# THE SUPPLY CHAIN OF THE SEA BASS AQUACULTURE INDUSTRY IN SURATTHANI PROVINCE

ห่วงโซ่อุปทานการเลี้ยงปลากะพงในจังหวัดสุราษฎร์ธานี

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**Abstract**

The purpose of this research were to analyze the costs, returns, marketing and supply chain of the sea bass aquaculture industry in Suratthani Province. It was found that the cost of cage sea bass aquaculture calculated per cubic meter was about 1,265.38 baht. The income was about 1,724.03 baht, and the net profit was about 458.65 baht. In the puddle, calculated per Rai, the cost was 88,912.42 baht. The income was 97,915.97 baht, and the net profit was 9,003.55 baht. The fish was marketed to private fishing boats and middlemen. The supply chain analysis of cage aquaculture was based on an average culture area of 374.03 cubic meters and the analysis of puddle aquaculture was based on an average area of 5.21 Rai. The aquaculturists bought the breeds from the private farms in Suratthani Province, Chon Buri Province, and Satun Province. The sea bass was cultured in cage two times per year. The culture average period was about 150.39 days. About 52.91 fries were released per cubic meter. The feed used was about 44.76 kilograms per cubic meter. On the other hand, the sea bass was cultured in the puddle one time per year. The culture period was about 210 days. About 3,174.46 fries were released per Rai and about 2,627.00 kilograms of feed were used per Rai. In midstream, the fish was distributed to private fishing boats and local merchants who would sell it within and outside of Suratthani Province, where as at downstream, the fish was bought by restaurants, hotels or other parties directly from the local merchants, private fishing boats and aquaculturists to distribute to consumers. The middlemen distributed the fish upcountry and to food processing plants in Nakhon Si Thammarat Province, Songkhla Province and Krabi Province.

**Keywords:** Supply chain, Sea bass aquaculture, Suratthani Province

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**ผ่านการรับรองคุณภาพจาก TCI (กลุ่มที่ 1) สาขามนุษยศาสตร์และสังคมศาสตร์**

**บทคัดย่อ**

งานวิจัยมีวัตถุประสงค์เพื่อวิเคราะห์ต้นทุน ผลตอบแทน การตลาด และห่วงโซ่อุปทานการเลี้ยงปลากะพงในจังหวัดสุราษฎร์ธานี ผลการศึกษาพบว่า การเลี้ยงปลากะพงในกระชังโดยคิดต่อลูกบาศก์เมตร มีต้นทุน 1,265.38 บาท รายได้ 1,724.03 บาท และกำไรสุทธิ 458.65 บาท ส่วนการเลี้ยงในบ่อดินมีต้นทุน ผลตอบแทนโดยคิดต่อไร่ มีต้นทุน 88,912.42 บาท รายได้ 97,915.97 บาท กำไรสุทธิ 9,003.55 บาท การตลาดขายปลาให้แพเอกชน พ่อค้าคนกลาง ในการวิเคราะห์โซ่อุปทานการเลี้ยงปลาในกระชังมีเนื้อที่เลี้ยงเฉลี่ย 374.03 ลูกบาศก์เมตร ส่วนการเลี้ยงในบ่อดินมีเนื้อที่เลี้ยงเฉลี่ย 5.21 ไร่ เกษตรกรซื้อลูกพันธุ์จากฟาร์มเอกชนในจังหวัดสุราษฎร์ธานี จังหวัดชลบุรี จังหวัดสตูล สำหรับการเลี้ยงปลากะพงในกระชังเลี้ยง 2 รุ่นต่อปี โดยในแต่ละรุ่นมีระยะเวลาการเลี้ยงเฉลี่ย 150.39 วัน มีการปล่อยจำนวนลูกปลา 52.91 ตัวต่อลูกบาศก์เมตร และให้อาหารเฉลี่ย 44.76 กิโลกรัมต่อลูกบาศก์เมตร ส่วนการเลี้ยงปลากะพงในบ่อดินเลี้ยง 1 รุ่นต่อปี มีระยะเวลาเลี้ยง 210 วัน ปล่อยจำนวนลูกปลา 3,174.46 ตัวต่อไร่ โดยให้อาหาร 2,627.00 กิโลกรัมต่อไร่ ส่วนกลางน้ำจำหน่ายให้แพเอกชน พ่อค้าท้องถิ่นส่งขายพื้นที่ภายในและนอกจังหวัดสุราษฎร์ธานี ส่วนปลายน้ำร้านอาหาร โรงแรม หรือผู้รับจัดงานเลี้ยงต่างๆ ซื้อจากพ่อค้าท้องถิ่น แพเอกชน เกษตรกรโดยตรงเพื่อไปจำหน่ายให้ผู้บริโภคในพื้นที่ สำหรับการจำหน่ายปลาให้นอกพื้นที่มีพ่อค้าคนกลางเข้ามารับซื้อ นำไปขายในต่างจังหวัดและส่งไปยังโรงงานแปรรูปในจังหวัดนครศรีธรรมราช สงขลา และกระบี่

