Available Online: 15 September 2026 DOI: 10.54254/2977-5701/2026.36823

From "White Pollution" to "Blue Granary": a multidimensional value study of the transition from traditional to ecological aquaculture

***Jie'an Xie*[1,*], *Tianlang Zeng*[2], *Yuchen Du*[3], *Haotian Bai*[4]**

[1]Luhe International Department, Beijing, China
[2]Guangzhou Peiying Middle School, Guangzhou, China
[3]Shanghai Qingpu World Foreign Language High School, Shanghai, China
[4]Chengdu Jinapple Jincheng No.1 Middle School International Program, Chengdu, China

*Corresponding Author. Email: xieja0719@sina.com

Abstract. Background: Traditional foam-based aquaculture in Dongshan Bay, Fujian, caused severe white pollution and ocean eutrophication. This study examines the multidimensional value of the transition from traditional to ecological aquaculture in the Xiaxikeng area. Methods: Field interviews with fishermen, on-site inspections, statistical analysis, and literature review were conducted. Results: Replacement of ~400,000 EPS foam buoys with HDPE plastic buoys, removal of 41,407 mu of illegal aquaculture, and installation of 100,000 plastic cages achieved significant ecological restoration. The 10,600-mu shellfish-algae co-culture area yields an annual carbon sink of 16,772.41 t, CO_2-equivalent (~¥946,100). Village collective income rose from ¥360,000 (2018) to ¥2.22 million (2024). Conclusions: The transition creates a positive feedback loop among ecological restoration, economic growth, and social governance, providing a replicable model for coastal China.

Keywords: Xiaxikeng, ecological aquaculture, transition value, blue carbon, HDPE buoys

1. Introduction

Traditional Expanded Polystyrene (EPS) foam buoys continuously release microplastics, impede seawater exchange, and cause severe ecological damage. Their disaster resistance is poor—they can only withstand winds up to level 10, leading to catastrophic losses during typhoons. Dongshan Island's Zhao'an Bay long relied on foam-buoy rafts for nearshore aquaculture (Figure 1). Extensive, unregulated expansion resulted in accumulated marine debris, overcrowded farming, deteriorating seawater quality, and escalating sea-use conflicts, while falling into a "high yield, low income" trap [1].

In 2019, the local government launched an ecological aquaculture pilot in Xiaxikeng Village. In 2021, 41,407 mu of illegal aquaculture were removed, bringing the total under control to 65,000 mu. A total of 100,000 plastic cages and 136,600 mu of floating raft systems were upgraded (Figure 2). In 2023, deep-water typhoon-resistant cages were introduced to replace traditional rafts (withstanding level-12 typhoons). This

Copyright: © 2026 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/).

research group observed that the specific transition from traditional to ecological aquaculture remains under-researched. Over 90% of Dongshan Island's residents depend on fisheries, yet their farming methods have been continuously evolving. This paper studies the ecological, economic, and social value of this transition [2].

2. Ecological value

2.1. Research background: the dual ecological dilemma of traditional nearshore aquaculture

As a mainstay of China's "Blue Granary" initiative, nearshore aquaculture under conventional practices faces two intertwined ecological deficits: plastic debris from farming structures and progressive eutrophication of semi-enclosed bays. During the extensive-farming era, widely adopted EPS foam floats persistently shed microplastics, giving rise to a "white pollution" crisis. Dense, unplanned raft arrays and uniform feeding regimes together promoted nitrogen and phosphorus loading, recurrent red tides and disease outbreaks, and a steady erosion of nearshore ecosystem services. By contrast, shellfish-algae Integrated Multi-Trophic Aquaculture (IMTA) acts as a central vector of fisheries blue carbon, concurrently delivering carbon sequestration, water-quality improvement and habitat recovery.

2.2. Multiple ecological benefits of shellfish-algae co-culture and blue carbon value realization

Functioning as a major blue-carbon reservoir, nearshore shellfish-algae culture simultaneously delivers carbon sequestration, water purification and habitat restoration. Macroscopic brown algae such as Gracilaria assimilate dissolved CO_2 through photosynthesis, whereas shellfish lock carbon away over the long term via shell calcification. Notably, the abalone-algae co-culture system attains an actual carbon stock 1.43-fold the theoretical sum of the two monocultures.

