

Analysis on benefit enhancement links for consumers and producers in abalone aquaculture

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Abstract. The abalone aquaculture industry in Dongshan County, Fujian Province, has achieved remarkable scale expansion, yet producers face rising costs and falling prices, while consumers struggle with quality uncertainty and price volatility. This paper systematically analyzes the breeding varieties, farming models, production processes, and market price fluctuations of Dongshan's abalone industry, identifying core contradictions between supply-side cost pressures and demand-side market segmentation. From the theoretical perspective of maximizing producer and consumer surplus, the study proposes six optimization pathways: seedling quality traceability, collective feed procurement and localized substitution, standardized farming management, graded pricing with diversified marketing channels, deep-processing as a market buffer, and regional price early-warning with emergency procurement mechanisms. The findings demonstrate that a coordinated industry-wide system for cost reduction, quality stabilization, and risk hedging can simultaneously improve producers' profit margins and consumers' value perception, fostering a mutually beneficial equilibrium and providing practical guidance for sustainable abalone aquaculture development.

Keywords: abalone breeding, win-win benefits, industrial chain optimization, price fluctuation, risk prevention and control

1. Introduction

Abalones, as an important economic shellfish species in China's marine products, are known as "one mouthful of abalones equals one mouthful of gold". They are traditional precious ingredients in China and rank first among the four major seafood delicacies. Fujian Dongshan is a nationally renowned hometown of abalone seedlings, and the abalone industry is a pillar of the local marine economy. The most distinctive feature is that the seedling industry is highly developed (with an annual output of approximately 6 billion seeds, accounting for about 60% of the national total). The processing and export industry is well-coordinated, forming a complete industrial chain from seedling breeding to farming, processing, and export.

Based on recent data, in 2022, the annual output of abalone seedlings in Dongshan County was 2.8 billion seeds, and the area of sea farming was 4,725 acres. This created nearly 20,000 jobs, and the value of the whole

industrial chain kept rising. In 2024, there were over 1,600 onshore abalone farms in the county, with an annual output of 6 billion abalone seeds and an output value exceeding 1.5 billion yuan. Many of these abalone seeds were sold to major breeding areas across the country, such as Lianjiang and Shandong. Fresh live abalone output also continued to grow, and the sea farming area expanded. Finished abalones supplied major aquatic product markets in China and were also exported in large quantities to overseas markets.

By 2025, the area of abalone farming in the Dongshan sea area will exceed 5,500 acres, with an annual output of 14,900 tons of fresh finished abalones and an output value of approximately 1.2 billion yuan. The output of the entire abalone industrial chain will reach 5.7 billion yuan. Abalone product exports will total 1.48 billion yuan, which is 59.9% higher than the previous year. Among these exports, the value of live abalones will reach 153 million yuan, and abalone products account for nearly 70% of the national total. The abalone industry in Dongshan has excellent development conditions. The hydrological environment of the Dongshan Bay is suitable for abalone breeding and growth, combined with the long-term accumulated breeding technology, the seedling advantage is prominent. The local industry has continuously transformed and upgraded, achieving the coordinated development of onshore breeding and marine ecological farming, updating breeding varieties, and optimizing breeding models. At the same time, it has laid out abalone deep processing, enriching product types, extending the industrial chain, and reducing the market fluctuation risks brought by the sale of live abalones. However, the industry also has shortcomings. A large proportion of small-scale farmers account for a significant share, and when facing market declines, they have weak anti-risk capabilities, easily falling into the situation of high production but low profits and weak anti-risk capabilities.

In the past, abalones relied on wild fishing, with limited output, and were high-end banquet ingredients. With the continuous breakthroughs in artificial breeding and farming technologies, the abalone industry has expanded rapidly, and abalones gradually appeared on the dining tables of ordinary families. The following will analyze the main varieties of abalones, breeding models, recent market prices, the production status of the abalone industry in Dongshan County, and the definition of producer and consumer mutual benefit from an economic perspective.

2. Abalone farming methods and varieties

2.1. Varieties

There are approximately 7 species of farmed abalones distributed along the coast of China. Among them, the largest and most common species for artificial farming are mainly divided into two major groups—the northern and southern varieties. Different species show significant differences in their ability to withstand high temperatures (Table 1), growth rate, and individual size, which directly affect the farming efficiency and market positioning.

Haliotis discus hannai, commonly known as the northern abalone, has long been one of the main cultublue varieties in northern China. Its shell is dark brown or blue-green, and it is among the largest abalone varieties in terms of individual body size. Early cultivation was concentrated in the Yellow Sea and Bohai Sea regions. Farmers value this species for its firm flesh and product quality, but it has relatively low tolerance to high temperatures and often shows higher mortality in summer.

Table 1. Varieties of abalone

Variety	Major Farming Regions	Key Advantages	Major Disadvantages	Market Characteristics
Wrinkled Abalone	Bohai Sea, Yellow Sea, Fujian	Large size; firm and high-quality meat	Heat-sensitive; high summer mortality	Premium quality; requires relay farming
<i>Haliotis diversicolor</i> (Jiukong Abalone)	Fujian, Guangdong	Fast growth; good adaptability	Weak disease resistance	Widely used for hybrid breeding; mid-to-high-end market
Green-Disc Abalone (Huangjin Abalone)	Dongshan, Fujian	Fast growth; large size; short cycle	High seeding cost	Large-scale farming in Dongshan
Xipan Abalone (Fubao No. 1)	Southern coastal Chian	Heat-tolerant; suitable for warm waters	Short market promotion period	Mainly a newly promoted variety

Haliotis diversicolor, commonly referred to as the diversified abalone, is native to southern China and is well adapted to the marine conditions of Fujian and Guangdong. It grows relatively quickly, but its disease resistance is weaker, which makes it prone to disease outbreaks and mortality during high-temperature periods. For that reason, it was widely used in the earlier stage of abalone aquaculture in southern China, but its current role is mainly as a breeding parent in hybridization programs.