**คำสำคัญ:** ห่วงโซ่อุปทาน การเลี้ยงปลากะพง จังหวัดสุราษฎร์ธานี

## Introduction

Currently, the culture of aquatic animals, especially sea bass, in the seaside provinces of Thailand such as Pattani, Chachoengsao, Songkhla, Suratthani and Satun has an important effect on the economy of the country. In 2012 Thailand exported about 16,861 tons of sea bass and related products which generated approximately 1,946 million baht (Kijjarattanapun, 2013: 24) Suratthani Province is an important area for the culture of sea bass. In 2012 there were 395 farms in total and yielded about 1,029 tons costing 116.28 million baht. Of the 395 farms, 190 were cage culture and 205 were puddle culture farms. The cage and puddle farms yielded 389 tons costing 50.204 million baht and 640 tons costing 66.078 million baht respectively (Refer to Figure 1).

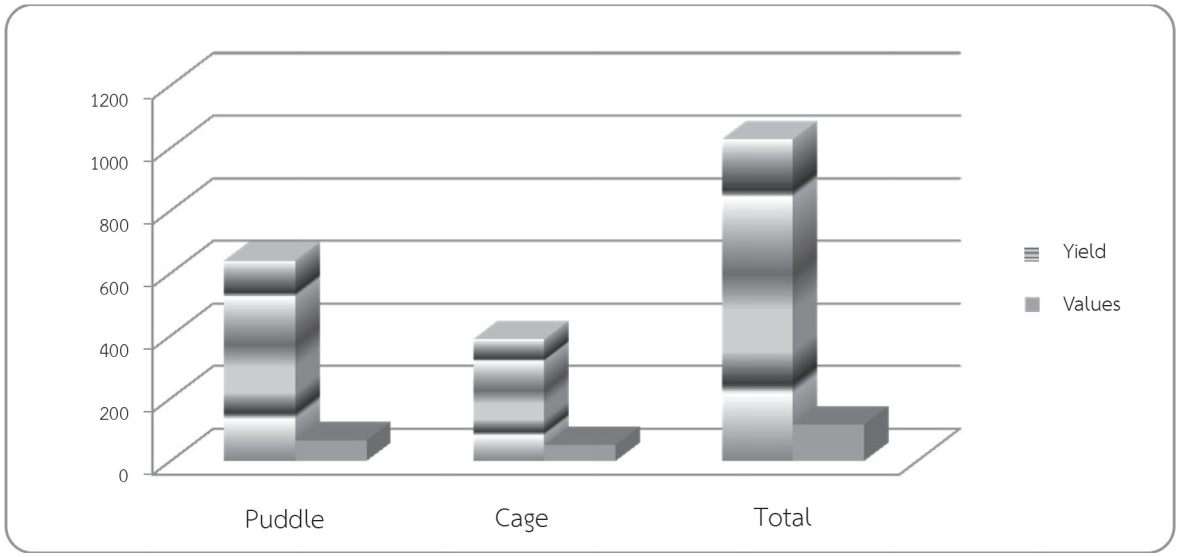


**Figure 1** Yields and values of sea bass cultured in Suratthani Province (2012)
**Source:** Register of data lists servicing web service through statXchange system of Ministry of Agriculture and Cooperatives. (2012)

The possible high income value for the aquaculturists as shown by the primary data has interested the researcher about the topic. A preliminary review showed that the aquaculturists were facing many problems such as high production costs, high feed cost, and poor distribution practice. With regard to farm management, the aquaculturists lacked farm environment management knowledge and as a result they could not control environmental problems such as natural disasters, drought and decadence of resources and environment.