Photosynthetically fixed carbon partitions into two distinct pools (Figure 3): (1) a tradable biomass pool—harvested Gracilaria and carbon in shellfish shells, both captured by conventional carbon accounting; and (2) a non-tradable pool of Dissolved Organic Carbon (DOC), Particulate Organic Carbon (POC) and sediment-buried carbon (5%–19% of total fixed carbon), accessible only through scientific assessment. Because prevailing carbon-market accounting counts only the harvestable pool, the true sequestration capacity is systematically underestimated.

Using the 10,600-mu shellfish-algae farming area of Xiaxikeng Village, Dongshan, as a case and applying the HY/T 0305-2021 carbon-stock-change method, the annual carbon-sink capacity amounts to 16,772.41 t, CO_2-equivalent. At current carbon-market prices, this implies a trading value of roughly ¥946,100, converting marine carbon sequestration into a marketable ecological product [3].

For water-quality recovery, experimental evidence indicates that Gracilaria strips more than 80% of inorganic nitrogen and inorganic phosphorus from aquaculture waters, markedly curbing eutrophication and red-tide incidence. Following the combined measure of buoy replacement and ecological retrofitting, phosphate levels in Dongshan Inner Bay fell by over 75%, with seawater quality holding steady at Class II [4]. Relative to conventional high-density fed culture, blue-carbon IMTA rebuilds the nearshore trophic web, curtails pollutant build-up, lowers disease pressure and reduces pharmaceutical dependence. Xiaxikeng Village channels part of its carbon-trading revenue into routine marine litter collection, coastal vegetation upkeep and sea-area stewardship, closing a virtuous loop of "ecological restoration → enhanced carbon sink → revenue reinvestment".

2.3 HDPE eco-friendly plastic buoys: tackling white pollution

HDPE plastic buoys bring several environmental and engineering benefits. Their one-piece sealed construction resists fracture and lasts 10–15 years—far outlasting traditional EPS foam buoys (1–3 years). Greater structural strength yields superior wave and impact resistance, substantially limiting the secondary marine debris generated by typhoon damage. At end of life, intact buoys can be centrally recycled, supporting whole-lifecycle environmental management and severing the chronic plastic-pollution chain at its source.

For their part, conventional EPS foam buoys—despite low upfront cost, light weight and adequate buoyancy—have a loose physical structure that readily pulverizes under wave action, ultraviolet exposure and biological abrasion. Microscopic foam fragments are difficult to recover fully at sea and persistently release microplastics, exerting prolonged ecological pressure on plankton, benthic shellfish and fish.

Once Dongshan County replaced roughly 400,000 white foam buoys, microplastic discharge was cut sharply at source. The regularized raft layout also broadened seawater-exchange channels and rehabilitated the coastal landscape. Coupled with Gracilaria's water-purifying effect, inner-bay phosphate concentrations declined by more than 75% and seawater held at Class II, laying a sound ecological foundation for blue-carbon accounting and trading. This realizes a triple linkage among infrastructure upgrading, marine environmental restoration and blue-carbon value realization, steering nearshore aquaculture toward long-term ecological sustainability.

2.4. A dialectical perspective: practical advantages and transition resistance of traditional EPS foam buoys

Field interviews led us to a dialectical assessment of whether "white foam buoys are entirely harmful". EPS buoys are not wholly deleterious: they retain irreplaceable practical advantages for smallholders, precisely the reason many farmers resist the transition.

Table 1. Comparison between EPS foam buoys and HDPE plastic buoys

Comparison Dimension	EPS White Foam Buoy (Pros & Cons)	HDPE Plastic Buoy (Pros & Cons)
Economic Cost	Pro: Low purchase price; Con: Frequent replacement, higher long-term cost	Con: High one-time cost; Pro: 10+ years without replacement, saves money long-term
Ecological Impact	Con: Easily weathers and fragments, continuously releases microplastics	Pro: One-piece sealed structure, resists breakage, recyclable at end-of-life
Engineering Durability	Con: Low strength, easily destroyed by typhoons, generates marine debris	Pro: Structurally robust, wind/wave/UV resistant, minimal disaster loss
Recycling	Pro: Lightweight and easy to handle; Con: Fragments scattered at sea, impossible to fully recover	Pro: Intact units for centralized recycling; Con: Relatively heavy, slightly harder to move at sea

First, their economic-cost advantage is striking: foam buoys are inexpensive, substantially lowering the upfront outlay for small and medium producers. HDPE plastic rafts, by comparison, carried a high initial unit cost (over ¥900 in the pilot phase, later subsidized to ¥400), yet farmers still bore most of the replacement expense—a genuine financial burden for lower-income aquaculture households.

