide valuable inputs for policymakers, extension agencies, and development organisations to design targeted interventions

focusing on income diversification, financial inclusion, skill development, and institutional strengthening to ensure the sustainable development of seaweed farming in Tamil Nadu.

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