A review of literature has shown that no study has been done on throughout supply chain of both cage and puddle sea bass culture from upstream to downstream. The study by D.A.M. De Silva (2011) on labor employment in sea bass culture had shown that supply chain analysis is needed to analyze labor employment in sea bass culture. Studies such as Arjarnmaraya (2009). Arjarnmarayat's 'An Economic Analysis of Barramundi Production in Cage Culture in Bang Pakong District, Chachoengsao Province in 2007', the Office of Agricultural Economics's research 'Production Economy and Marketing of Barramundi in Cage Culture', Julasiripong's 'Costs and Returns Analysis of Barramundi in Cage Culture in Bang Pakong District, Chachoengsao Province' and Ruamchat and Nutchanet 'Barramundi Culture in Ponds, Brackish and Salt Water, Prachuap Khiri Khan Province' had produced findings in different areas, however, there was no study showing the connection from production to consumers.

This has prompted the researcher to conduct a supply chain study analyzing costs and returns, marketing, and management in the

upstream, midstream and downstream activities of the sea bass aquaculture in Suratthani province. Suratthani was chosen because it has both the cage and puddle sea bass farms. The research findings could be used in the capability development of entrepreneurs in both the production and marketing of sea bass in Suratthani. This in return, would encourage the entrepreneurs to be independent and engage in sustainability-based competition.

**Objectives of the study**

1. To analyze the production, costs and returns of cultured sea bass in Suratthani Province.

2. To analyze the marketing of cultured sea bass in Suratthani Province.

3. To analyze the supply chain of the sea bass aquaculture in Suratthani Province.

**Literature Review**

The secondary review did not find any studies on supply chain of sea bass culture covered both cage and puddle from upstream, midstream and downstream. The study by D.A.M. De Silva (2011: 9) found that the workforce for preparation of pond with size of 5 Rai was mainly members of the family. Fish with size of 3 inches were released at a rate of 2,000-3,000 fishes/Rai. Feeding was provided 2 times a day. Increased feeding might be considered at depending on the size and weight of the fishes. Farm management had to be carried out every day. However, when the water has low temperatures, the farm has to be attended more carefully. It may need to use paddle wheel aerator to increase oxygen level in the pond. For marketing, the aquaculturists were connected with the buyer, wholesaler and retailer. The survey in the wholesale market revealed that the buyer who bought the fishes would send them to the wholesalers in the marketplace. The consumers could buy directly from the wholesalers and retailers. The Samutprakan Provincial Cooperative Office's analys is of the supply chain of sea bass cultured in puddle found that fish pond preparation such as fish pond cleaning, slicing off the ground and air drying the ground took about 10 days. The release of salt water into the fish pond by pumping it from the irrigation canal and the adjustment of water conditions by adding about 7 bottles iodine solution took about 15 days. Paddle wheel aerators were used to increase the water oxygen level. As for culture maintenance, the fries that were released in the prepared pond were fed with two 20 kilogram sacks of feed in the first day. In the first month, about 180 sacks of feed were used. In the second and third months, the feeding rate was about 220 sacks per month. In the fourth and fifth months it increased to about 360 sacks per month. With regard to maintenance, the aquaculturists added lime into the pond to adjust water conditions 2 times per month at a rate of 2 bags per time. They released microbe into the pond to adjust water conditions once every 7 days at a rate of one liter per Rai. If the fish suffered from diseases, one tank of formalin would be used per Rai.

After 8 months, the fish was harvested for sale. The cooperative members helped each other to do it and might employed additional 15 people to help in the task. The seine net was used in the harvesting. It either belonged to the members or was hired at a cost of 300 baht per day. When the fish were harvested, the members sorted the fish by weight for sale. Fish with a weight of 0.7-1 kg would cost about 185 baht per kilogram and fish with a weight of 3 kilograms would cost about 190-200 baht per kilogram. Fish with weight less than 700 grams would be cultured in the next month. The sorted fish would then be distributed at the Thai Seafood market in Samut Sakhon Province with price ranging between 90-190 baht.

Arjarnmaraya (2009: 2) study on costs and returns of sea bass culture in Bangpakong District, Chachoengsao Province in 2007 found that average net profits of the aquaculturists who used floating cage was about 3,951.56 baht or 1.01 baht per cubic meter, whereas the average net profit of those using adherent cage was about 1,442.06 baht or 73.82 baht per cubic meter. The research entitled 'Production Economy and Marketing of Sea Bass in Cage' by the Culture Office of Agricultural Economics (2014) found that for sea bass cultured in cage the average cost was 46,123.37 baht per cage. The average yield was 496.55 kilograms per cage. The average price was 162.94 baht per kilogram, and the average income was 80,907.86 Baht per cage. The total net income was 36,467.51 baht per cage and the total net profit was 34,784.49 baht per cage.