Second, foam buoys are readily recycled: when damaged, farmers can simply carry them onto the raft and haul them ashore for centralized disposal, revealing a clear willingness to recycle.

On balance, the cost convenience of foam buoys (Table 1) suits only small-scale extensive farming and cannot resolve the chronic microplastic pollution caused by weathering. Relying on voluntary farmer recycling alone will not root out marine white pollution. Infrastructure upgrading therefore remains indispensable for long-term bay protection, and local governments can lower farmers' economic resistance by raising purchase subsidies and creating low-interest agricultural loans.

3. Economic value

3.1. Breaking the "Tragedy of the Commons": resource assetization and institutional economics restructuring

Under the traditional marine governance framework, ill-defined sea-area property rights and intermittent regulatory oversight allowed aquaculture in Dongshan Island and Zhao'an Bay to lapse into a classic "Tragedy of the Commons". Motivated by "first-come, first-served" self-interest, farmers competitively raised the density of foam-buoy and wooden-raft installations. This disorderly expansion severely encroached upon navigation channels and pushed the bay's hydrodynamic circulation to the verge of collapse, producing a dirty, disordered and hazardous marine setting rife with boundary disputes. Economically, a production model that fails to internalize externalities inevitably stagnates or regresses in Total Factor Productivity (TFP).

3.2. Facility resilience upgrade and Life-Cycle Cost (LCCA) reduction

A less visible dimension of economic value lies in the sharp reduction of systemic risk and depreciation cost through facility upgrading. Situated in a typhoon-prone southeastern coastal zone, conventional EPS foam buoys and wooden rafts (withstanding at most level-10 winds) are exceedingly fragile. Aligning with the "white-to-plastic" policy, Dongshan Rural Credit Union extended ¥2.67 billion in loans for county-level marine-economy development, representing 53.33% of its total loan balance. Provincial, municipal and county fiscal authorities subsidized up to 50% of upgrade costs. The deep integration of fiscal transfers and green finance removed the capital bottleneck confronting fishermen as they shifted from traditional smallholder production to modern, capital-driven fisheries [5, 6].

3.3. The "reduction-for-increase" mechanism

"Reduction-for-increase" sits at the conceptual core of the ecological transition. "Reduction" means cutting the absolute physical density of farming infrastructure, whereas "increase" denotes the biological positive feedback and exponential economic returns unlocked once environmental capacity is released. This captures the nonlinear relation between environmental carrying capacity (K) and optimal yield in bioeconomics. The economic evaluation dimensions are summarized in Table 2.

3.3.1. Accelerated water flow and dramatically shortened farming cycles

Following the removal of redundant infrastructure and the upgrading of nearly 1,800 plastic rafts and 500,000 plastic buoys across Dongshan County, the seascape was transformed: distinct physical boundaries emerged between navigation channels and aquaculture zones. Dense foam buoys had formerly acted as underwater walls, blocking tidal exchange; once density was reduced, current velocities in Zhao'an Bay and Dongshan Inner Bay rose markedly. Swifter flow imports more Dissolved Oxygen (DO) and richer planktonic microalgae—natural nourishment for filter-feeding shellfish such as oysters—while flushing away residual feed and excreta, preventing localized eutrophication and disease outbreaks.

With controlled spacing between farming units, oysters no longer compete for nutrients in cramped quarters and feeding efficiency improves qualitatively. Field observations and farmer feedback corroborate that accelerated flow shortens the oyster growth cycle, raises survival rates and yields larger, fuller individuals that command higher market premiums—realizing "counter-trend income growth" under total-volume control.