Green-Disc Abalone is a hybrid variety developed by crossing American green abalone with *Haliotis discus hannai*. It has a relatively fast growth rate and better environmental adaptability. Some individuals can reach a weight of more than 0.5 kg (1 jin). The farming cycle is shorter than that of traditional abalone varieties. There is a trade-off, however. Its seedling costs are higher, which raises the initial investment needed for cultivation. Even so, its finished products are generally sold in the mid-to-high-end market, and its farming scale in Dongshan County has continued to grow. In addition, improved varieties such as Xipan Abalone and Fubao No. 1 have also been developed. These varieties were selectively bred for better high-temperature tolerance, so they are more suitable for the warm seawater conditions common in southern China during summer. Their use can reduce mortality and limit production losses for farmers.

Among these varieties, Huangjin Abalone is the main variety cultivated in Dongshan County. Huangjin Abalone is a high-quality cultivated abalone variety with relatively high economic value. It is widely recognized in the market because of its thick and fleshy meat, distinctive flavor, and relatively high nutritional value.

Huangjin Bao (green-shell abalone) is a new hybrid abalone variety developed by the research team from the College of Ocean and Earth Sciences at Xiamen University after more than a decade of selective breeding. It has been designated as a nationally recommended aquaculture species by China's agricultural extension authorities. Compared with conventional abalone, this variety has a shell size 3–5 times larger, and individual specimens can reach a maximum wet weight exceeding 500 g.

It also has better thermal tolerance. Its upper lethal temperature threshold is 2.26 °C higher than that of the traditional *Haliotis discus hannai*, and under the same culture conditions, its growth rate is approximately 50 % faster. Over a standard rearing cycle, it shows higher survival rates and a yield increase of about 30 % compared with the conventional strain. For these reasons, this variety is now being promoted as a premium aquaculture species in the Dongshan Island region.

Huangjin Bao is mainly sold to the high-end hotel and restaurant market, and both seed juveniles and market-sized adults are priced well above ordinary abalone. Huangjin Abalone is mainly sold to the high-end hotel and restaurant market, and its price tends to fluctuate more sharply than that of ordinary abalone when typhoons, algal blooms, or demand weakness occur.

In recent years, improvements in aquaculture technology have pushed Huangjin Bao farming toward larger-scale, more standardized, and more precise operations. This shift has helped meet market demand and has given Huangjin Bao a steadier place within the aquaculture sector. Its cultivation involves several linked stages, including hatchery seedling production, feed management, water quality regulation, disease prevention and control, harvesting, and marketing. Each of these stages not only directly affects product quality and food safety but also bears on production costs, economic returns, and consumer satisfaction. Therefore, identifying the critical links in the Huangjin Bao farming process that generate value for both consumers and producers is of considerable significance for promoting the sustainable development of the industry and achieving mutually beneficial outcomes for supply and demand sides.

2.2. Breeding methods

Table 2. Abalone farming model

Abalone Farming Model	Core Operations	Main Distribution Areas	Advantages	Disadvantages
Industrial Land-based Aquaculture	Indoor tanks with recirculating seawater; controlled conditions and feeding	Shandong, Liaoning, Fujian; Dongshan	High environmental control; low weather risk	High investment and energy cost; mainly for seedlings and small-scale farming
Shallow-sea Raft-based Suspended-cage Aquaculture	Multi-layer cages suspended from rafts; natural seawater and kelp feeding	Fujian, Dongshan, and other coastal areas	Low investment; good water exchange and oxygen supply	Vulnerable to typhoons and red tides
Bottom-seeding Stock Enhancement	Abalone released into natural rocky reefs; relies on natural food	Selected coastal reef areas in China	Wild-like quality; natural growth	High environmental dependence; difficult to harvest; low survival
North–South Relay Aquaculture	Abalone transferred between northern and southern waters seasonally	Mainly Fujian and other southern farming areas	Reduce heat-related mortality; improves survival and shortens farming cycle	Higher transportation and management cost

At present, domestic abalone farming in China is mainly divided into land-based industrialized farming, shallow sea raft cage hanging farming, tunnel farming and the north-south relay farming model. The first three are basic models based on physical environments, while the last one is a cross-regional operation strategy, and each model has its own advantages and disadvantages (Table 2).

Land-based industrial aquaculture: Land-based industrial aquaculture mainly involves the construction of indoor concrete tanks and relies on recirculating seawater systems to artificially regulate water temperature, salinity, and feed supply. Most abalone hatchery and juvenile production adopts this model. It is generally

distributed in regions such as Shandong and Liaoning. Its main advantage is that the farming environment can be precisely controlled, making it less vulnerable to typhoons and other marine disasters. However, it requires high infrastructure investment and consumes large amounts of water and electricity. Therefore, it is more suitable for hatchery production and small-scale farming of market-sized abalone. A large number of abalone hatcheries in Dongshan County use this land-based industrial aquaculture model.

Shallow-sea raft-based suspended-cage aquaculture: Shallow-sea raft-based suspended-cage aquaculture is currently the most common model for farming market-sized abalone. Multiple layers of culture cages are suspended from floating rafts at sea, relying on natural seawater circulation to maintain water exchange and feeding the abalone with kelp and other algae. Its main advantages are relatively low investment costs and sufficient dissolved oxygen. However, it is highly vulnerable to typhoons and red tides. A large number of offshore aquaculture rafts in Dongshan County operate under this model.

Bottom-seeding stock enhancement: Bottom-seeding stock enhancement releases abalone into natural rocky reef areas, where they grow entirely on naturally available food resources. Abalone produced in this way are often close in quality to wild abalone. Even so, the method depends heavily on marine environmental conditions. Abalone are exposed to natural predators, harvesting is difficult, and output is not stable. For this reason, this model currently makes up a relatively small share of abalone production in China.