Julasiripong (2010: 2) study' Costs and Returns Analysis of Sea Bass in Cage Culture in Bang Pakong District, Chachoengsao Province' found that total costs per square meter of total farms, small farms and large farms were 8,838.96, 13,243.95 and 7,179.75 baht, respectively. The total costs per kilogram of sea bass were 89.45, 98.08 and 84.34 baht, respectively. The total income per kilogram of sea bass for the total farms, small farms and large farms was 122.48, 111.17 and 129.25 baht, respectively. The average net income per square meter of the total farms, small farms and large farms was 4,061.61, 2,944.37 and 4,482.47 baht, respectively. The average net income per kilogram of sea bass weighing 1 kilogram was 41.13, 21.80 and 52.66 baht, and the average net income per square meter for the three types of farms was 3,261.10, 1,769.17 and 3,823.09 baht respectively. The reasons why the larger farms were having more net profits than the smaller farms were because the larger farms could produce more sea bass and sell at higher price and thus earning more income at lower costs.

Maikaensarn and Moonkhum (2014: 1) study' Changes in agribusiness in the context of future world found the major contents of this article will be divided into the following two sections the driving forces leading to the changes of agribusiness environment and changes in agricultural practice under the direction of those changes. This article expected to lead farmer and agribusiness owner to understand the changes and to set up strategy in order to improve management skills of

agribusiness. Additionally, the contents in this article attempted to point out entrepreneurial opportunities to make sustainable growth in agribusiness sector and also to enhance capabilities in the global competition.

Whereas the Office of Agricultural Economics in its research entitled 'Production Economy and Marketing of Sea Bass in Cage Culture' which studied the conditions of production and marketing, costs and returns analysis found that average costs of sea bass cultured in cage was 46,123.37 baht per cage. The aquaculturists had average yields of 496.55 kilogram per cage at an average price of 162.94 baht/kilogram. Their average income was 80,907.86 baht per cage. The total net income was 36,467.51 baht per cage and the total net profit was 34,784.49 baht per cage. Market survey found that the aquaculturists sold 70% of their yields to regional merchants, 20% to local merchants of 20% and 10% to restaurants. Each merchant would then distribute up to 95% or more of their purchase to restaurants.

For sea bass cultured in puddle, Ruamchat and Nutchanet (2013: 3) found that the expenses of brackish pond were 335,127.00 baht, the production costs were 850,784.15 baht and the income was 1,914,250.00 baht per Rai. Sea bass cultured in salt pond produced more returns than sea bass cultured in brackish pond because of lower production costs per Rai. The net present value and return rate within project was about 17.47%.

## Research Methodology

In this research, the researcher used the Supply Chain Operations reference (SCOR) Model which consists of 5 parts, namely planning, raw source acquisition, production, delivery and return, as the basis for the analysis of costs and returns and supply chain. The model, by describing supply chains using process modeling building blocks, can be used to describe supply chains that are very simple or very complex using a common set of definitions. As a result, different industries can be linked to describe the depth and breadth of virtually any supply chain in support of strategic planning and continuous improvement. (Rattanawong, 2011: 95)

Purposive sampling was used in this research. The population size was 379 aquaculturists who cultured sea bass in Suratthani Province. The calculated sample size was 57.99 people for the population. However, the researcher adjusted the sample size to 100 people chosen from 5 districts surrounding Bandon Bay, Suratthani Province. The Instruments used in the data collection were an in-depth interview for collecting data on production costs and a questionnaire with Cronbach's Alpha Coefficient of .82 was used for collecting general and marketing data. The instruments were reviewd by three experts and their comments were used to revise the instruments.

**Data collection:**

Primary data were generated using structured interview and questionnaire. Secondary data were collected from various documents from the government sector such as the Department of Fisheries, Agricultural Cooperative, Sub-district Administrative Organization, and research studies conducted.