3.3.2. Revenue leap in the gracilaria industry and technical breakthroughs

Gracilaria is a major commercial seaweed and an essential feedstock for high-value abalone (notably green disk abalone). In Dongshan and Zhao'an, Gracilaria farming has shifted from extensive hanging culture toward scalable, intensive production, with revenue expanding explosively. Water-quality gains—Gracilaria removes over 80% of inorganic nitrogen and phosphorus—together with Dongshan's natural advantages (ample sunlight, suitable water temperature and optimized density), permit harvest cycles of about 4–7 days and demonstrate an exceptionally high biomass conversion rate [7].

Taking Xiaxikeng Village, Qianlou Town, as an example, the village allocated one-third of its farming volume (~2,600 mu) to standardized Gracilaria hanging culture. Through a chained production model, the village realized end-to-end "seedling → processing → hanging → harvesting → sales" services, eliminating intermediary profit erosion. The village alone now produces over 60 million jin (≈30,000 t) of Gracilaria annually, generating nearly ¥30 million in direct output value. In the outer deep waters of Zhao'an Bay, strings of Gracilaria form expansive "sea vegetable gardens"; one aquaculture enterprise harvested 5 million kg last year, satisfying the feed demand of roughly 200,000 kg of green disk abalone and constructing a full-chain closed loop of "breeding → farming → production → sales" for deep cost reduction and income growth.

Table 2. Economic evaluation dimensions: data and summary

Economic Dimension	Traditional High-Density Model	Post-Ecological Model	Value-Enhancement Mechanism
Spatial Efficiency	Very low (encroachment, tragedy of the commons)	Very high (registered property rights, competitive bidding)	Clear property rights drive intensive management; secondary market enables Pareto improvement
Capital & Lifespan	Very low; EPS life 1–3 yrs, weak typhoon resistance	Higher; HDPE life 10–15 yrs, resists level-12 typhoons	Capital replaces cheap infrastructure; life-cycle costs reduced; typhoon-risk eliminated
Hydrodynamics & Cycle	Flow blocked, hypoxia & disease, long cycle	Faster flow, higher DO, shorter cycle	Released carrying capacity improves size and quality; accelerates capital turnover
Gracilaria Economy	Seasonal supply gaps, reliance on northern seedlings	Year-round supply, ¥30 million/village	Lower logistics & loss costs; full-chain closed loop; labor dividend released
Externality Mgmt.	Waste discarded freely, pollution cost socialized	Oyster shells converted to soil conditioners	Internalization of negative externalities; circular economy turns pollution cost into product revenue

3.3.3. Labor activation and waste resource utilization for cost reduction

The economic benefits of "reduction-for-increase" extend beyond corporate balance sheets to generate inclusive employment effects. Gracilaria harvesting and bundling are light, labor-intensive manual tasks. At peak season, large numbers of idle elderly residents (50–70 years old) and targeted poverty-alleviation beneficiaries from Xiaxikeng and surrounding villages are mobilized, securing considerable wage income—directly converting idle labor resources into household-level economic value.

The circular economy further plays a pivotal cost-reduction role. Zhao'an County produces 326,000 t of oysters annually, yielding about 100,000 t of waste oyster shells that once posed a massive environmental burden. Centralized collection and transport systems have since been established, and resource-utilization projects now convert waste shells into higher-value products such as soil conditioners. This "oyster farming → waste-shell collection → scientific processing" circular chain turns what was formerly a pollution-control cost into "green wealth", achieving a further dimension of "reduction (of pollution) and income growth" at the macro-industrial level.

3.4. "High value-addition": deep-sea platforms and marine ranching capitalization

If "reduction-for-increase" optimizes existing nearshore space, "high value-addition" extends into deep-sea incremental space. As nearshore carrying capacity nears saturation, deploying modern heavy offshore equipment in deeper waters (15–50 m) to produce high-premium seafood has become a core strategic direction for Dongshan and Zhao'an.

Off the coast of Zhao'an Bay, the local government attracted investment from state-owned Danzhao Assets and Fujian Haichao Machinery, which partnered with Pingtung Aquaculture Cooperative to invest ¥210 million in a deep-water cage project. The planned sea area spans 290 hectares, with 23 ultra-large semi-submersible deep-water cages totaling 592,900 m³ of farming volume. In November 2023, the first four units were deployed, marking Zhao'an's formal shift from "shallow blue" to "deep blue". Upon full completion, estimated annual output will exceed 6,000 t, with annual output value approaching ¥500 million and over 500 upstream and downstream jobs created [8, 9].