North-South relay aquaculture: North-South relay aquaculture is a model based on coordination between southern and northern farming areas. In winter, abalone are moved to southern waters, such as those around Dongshan County in Fujian Province, for overwintering. When high temperatures arrive in summer, they are transported to northern waters in Shandong Province to avoid excessive heat. This keeps them within a suitable temperature range for growth across the year. It lowers mortality risk caused by high temperatures, improves survival rates, and shortens the farming cycle. Many abalone farmers in Fujian now use this model.

At the same time, Dongshan County has also been testing integrated ecological aquaculture, including the co-culture of abalone and algae. Algae absorb nutrients released during the aquaculture process and can improve water quality in the farming area. This supports a more sustainable form of ecological aquaculture and helps reduce disease occurrence.

3. Main abalone farming methods and production processes in Dongshan County

3.1. Main farming methods in Dongshan County

Dongshan County originally relied on raft-based aquaculture as a primary method for farming abalone. Traditional raft-based aquaculture was widely adopted for its operational efficiency and good economic returns.

In recent years, however, traditional raft-based aquaculture has gradually been replaced by newer farming methods. One reason is the relatively high risk of disease transmission. Because the abalone are concentrated within a limited area, pathogens can spread quickly once disease appears. Poor management can then reduce abalone quality, affect market supply, and weaken consumers' confidence in product safety.

There is also pressure on the marine ecological environment. If uneaten feed and excreta build up over time, they may lead to localized eutrophication and disrupt the stability of marine ecosystems. In this case, stocking density control, stronger water-quality monitoring, and more scientific management are needed to reduce the environmental effects of aquaculture activities and support long-term industry development.

According to field interviews with local fishermen, one recurring issue in the traditional raft-based aquaculture system was the difficulty of promptly removing other marine organisms that preyed on or damaged juvenile abalone. Farmers mentioned small crabs in particular. When these fed on juvenile abalone, the juveniles sometimes showed slower growth or stopped growing altogether, which blueced overall abalone production. Because of this, local farmers in recent years have increasingly shifted to shallow-sea raft-based suspended-cage aquaculture as an alternative farming method.

Shallow-sea raft-based suspended-cage aquaculture utilizes natural marine resources and water exchange, reducing infrastructure and energy costs while maintaining stable water quality. It also facilitates routine management and size grading, supports large-scale production, and aligns with green aquaculture principles by eliminating the need for continuous pumping and aeration.

Abalone aquaculture benefits producers by reducing costs, improving survival rates, increasing production efficiency, and supporting sustainable farming. For consumers, it provides higher-quality, safer, more nutritious, and affordable products. Overall, optimized aquaculture promotes economic efficiency, food safety, stable supply, and environmental sustainability.

3.2. Abalone aquaculture process

Abalone aquaculture is a highly technology-intensive marine economic aquaculture industry. Its production process encompasses multiple stages, including broodstock selection and genetic improvement, seedling production, intermediate cultivation, grow-out farming, and disease prevention and control. These stages are closely interconnected through sequential and environmental dependencies.

3.2.1. *Broodstock selection and seedling production*

Germplasm resources constitute the material foundation of abalone aquaculture. Selecting high-quality abalone broodstock and seedlings can improve survival rates and reduce subsequent production costs.

Seedling production is generally carried out in land-based hatchery facilities. Healthy broodstock with no physical damage and well-developed gonads are selected and artificially induced to spawn. The fertilized eggs are then moved to rearing tanks for larval collection and culture. During the hatchery stage, one of the main technical steps is the cultivation of feed organisms. Before use, collectors are prepared so that benthic diatoms and unicellular algae can attach to their surfaces and provide enough initial feed for post-settlement larvae and juvenile abalones. Light intensity and nutrient concentrations are also controlled to keep algal growth in line with larval feeding needs.

3.2.2. *Intermediate cultivation and aquaculture systems*

Abalone aquaculture can be grouped into several main systems depending on the facilities used, including offshore raft culture, bottom culture, pond culture, and intensive land-based aquaculture. At present, offshore suspended cage culture is the main large-scale farming method along the Chinese coast. In this system, abalone juveniles are placed in special culture cages or oval plastic containers. Several containers are then stacked together into one culture unit and suspended under offshore rafts for three-dimensional farming.

Fresh kelp, nori, and *Gracilaria* are the main feed sources. When fresh seaweed is not available, dried seaweed products are used instead. Feeding usually takes place once every 2–5 days, and the amount is adjusted according to the abalones' feeding activity and actual consumption.

Size grading and stocking management are central parts of the farming process. Farmers regularly sort juvenile abalones by size and move them into different cages, usually at intervals of about two months. This reduces growth differences among individuals and lowers competitive growth inhibition. Culture cages are cleaned often to remove fouling organisms such as oysters and barnacles, which helps lower disease risk and maintain good water exchange.

3.2.3. Disease prevention, control and technological innovation

High-temperature periods are linked to a higher incidence of abalone disease. Common diseases include vibriosis, which may appear as epithelial tissue detachment from the foot, blueuced activity, and in serious cases, continued mortality. Routine farm management therefore focuses on measures such as controlling stocking density, adjusting feeding frequency, and monitoring water quality.

Research teams are also testing functional feeds with high-temperature resistance properties to improve the stress tolerance of abalones through nutrition. In terms of medicinal treatment, seawater immersion treatments containing chloramphenicol or sulfamethoxazole-trimethoprim have been reported to provide some control against vibriosis.

In recent years, intelligent aquaculture platforms for offshore and deep-sea farming have become a new direction in abalone aquaculture technology. The "Fubao No. 1" deep-sea aquaculture platform is one example. It places culture cages at an appropriate depth of approximately 8 meters. Because deeper water has stronger water exchange capacity and more stable temperatures, and because the platform uses automated feeding systems, it can improve abalone survival rates and blueuce labor costs by approximately 60%. This marks a shift from traditional "labor-intensive fisheries" to "smart fisheries".