**Data analysis:**

The costs and returns analysis was used to analyse the costs relationship. The costs were categorised into 2 types, which were the fixed and variable costs. For marketing analysis, the marketing path was analysed to show yields movement from aquaculturists to consumers. In the supply chain analysis, the Supply Chain Operations Reference (SCOR) Model consisting of 5 parts of process, namely planning, raw source acquisition, production, delivery and return was used.

## Results

### 1. General data of aquaculturists

1.1 Cage Sea bass culture

There were 65 aquaculturists who cultured sea bass in cage. They were mostly male with age around 41-50 years, educated at the primary level and had 16-20 years of experience culturing fish. The farm ownership was single owner. The reason they decided to culture sea bass was it gave good income. The funds used were personal capital and borrowing taken from fish buyers which would be deducted from the payment for the fish sold without interests if the fish was sold to buyers whom they borrowed the money from. Most aquaculturists selected places near their homes to culture the fish due to the convenience in carrying out farm maintenance.

1.2 Puddle Sea bass culture

There were 35 samples. Most were male with age of 41-50 years, educated at the primary level and possessed 6-10 years of experience. The farm ownership was single owner. The reason they decided to culture sea bass was it gave good income. The funds used were personal capital and borrowing taken. They chose area near their homes for their farms.

### 2. Costs and returns analysis of sea bass culture in Suratthani Province

The costs and returns analysis of sea bass cultured in the cage found that total cost. Fixed cost was 49.32 baht/cubic meter accounting for 3.90% of the total cost. Total yield was 12.99 kilograms/cubic meter. The sale price was 132.72 baht/kilogram. The income was 1,724.03 baht/cubic meter with a net profits of 458.65 baht. (Refer to Table 1)

**Table 1** Costs and returns of cage sea bass culture in Suratthani Province

| Lists | Cash | Non Cash | Total | % |
|---|---|---|---|---|
| Variable cost | 1,144.75 | 71.31 | 1,216.06 | 96.10 |
| Fixed cost | 0.80 | 48.52 | 49.32 | 3.90 |
| Total cost | 1,145.55 | 119.83 | 1,265.38 | 100.00 |
| Total yield (kg/$m^3$/time) | | 12.99 | | |
| Price (baht/kg) | | 132.72 | | |
| Income (baht/$m^3$) | | 1,724.03 | | |
| Net profit (baht/$m^3$) | | 458.65 | | |

**Source**: Own calculation

The costs and returns analysis of sea bass cultured in puddle showed that the total cost was 88,912.42 baht/Rai. Variable cost was 86,921.09 baht/Rai accounting for 97.76% of total cost. Fixed cost was 1,991.33 baht/Rai accounting for 2.24% of total cost. Total yield was 662.40 kilogram/Rai. The sale price was 147.82 baht/kilogram. The Income was 97,915.97 baht/Rai with a net profit of 9,003.55 baht/Rai (Refer to Table 2).

**Table 2** Costs and returns of puddle sea bass culture in Suratthani Province

| Lists | As Cash | Non cash | total | % |
|---|---|---|---|---|
| Variable cost | 79,469.71 | 7,451.38 | 86,921.09 | 97.76 |
| Fixed cost | 55.00 | 1,936.33 | 1,991.33 | 2.24 |
| Total cost | 79,524.71 | 9,387.71 | 88,912.42 | 100.00 |
| Total yield (kg/$m^3$/time) | | 662.40 | | |
| Price (baht/kg) | | 147.82 | | |
| Income (baht/Rai) | | 97,915.97 | | |
| Net profit (baht/Rai) | | 9,003.55 | | |

**Source**: Own calculation

**3. Marketing of sea bass cultured in Suratthani Province**

Fishes with weight of about 0.7-1.0 kilogram were what the market needed and fetched an average sale price of 140.27 baht/kilogram. When the fishes were of the proportion wanted, the aquaculturists would sell the cage or puddle fish to private fishing boat or middleman at an agreed the price based on the market price. In some cases the buyer

would act as valuer of the price. The fish was sold as yields without buyer's obligation. The payment was both cash and credit.

3.1 Marketing patterns of cultured sea bass

The cultured sea bass entered the market and reached the consumers in four ways as follows: (refer to Figure 2)

**Pattern 1:** Aquaculturists sell the fishes to private fishing boat when the fishes are matching the needs of the market. The fishes were collected and sent to various outlets such as restaurants, resorts and party hosts, fresh-food markets in town such as the Diamond fresh-market, Bang Kung fresh-market, Khun Thale fresh-market, etc. and markets in Suratthani Province. For the markets outside of the area, the fishes were sent to the provincial food processing plants in Nakhon Si Thammarat, Songkhla, etc to be processed first. In addition, provincial middleman may take the fishes in fishing boats to be sold to consumers outside the area.