3.5. Industrial boundary expansion: fishery-tourism integration, blue carbon, and secondary industry extension

Deep-sea platforms such as "Mintou Dongshan No.1" are conceived as multifunctional marine complexes integrating "deep-sea equipment aquaculture + leisure tourism". Accommodating 150 people for sea fishing, sightseeing and science education, plus roughly 50 overnight guests, the model taps urban demand for high-end marine cultural tourism. The "catch-cook-sell on site" experiential marketing shortens the ROI cycle for heavy offshore equipment. Additionally, Zhangpu is exploring "fishing-solar complementarity" and "wind farm + pasture" dual-use models, stacking clean-energy and premium seafood production within the same sea area [10, 11].

The realization of blue-carbon value is likewise of historic significance. The 10,600-mu shellfish-algae area in Xiaxikeng yields an annual carbon sink of 16,772.41 t, directly convertible to ¥946,100 through carbon trading—overturning the conventional view of environmental protection as a pure cost center. Within the industrial park, anchor firms such as Runke Biotechnology lead a cluster of seven national high-tech enterprises; in 2022, the regulated output value reached ¥2.1 billion (up 10.43% year on year), completing the value leap from agricultural product to high-tech industrial good [12].

4. Social and governance value

The ecological restructuring of aquaculture rafts is far more than an infrastructure upgrade; it reconstitutes marine governance itself. Its social and governance value unfolds across three levels—navigation safety, property-rights clarification and fishery-tourism integration—and this chapter cross-validates these dimensions against government documents, historical records and field interviews.

4.1. Navigation safety: from "encroachment and blockage" to "unimpeded flow"

Prior to the transition, Xiaxikeng Village was plagued by rampant illegal sea occupation, channel encroachment and disorderly raft construction. As one village official recalled: "A few bamboo poles and ropes, and the sea belonged to whoever got there first—some channels were narrowed to just a few centimeters". Driven by profit, individuals recruited outsiders to arbitrarily seize sea areas, leaving the seascape in a "free, disorderly, and unbounded" condition rife with disputes and safety hazards.

In December 2019, Qianlou Town mobilized the County Marine and Fisheries Enforcement Brigade and the Border Defense Police Station, deploying five vessels and over 80 personnel to clear 350 mu of channel area. In 2021, remediation of the Zhao'an Bay Dongshan Qianlou area was launched [13]. Over three years, the town cleared nearly 8,000 mu of prohibited aquaculture, replaced ~500,000 foam buoys with more durable plastic ones and upgraded nearly 1,800 plastic rafts. Larger farmers confirmed: "Multiple channels were designated, the overall area is much larger now"—evidence that clear boundaries between navigation channels and aquaculture zones have taken shape [14-17].

In November 2024, Southern Fujian Daily interviewed Xu Ruixiang, owner of a sea-based restaurant in Xiaxikeng: "A few years ago, the sea was disordered, channels were blocked, water quality was poor, and farming income was low. Over the past two to three years, the sea has widened, the water has cleared, and business is getting better". This attests to a shift in navigation-safety governance—from ex-post cleanup to ex-ante planning, and from campaign-style enforcement to institutionalized control [15, 18].

4.2. Property rights clarification: from "ancestral sea" to "asset sea"

Securing sea-area use certificates is a prerequisite for clarifying property rights. In March 2017, the Dongshan government allocated ~5,663 mu of sea area adjoining Xiaxikeng to the village; the first batch of 1,510 mu of certificates was processed in 2018, and the second batch of 4,153 mu in August 2019. Yet, owing to institutional restructuring and weak inter-departmental coordination, the sea area once fell into an "afraid to invest without certificates" predicament [19].

Since 2023, Qianlou Town has applied a "Four Fixes and One Supervision" mechanism—fixing the reserve price, term, procedures and binding clauses, coupled with full-process disciplinary oversight. After public consultation, the town restricted collective sea-area contracting to village residents; the village committee transparently disclosed reserve prices, contract terms and procedures; and the town discipline inspection commission supervised the entire sequence of resource recovery, pricing and contracting, with bidding plans pre-announced and sessions live-streamed [15, 18-20].