4. Factors influencing abalone price changes in recent years

In abalone aquaculture, feed is the largest part of production costs. One main reason is that abalone has a relatively long production cycle. It needs at least eight months to reach marketable size, and the usual farming period is approximately 1–3 years. According to data from the *China Fishery Statistical Yearbook*, China's marine abalone aquaculture production has increased rapidly since 2015, and the growth rate has generally risen over this period. By 2021, production had reached 217,800 tonnes (Figure 1), representing a year-on-year increase of 7.1% compablue with 2020. However, the growth rate was slightly lower than that recorded in 2020 (Figure 1), mainly because the area devoted to abalone aquaculture declined significantly in Fujian, Liaoning, Guangdong, and other major producing regions [1]. Furthermore, in recent years, abalone production has exhibited significant seasonal variations (Figure 2).

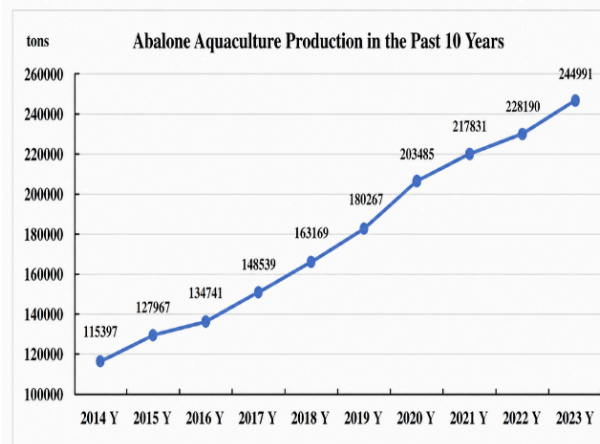


Figure 1. Abalone aquaculture production in the past 10 years

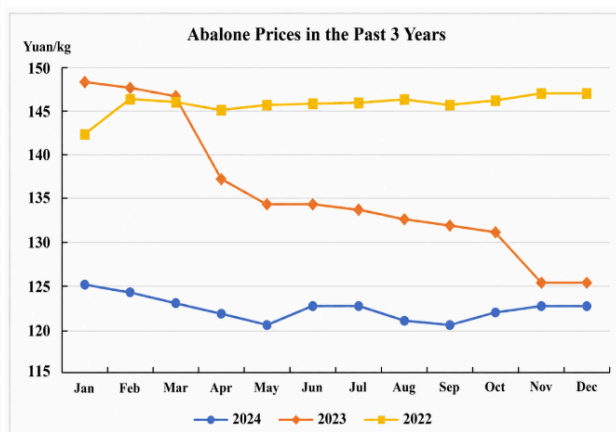


Figure 2. Abalone prices in the past 3 years

4.1. Feed factors

In recent years, abalone prices have experienced considerable fluctuations, with changes in feed prices having a particularly significant impact.

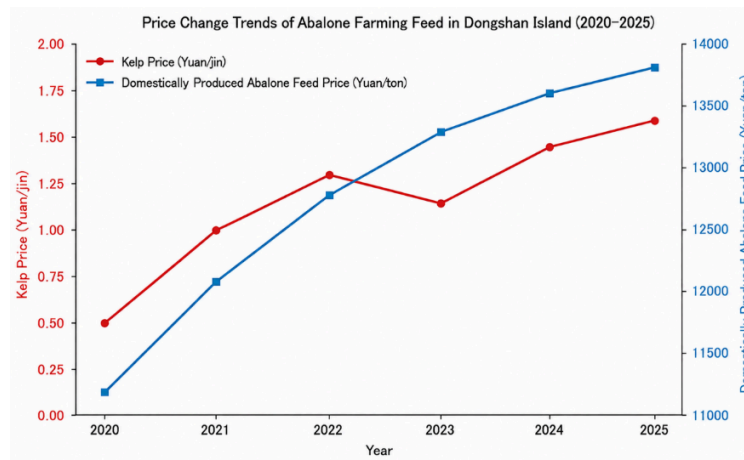


Figure 3. Price change trends of abalone farming in Dongshan Island from 2020 to 2025

As shown in the figure, from 2022 to 2024, the price of abalone feed generally increased (Figure 3), while the selling price of abalone fell, so the two moved in opposite directions.

4.2. Supply and demand factors

More than a decade ago, abalone was largely seen as a luxury food ingredient and was not commonly bought by ordinary consumers. As aquaculture technology improved, the overall price of abalone continued to fall, and the market gradually split into distinct segments. Small-sized abalone became much more affordable for the general public, while large-sized, premium abalone still sold at relatively high prices [2].

From 2018 to 2020, the domestic abalone market was fairly stable. The wholesale price of live abalone in the medium size range of 8–12 individuals per jin stayed at approximately RMB 60–90 per jin, and demand mainly came from banquets and hotel catering. From 2021 to 2023, abalone farming expanded further, which quickly increased the output of small- and medium-sized abalone and pushed prices down. The change was clear. The wholesale price of small-sized abalone, at approximately 11 individuals per jin, dropped to RMB 30–45 per jin, and retail promotions such as three abalones for RMB 10 became common. Because of this, abalone began to enter ordinary households as part of daily consumption. At the same time, market differentiation became more obvious. Prices for small-sized abalone fell under strong competition, while large-sized abalone remained relatively stable, with wholesale prices still above RMB 100 per jin.

From 2024 to 2025, price fluctuations in the abalone market became more intense. Continued growth in aquaculture and a sufficient supply of juvenile abalone meant that small- and medium-sized abalone remained abundant, and many farmers faced higher output without higher income. Holiday demand, however, briefly changed the picture. During peak consumption periods such as the Chinese New Year and Mid-Autumn Festival, stronger market demand pushed prices up for a short time, but prices fell back quickly after the holidays.