**Pattern 2**: Aquaculturists sell the fishes to local merchants who contracted the fishes. The local merchants would then send the fish to private fishing boats, restaurants, resorts and party hosts as had been ordered and the remaining would be send to fresh-food markets in the area to be sold to consumers.

**Pattern 3**: Aquaculturists sell the fishes directly to restaurants, resorts and party hosts who needed fishes of certain required weight. Another reason the restaurants buy the fish is that they are still not expensive.

**Pattern 4**: Aquaculturists sell the fishes to consumers who purchase the fish directly from them.

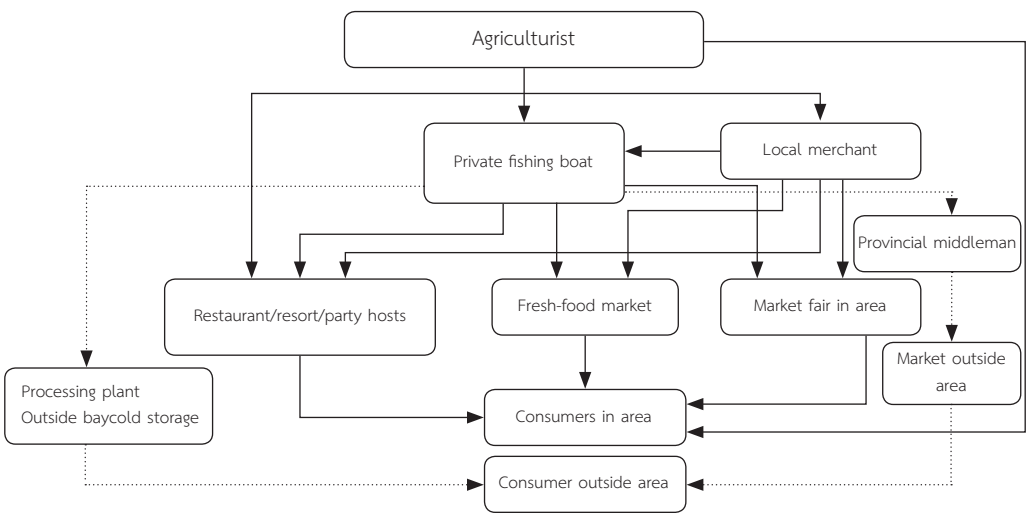


**Figure 2** Market way of sea bass culture in Suratthani Province

**Note:** ——► Area in Suratthani Province

·····► Area outside Suratthani Province

**4. The supply chain analysis of cultured sea bass in Suratthani Province**

This research used the SCOR Model to analyse supply chain of cultured sea bass. The details are as follows (refer to Figure 2).

4.1 Upstream analysis

1) Planning and area preparation analysis:

The aquaculturists' investment capital was from personal fund and borrowing. Most aquaculturists selected places near their homes due to convenience in farm maintenance. The average cage culture area was 374.03 $m^3$/person whereas the average puddle culture area was 5.21 Rai/person. In puddle culture preparation, the ground had to clean, cut and aired (refer to Table 3).

**Table 3** Sea bass culture in Suratthani Province

| Lists | Culture in cage | Culture in puddle |
|---|---|---|
| 1. Culture area | 374.03 $m^3$ | 5.21 Rai |
| 2. Amount of time in 1 year | 2 times | 1 time |
| 3. Culture period | 150.39 days/time | 210 days/time |
| 4. Breed size (inch) | 3-4 inches | 5-6 inches |
| 5. Breed release | 52.91 fishes/$m^3$ | 3,174.46 fishes/Rai |
| 6. Feeding | 44.76 k.g./$m^3$ | 2,627.00 k.g./Rai |

**Source:** From survey

2) Raw source provision analysis:

The aquaculturists bought the sea bass breed from private fishing boats in Suratthani Province and Chon Buri Province and from private farm in Satun Province. The breed selected had a size of 3-6 inches.