Concrete outcomes: Xiaxikeng now holds 4,691 mu of sea-area use certificates and 10,600 mu of aquaculture certificates. A total of 8,352 mu was contracted in seven lots at an average price of ~¥91/mu, yielding ¥2.57 million over three years. The town rectified 262 legacy issues, recovered ¥177,400 in arrears, standardized 109 collective-asset contracts and lifted village revenue by ¥3.78 million. Xiaxikeng's village revenue rose from ¥360,000 (2018) to ¥1.3 million, reaching ¥2.22 million in 2024 [15].

Field interviews indicated that a large-scale farmer operating 700+ cages pays ~¥70,000/year for sea-surface lease (about 30 mu at ~¥2,000/mu). This micro-level account is consistent with the macro-level "paid sea use" mechanism, confirming that property-rights reform has permeated individual operating-cost structures.

Tensions nevertheless remain between policy objectives and operational experience. The government mandates HDPE plastic buoys over foam, citing superior environmental performance, while interviewed farmers favor wooden rafts ("cedar can last 10–20 years"), pointing to slippery surfaces (a fall risk for workers) and questioning "cut-off plastic fragments sink to the seabed—is that really eco-friendly?" This suggests that ecological standards must accommodate frontline safety logic and operational know-how [15].

4.3. Fishery-tourism integration: from "single-species farming" to "fishery-tourism symbiosis"

At the industrial level, Xiaxikeng's mariculture output value surpassed ¥200 million in 2024, with average farmer income reaching ¥400,000/year. Fishery-tourism integration changed villagers from "half-year idle" to "year-round active". One farmer remarked: "Previously, farming alone earned money for only half the year; now there's work and income all year round". In June 2023, the village founded Fujian's first village-level blue-carbon service center, with annual carbon-trading value of ¥946,000; since 2023, ¥690,000 in carbon credits have been purchased, and part of the proceeds has been reinvested in marine debris removal and ecological governance, forming an "ecology-economy-governance" closed loop [15, 19-22].

At the governance level, Qianlou Town formed a "Rural-Fishery-Tourism Shared Prosperity" joint Party committee centered on Xiaxikeng, with surrounding villages investing capital, assets and resources into fishery-tourism projects. The town also adapted the maritime "Fengqiao Experience", partitioning the sea area into 14 maritime grids covering eight docks, 956 township vessels and 500+ maritime workers.

Field interviews revealed stratification in fishery-tourism participation: larger farmers have introduced ¥98 sea-fishing packages (including transport, on-site cooking and family activities), citing "difficulty in promotion, not access"; meanwhile, pure farmers avoid tourism for fear of "tourists damaging nets (each worth hundreds of thousands)". This has produced a separation between production rafts and tourism rafts. Tourism, moreover, operates "entirely spontaneously, without guidance or subsidies", and somewhat larger operations face frequent inspections—a regulatory pattern that moderately constrains small farmers' ability to spread costs through multi-industry integration.

5. Conclusion

In summary, the ecological transition of mariculture in Dongshan Island and Zhao'an Bay addresses the "Tragedy of the Commons" through property rights restructuring, achieves reduction-for-increase via facility upgrades and spatial optimization, and completes value leap via deep-sea equipment and multi-industry integration—establishing a virtuous cycle of mutual reinforcement between ecological improvement and economic growth.

The transition tackles two major challenges of traditional nearshore aquaculture: foam microplastic pollution and seawater eutrophication. It demonstrates that shellfish-algae co-culture delivers dual ecological benefits—carbon sequestration trading and water purification—with the demonstration area generating nearly ¥950,000 in annual carbon value, the revenue of which is reinvested in sea area governance. The clean-sea campaign cleared nearly 8,000 mu of prohibited aquaculture and replaced 500,000 buoys, restoring navigation channels from "blocked" to "wide and clear", boosting local trade.

The promotion of durable, recyclable HDPE plastic buoys remains essential, yet the high upfront cost creates financial pressure for fishermen, and some farmers' production habits are not fully aligned with new technologies. Future challenges may include talent shortages and insufficient funding. Nevertheless, this transition represents a bold and valuable experiment, providing a practical template for coastal aquaculture ecological transition and blue carbon economy development, laying a solid foundation for future growth.