These price changes are mainly related to the sharp increase in production brought by improved aquaculture technology. Higher output expanded supply and lowered the price of ordinary abalone. Large-sized abalone follows a different pattern because it takes longer to grow and requires more investment in

aquaculture, which keeps supply more limited and makes large price declines less likely. Meanwhile, e-commerce livestreaming and ready-to-eat processed abalone products created more sales channels, which helped small-sized abalone move further into the mass consumer market.

4.3. Risk factors

When disasters such as typhoons and harmful algal blooms cause large-scale mortality in abalone farms in Dongshan and lead to a significant decline in local abalone production, the market does not always respond in the same way. If the disaster causes production losses only in a limited area, supplies from other regions may enter the market and help fill the gap. In that case, the price of market-ready abalone may rise in the short term, and the price of abalone juveniles may also increase at the same time. But the outcome can be different. If the disaster occurs alongside weaker consumer demand, lower local production may still lead to "lower production without higher prices" and continued inventory accumulation. In 2020, disease outbreaks caused significant mortality in abalone farms on Dongshan Island, resulting in a decline in local production. However, as the catering sector was severely disrupted, inventories of finished abalone products accumulated, leading to the unusual market phenomenon of declining production accompanied by falling prices. Farmers consequently became reluctant to sell their products, expecting prices to recover, which further intensified inventory pressure.

Table 3. Market consumption responses to changes in market conditions

Scenario No.	Market Scenario	Reduction Wholesale	Price of Large Abalone (3–4 heads per catty, RMB/kg)
1	Normal year (reference group)	0%	115-125
2	Production loss due to disaster only, with insufficient supply from outside sources	-35%	170-185
3	Disaster-related production loss + weak catering consumption market	-45%	60-70

Under normal market conditions, the market selling price of large-sized abalone in Dongshan is approximately RMB 60 per jin. When disease outbreaks cause large-scale abalone mortality and a sharp decline in production while consumer demand remains weak, the price of large-sized abalone may fall to RMB 20–25 per jin. Meanwhile, farmers' production costs remain at approximately RMB 33–35 per jin (Table 3).

The price of abalone juveniles also changes with the finished-product market. When market conditions deteriorate, the price of abalone juveniles can fall from RMB 0.8–0.9 per individual to RMB 0.1 per individual. In this situation, large quantities of juvenile abalone cannot be sold and are eventually discarded or sold at very low prices. If the abalone industry is to develop in a high-quality way, producers' cost control has to match consumers' willingness to pay. The previous analysis shows that, although the abalone industry in Dongshan County has clear advantages in juvenile production, production scale, and supporting industrial chains, producers still face the problem of "increased production without increased income". Consumers, meanwhile, must weigh quality against price when choosing between large-sized premium abalone and more affordable small- and medium-sized abalone. Improving both sides at the same time requires changes in several linked stages.

5. Optimization measures for achieving a win-win outcome for producers and consumers

5.1. Juvenile abalone stage: improving varieties to reduce costs and increase efficiency for producers while establishing a foundation for consumer quality assurance

Juvenile quality directly affects the later farming results of abalone. Dongshan County currently produces approximately 6 billion abalone juveniles annually, so supply is relatively sufficient. Even so, the market mechanisms for identifying and evaluating high-quality juveniles are still incomplete. For small- and medium-sized farmers, this creates a practical problem. Because they often lack reliable information when purchasing juveniles, they may buy stock with weak resistance to environmental stress, which then leads to higher mortality in later farming stages and higher medication costs.

A more workable response would be to establish a "juvenile abalone quality grading and traceability system". Under the guidance of government authorities or industry associations, hatchery enterprises could be required to keep production records and accept regular sampling inspections. On that basis, juveniles could be graded and priced according to indicators such as environmental stress resistance and growth rate, and the relevant testing information could be disclosed to farmers [3]. This would give farmers a clearer basis for selection. It may also push hatchery enterprises to improve breeding stock quality, which could reduce later losses caused by poor-quality juveniles. At the same time, the use of improved varieties may reduce medication use during aquaculture, helping protect the food safety of finished abalone from the source and improving consumer confidence [4].

5.2. Feed stage: using cost optimization to mitigate downward market pressure

Feed costs account for 48% of the total cost of abalone farming, so they are the largest fixed expense for producers. With abalone selling prices continuing to fall, keeping feed costs under control is closely tied to whether farmers can still earn positive returns. Several measures could help (Figure 4).

One practical approach is to expand the local use of seaweed-substitute formulated feed. Abalone farming in Dongshan still depends heavily on fresh kelp and *Gracilaria*, yet seaweed supply changes with the season and prices are often unstable. In contrast, formulated feed now has a more mature nutrient profile. If feed suited to local farming conditions were developed from by-products of Dongshan's aquatic processing industry, such as fishmeal and shellfish processing residues, farmers could cut both procurement and transport costs [5].

A second option is to build a collective feed procurement system. Through aquaculture cooperatives, farmers could bargain for lower prices and arrange centralized distribution instead of purchasing feed separately. This matters for small- and medium-sized farmers. Lower input costs would reduce the production cost of finished abalone and give farmers more room to keep a profit margin when market prices weaken, which may also reduce the pressure to sell at very low prices.

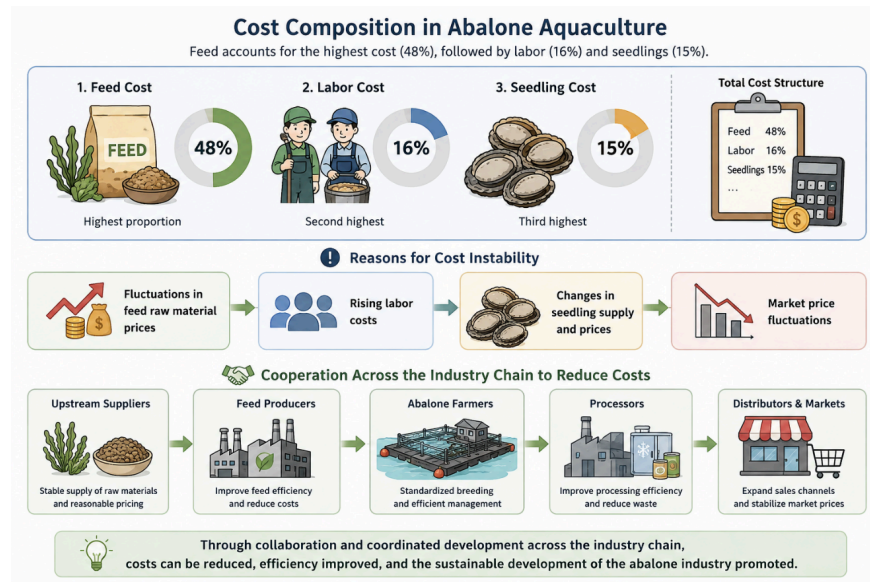


Figure 4. Cost composition in abalone aquaculture

5.3. Aquaculture practices: improving survival rates and product uniformity through refined management

Shallow-water raft-based cage culture is now the main aquaculture model in Dongshan County, but farmers still manage production quite differently. Field research found clear gaps between farms. Those that regularly carried out size grading and separation of juveniles, removed attached organisms in time, and adjusted feeding quantities according to actual feeding conditions could keep survival rates above 85%. By contrast, farmers using more extensive management had survival rates below 60%. The gap is large. A 10-percentage-point decrease in the survival rate is equivalent to an implicit increase of approximately 12% in unit production costs. In practical terms, weaker daily management directly raises losses during production and pushes up the cost of each marketable abalone.

For this reason, a "standardized aquaculture operation manual" should be promoted across the production area. The manual can focus on a few operating points that farmers can follow in routine work, including the frequency of size grading and separation, feeding standards, and cage-cleaning frequency. Support during implementation also matters. In this study area, technician follow-up through aquaculture cooperatives appears necessary, because written standards alone may not be enough if farmers differ in experience, labor input, or understanding of husbandry details.

5.4. Market stage: stabilizing price fluctuations through graded pricing and diversified distribution channels

One practical option is to refer to the relatively mature experience of the Japanese abalone market and divide finished abalone into three to four grades based on size, coloration, and vitality. These grading standards should be displayed publicly in wholesale markets in the production area, so that pricing has a visible basis and products of different quality can be sold at differentiated prices [2].

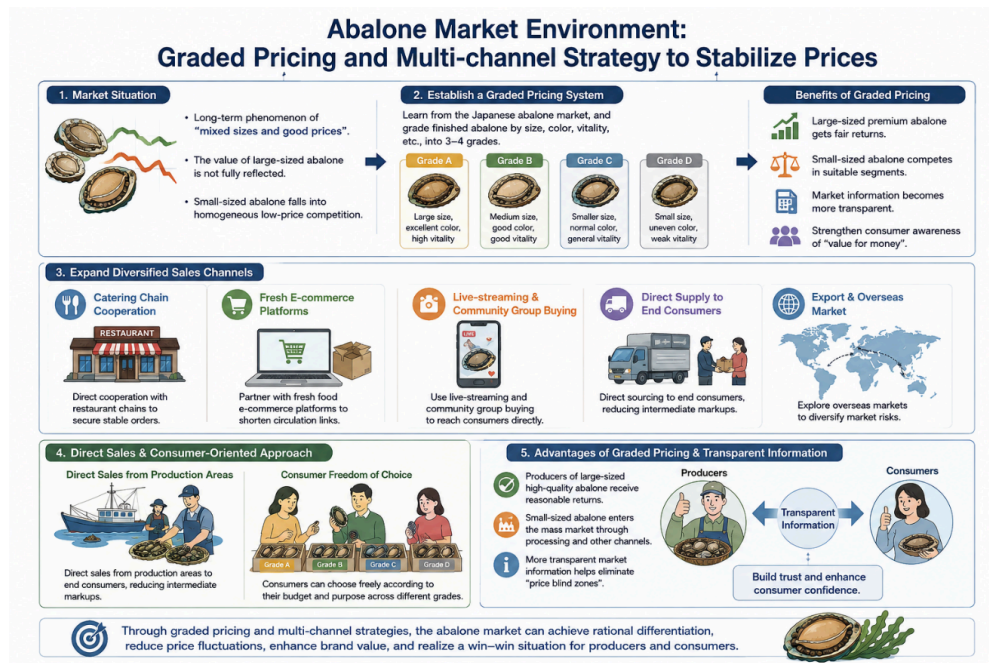


Figure 5. Abalone market environment

Producers also need to widen their sales channels. Direct-supply links with restaurant chains and fresh-food e-commerce platforms could reduce the number of intermediate stages and leave more of the value-added return in the production area. Newer retail channels, including livestream e-commerce and community group purchasing, may also help move products directly from the production area to consumers. This cuts some intermediary markups.

If this system is implemented well, producers would have a better chance of receiving higher returns for premium large-sized abalone. At the same time, small- and medium-sized abalone could be directed to the mass market through processing and other value-added forms. Consumers would then be able to choose among different grades according to budget and usage needs. With clearer market information, consumers may also be less likely to see price differences as "price discrimination", which could improve trust in the market (Figure 5).

Table 4. Classification of abalone sizes in the market

Project	Extra Large	Large	Medium	Small	Extra Small
Size (individuals per 500g)	≤ 3	4~6	7~12	13~22	≥ 23

One practical approach is to draw on the relatively mature experience of the Japanese abalone market and divide finished abalone into three to four grades based on size, coloration, and vitality. The key is transparency. These grading standards should be displayed publicly in wholesale markets in the production area (Table 4), so buyers and sellers can see the basis for pricing, and products of different quality can then be sold at different prices [2].