References

[1] The People's Government of Fujian Province. (2024, March 3). *Sea-area "registration": Assetizing marine resources*. https://www.fj.gov.cn/zwgk/ztzl/sxzygwzxsgzx/sdjj/hyjj/202403/t20240303_6408450.htm

[2] People's Daily Online Fujian Channel. (n.d.). *Zhangzhou Zhao'an: Clean water, fat fish, happy laughter.*

[3] Yan, X., Zhou, X., & Han, H. (2024). Accounting pathways and value realization models for blue carbon in China's shellfish and algae fisheries. *Acta Oceanologica Sinica, 46*(6), 1–12.

[4] Tang, K. (2005). Bioremediation of eutrophic seawater by *Gracilaria*. *Acta Ecologica Sinica, 25*(11), 3004–3009.

[5] The People's Government of Fujian Province. (2024, March 3). *Zhangzhou: Outstanding results in fisheries carbon sink commercialization.* https://www.fj.gov.cn/zwgk/ztzl/sxzygwzxsgzx/sdjj/hyjj/202403/t20240303_6408450.htm

[6] The People's Government of Dongshan County. (2021). *Dongshan County action plan for marine aquaculture transformation and upgrading (Draft)*.

[7] The People's Government of Fujian Province. (2025, July 4). Good ecology can make money! *Fujian Provincial Government*. https://www.fujian.gov.cn/zwgk/ztzl/sxzygwzxsgzx/sdjj/hyjj/202507/t20250704_6961482.htm

[8] China Classification Society. (2023). "Mintou Dongshan No.1": Yellow croaker capacity and leisure fishery configuration. *China Classification Society*. https://www.ccs.org.cn/ccswz/articleDetail?id=202303170877901194

[9] Fujian San Nong Info. (2022, November 25). "Mintou Dongshan No.1" project investment, scale, and industrial background. *Fujian San Nong Info*. http://www.fujiansannong.com/info/82740

[10] Fujian San Nong Info. (2023). Spatial stacking reuse (fishing-solar, wind farm + pasture) and deep-sea economy models. *Fujian San Nong Info*. http://www.fujiansannong.com/info/87455

[11] The People's Government of Fujian Province. (2023, April 13). Zhao'an Bay marine biotech industrial park and secondary industry. *Fujian Provincial Government*. https://www.fj.gov.cn/zwgk/ztzl/sxzygwzxsgzx/flsxkmh/202304/t20230413_6148538.htm

[12] The People's Government of Fujian Province. (2026, January 21). Zhangzhou rural revitalization & cultural creativity. *Fujian Provincial Government*.

[13] Dongshan News. (2019, December 12). *Joint action: They become maritime "scavengers."*

[14] Zhangzhou Discipline Inspection Commission. (2019, November 22). *Dongshan: Full-force rectification, joint resolution of public concerns.*

[15] Dongshan County Government. (2024, April 10). *Qianlou Town: Singing the "tourism song," pioneering a rural revitalization path through agriculture-fishery-tourism integration.*

[16] Zhangzhou Municipal Government. (2026, January 21). *Rural revitalization & cultural creativity: Zhangzhou, Fujian—Exploring ancient charms and mountains-sea wonders.*

[17] China Agricultural Net. (2026, May 16). *Demonstration villages (first batch): Zhangzhou City*.

[18] Fujian Provincial Department of Ecology and Environment. (2024, October 10). *Clear waters, blue seas, fishing and farming fun.*

[19] Xiamen Ocean Vocational College. (2025, October 16). *Party building spotlight: Fujian Zhangzhou—Rising tides, red sails.*

[20] Dongshan Discipline Inspection Commission. (2024, September 26). *Four fixes and one supervision: Qianlou Town enhances "three-asset" oversight, safeguarding the "blue barn."*

[21] CCTV. (2025, July 15). *Zhangzhou Xiaxikeng Village: The metamorphosis of a small fishing village.* https://big5.cctv.com/gate/big5/local.cctv.com/2025/07/15/ARTIIGEeyZQIFRDFnS8kAYpq250715.shtml

[22] Zhangzhou Rural Revitalization. (2021, April 16). D*ongshan Xiaxikeng: Industrial integration, livable and business-friendly village.*