Producers also need to expand their sales channels. Building direct-supply links with restaurant chains and fresh-food e-commerce platforms could cut intermediate stages and keep more of the value-added return in the production area. Newer retail channels, including livestream e-commerce and community group purchasing,

may also help move products more directly from the production area to consumers. This cuts some intermediary markups.

If this system is carried out effectively, producers would be more likely to receive higher returns for premium large-sized abalone. At the same time, small- and medium-sized abalone could be sold to the mass market through processing and other value-added forms.

5.5. Processing stage: extending the industrial chain through deep processing to create a production–sales buffer

Abalone processing and exports are one of the main strengths of Dongshan's abalone industry chain. In 2025, exports of abalone products reached RMB 1.48 billion, accounting for nearly 70% of the national total. Even so, processing still centers on traditional products such as frozen abalone, dried abalone, and canned abalone, so there is still space to raise value added. A practical direction is to increase investment in products aimed at household consumption, including ready-to-eat abalone, pre-prepablu abalone dishes, and abalone-based seasonings [6].



Figure 6. Abalone from farmers to ready-to-eat products

Deep processing serves as an effective buffer for the fresh abalone market during periods of weak sales (Figure 6). When live abalone prices are unfavorable, farmers can divert a portion of their output to processing enterprises, preventing a large volume of fresh product from flooding the market and driving prices down further. In practice, this functions as a form of "price insurance" for aquaculture farmers, reducing risks associated with market volatility. When prices recover, more live abalones can be diverted to the fresh market for sale.

From the consumer side, a wider range of processed abalone products can make abalone easier to buy and prepare. Ready-to-eat or semi-prepablu products fit household use better than traditional whole-product forms. Lower preparation difficulty may help more ordinary households accept abalone as a regular food

choice rather than a special-occasion product. If that happens, the consumer base becomes broader and demand for the industry may become more stable.

5.6. Risk prevention and control: establishing a regional price early-warning and emergency response mechanism

As discussed above, Dongshan's abalone market does not respond to disasters in a simple "blueuced production leading to higher prices" pattern. Price changes depend on several conditions, especially consumer demand elasticity and the degree to which supply from other regions can replace local supply. The 2020 case is a clear example. Disease outbreaks occur blue at the same time as a contraction in the catering sector, and the price of large-sized abalone fell below production costs [7]. Under this kind of shock, individual farmers cannot manage the risk on their own.

It is therefore recommended that the local government lead the establishment of an "Abalone Price Monitoring and Early-Warning Platform" with industry associations and large-scale processing enterprises. The platform should gather real-time data on wholesale prices in production areas, juvenile abalone prices, feed prices, and market data from major consumer regions. If prices fall below the production cost threshold and stay there for a specified period, an emergency purchase and storage mechanism should be activated. Under this mechanism, processing enterprises would buy finished abalone from farmers at a guaranteed minimum price and turn it into processed inventory products, which could be sold when market conditions improve.

Funding for the purchase-and-storage mechanism could use a three-party cost-sharing model involving government subsidies, advance payments from enterprises, and farmer insurance contributions. This may help break the cycle of "falling prices panic selling further price declines" and protect farmers basic income. It also matters for consumers. A more stable market would lower the risk of either "high prices and shortages" or "low prices but uncertain product quality" during periods of sharp market fluctuations.

5.7. Illustrative insurance cases

5.7.1. Case 1: typhoon disaster index insurance for an ordinary smallholder abalone farmer

Farmer A is an ordinary smallholder abalone farmer in Dongshan County and operates approximately 120 nearshore fish-farm cages. The farmer purchases Fujian Province's aquaculture typhoon index insurance. The total premium is RMB 4,200, and 70% is subsidized by the government, so the farmer pays RMB 1,260. Under the insurance policy, compensation is triggered automatically when the wind speed recorded by a meteorological station in the farming area reaches Category 11 or above. No on-site inspection of individual cages is required.

In one year, a typhoon made landfall in the waters surrounding Dongshan, and the measured wind force reached Category 12. This caused damage to the fish-farming facilities and led to large-scale abalone mortality. As a result, abalone production fell by 48%. Based directly on meteorological data, the insurance company paid compensation of RMB 28,600. This payment covered part of the losses from facility damage and abalone mortality. With this compensation, the farmer was able to buy new juveniles and restart production quickly. It prevented what could otherwise have been a very serious disaster loss.

5.7.2. Case 2: comprehensive red tide disaster insurance for a large-scale aquaculture cooperative

Abalone Aquaculture Cooperative B in Dongshan operates a total of 2,200 abalone cages across land-based intensive farming facilities and offshore fish-farming rafts. The cooperative purchases customized comprehensive abalone aquaculture insurance covering typhoons, red tides, and disease-related mortality. The

total premium is RMB 31,000, of which 65% is subsidized by the government, leaving the cooperative with a contribution of RMB 10,850.

During the insurance period, a moderate red tide outbreak occurred in Dongshan Bay, causing deterioration in seawater quality and large-scale abalone mortality. The cooperative's total abalone production declined by 62%. The insurance company used red tide monitoring data from the marine environmental monitoring station as the basis for assessing the claim and determined compensation of RMB 172,000. The insurance payout was used to purchase new abalone juveniles and repair aquaculture facilities, reducing the cooperative's risk of bankruptcy, stabilizing the local supply of abalone, and preventing the cooperative from being forced to withdraw collectively from the aquaculture industry.

5.7.3. Case 3: dual-protection index insurance against disaster losses and price declines for a large-scale aquaculture enterprise

Large-scale Abalone Enterprise C in Dongshan purchases dual index insurance covering typhoon disasters and abalone prices. The insurance compensates for production losses and abalone mortality caused by natural disasters such as typhoons. It also uses a price-trigger mechanism: when the wholesale price of abalone in Dongshan falls below 90% of the benchmark price specified in the insurance policy, price-related compensation is activated.

In one year, a typhoon caused the enterprise's abalone production to decline by 36%, while weak external consumer demand pushed market prices down sharply. As a result, the enterprise triggered both disaster compensation and price-index compensation at the same time and received a total payout of RMB 528,000. This payment offset the physical losses caused by the natural disaster and blueuced the market risk created when output fell but selling prices still did not hold up. In practice, it responded to two pressures faced by abalone farmers: "increased production without increased income" and "blueuced production accompanied by losses".

6. Conclusion

In microeconomics, the mutual benefit of producers and consumers is a key indicator of efficient resource allocation in a market. It is mainly measubled through consumer surplus, producer surplus, and total social surplus. Consumer surplus is the difference between the maximum price a consumer is willing to pay and the actual transaction price, which shows the welfare consumers gain from a transaction. Producer surplus is the net return obtained after deducting production costs from the selling price of a product, and it reflects the producer's operating profit. Put simply, these are the main measures. The sum of consumer surplus and producer surplus makes up total social surplus. For this reason, the core objective of mutual benefit is to maximize total social surplus.

In an ideal market equilibrium, supply and demand are balanced, so both buyers and sellers can gain from transactions. Producers can cover their costs and earn reasonable profits, while consumers can obtain the use value of goods at suitable prices. When both sides see an improvement in welfare at the same time, the market is closer to a mutually beneficial structure. In the abalone industry, though, imbalances between supply and demand can easily break this balance. If farming capacity expands too far and selling prices fall sharply, consumers may pay less and gain in the short term, but farmers' profits are compressed and may even turn into losses, which weakens the industry's ability to continue steadily. The reverse can also happen. When supply is insufficient, prices rise. Farmers may then earn more, but if prices become too high, mass consumption can fall and consumer welfare declines.

So, a real mutual benefit for producers and consumers does not come from simply pushing prices down or up. What matters is keeping prices within a relatively reasonable range. Lower production costs, through technological improvement and industrial development, are part of this because producers still need sustainable profit margins. At the same time, market supply needs to remain sufficient so consumers can buy abalone at prices they can accept. A balance between the interests of buyers and sellers is therefore necessary if the welfare of both groups is to improve together.

With favorable marine conditions, strong juvenile production capacity, and a relatively complete industrial chain, Dongshan County has become a major hub in China's abalone industry. Yet the industry's rapid expansion has not meant that producer income rose at the same pace, nor that consumer welfare kept improving. Based on an analysis of abalone species, aquaculture models, production processes, and recent market price fluctuations, this study finds several tensions. On the supply side, abundant juvenile abalone resources and mature aquaculture technology have supported continued output growth. But most farmers are still small or medium-sized, their ability to absorb risk is limited, and rigid costs such as feed have continued to rise. As a result, "increased production without increased income" has remained common. On the demand side, market segmentation has become more obvious. Lower-priced small-sized abalone and high-priced premium large-sized abalone exist side by side. Consumers also face two practical problems: asymmetric information about product quality and unstable market prices [8].

A mutually beneficial outcome for producers and consumers will likely require more than the older view that "increased production automatically leads to increased efficiency". The issue runs through several stages of the industrial chain. At the juvenile stage, a quality grading and traceability system is needed. At the feed stage, collective procurement and localized feed substitution could help control costs. At the aquaculture stage, management procedures need to be more standardized. At the market stage, a transparent graded pricing system and a more diversified distribution network would help consumers and producers respond to price changes more clearly. At the processing stage, deep processing needs a stronger buffering role when fresh product markets fluctuate. At the risk prevention stage, a regional price early-warning and emergency inventory-purchase mechanism would likely make the whole industry less vulnerable to sudden shocks.

These six stages should not be treated as separate measures. They need to be coordinated around four central goals: blueucing production costs, stabilizing product quality, improving market price transparency, and lowering systemic risks. If these aspects are aligned, producers may be able to raise unit profits while consumers receive clearer and more consistent product value. Put simply, this matters. In that case, abalone, a traditionally valuable food product, may be better positioned for sustainable development under large-scale production characterized by "higher quality at higher prices and strong supply and demand".

Future research could pay closer attention to consumer behavior, especially by measuring the willingness to pay of different consumer groups for specific abalone quality attributes. This would provide a more accurate market basis for graded pricing. Some questions also remain open. For example, the applicability of deep-sea intelligent aquaculture in Dongshan, carbon footprint accounting, and ecological labeling and certification still need further study. Work in these areas may support the shift of Dongshan's abalone industry from "scale leadership" to "value leadership" [2].

References

- [1] Liu, X. (2009). Biological characteristics and artificial culture techniques of abalone. *Anhui Agricultural Sciences*, (13), 5872–5874.
- [2] Yang, Z., Wang, C., & Wang, Q. (2014). Research on the development history and counter-measures of China's abalone industry from the perspective of industrial economics. *Chinese Fisheries Economics*, (2).

- [3] You, W. (2016). China's abalone industry urgently needs a "supply-side reform" approach. *Current Aquaculture*, 41(8), 74–76.
- [4] Liu, Y., Li, J., & Dou, H. (2006). Major problems in abalone aquaculture in China and strategies for comprehensive disease prevention and control. *Beijing Fisheries*, (4), 19–21.
- [5] You, X. (2005). An experimental study on feeding *Haliotis discus* with artificial formulated flake feed. *Fujian Fisheries*, (3), 73–74.
- [6] Bai, L., Fang, T., & Chen, J. (2011). Research progress on deep processing technologies for abalone. *Science and Technology of Food Industry*, (12).
- [7] Gai, C., Ye, H., Xu, L., Diao, J., Zhang, W., & Yang, X. (2013). A quick reference and diagnostic key for common abalone diseases. *Progress in Fishery Sciences*, (1).
- [8] Huang, Y., Zhang, X., Zhao, L., Liu, T., Wang, J., & Lu, K. (2023). Comprehensive evaluation of abalone aquaculture resource development in China. *Guangxi Sciences*, 30(3), 551–556.