3) Cage sea bass culture: The sea bass was cultured in cage two times per year with an average culture time of 150.39 days/time. The average release rate was 52.91 fishes/$m^3$ and the average feed used was 44.76 kg/$m^3$ whereas puddle sea bass culture was done once per year with an average culture time of 210 days in both farms. The average fishes release was 3,174.46 fishes/Rai and the average feed used was 2,627.00 kg/Rai.

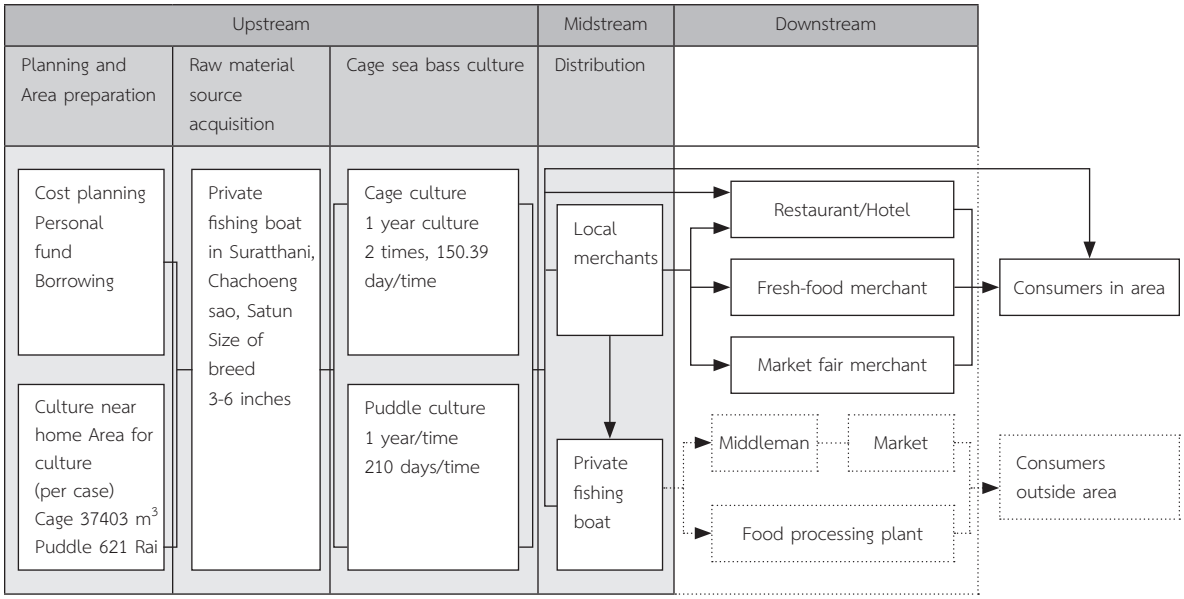


**Figure 3** Supply chain of sea bass in Suratthani Province

**Note:** ▭ Area in Suratthani Province

⋯ Area outside Suratthani Province

4.2 Downstream analysis

Restaurants, hotels or various party hosts, including merchants in fresh-food market and market fairs ordered directly from local merchants, private fishing boats, and aquaculturists to further distribute the fish to consumers. For distribution of fishes to outside areas, the provincial middlemen would buy and sell in the provincial fresh-food markets and send to processing plants in other provinces such as Nakhon Si Thammarat Province, Songkhla Province and Krabi Province, etc. Buyers who are local merchants would sell to private fishing boats, restaurants, hotels and various party hosts, merchants in fresh-food market and market fairs to further distribute to consumers.

## Discussion

The study of the supply chain of sea bass which looked at both the cage and puddle culture in Suratthani Province showed the abundance of areas for fish culturing. The aquaculturists had turned the crisis of loss in shrimp culture into opportunity in sea bass culture instead.

The costs and returns analysis of cage sea bass culture showed that the average cost was 1,265.38 baht/cubic meter consisting of an average variable cost of 1,216.06 baht/cubic meter and an average fixed cost of 49.32 baht/cubic meter. The average yield was 12.99 kilogram/cubic meter. The average sale price was 132.72 baht/kilogram. The average income

was 1,724.03 baht/cubic meter and the average net profit was 458.65 baht. The results were consistent with Arjarnmarayat's study carried out in Bang Pakong District, Chachoengsao Province in 2007 which found that aquaculturists using floating cage had total costs and average net profit equal to 3,951.56 baht and 1.01 baht/cubic meter respectively, whereas aquaculturists using adherent cage had total costs and average net profit equal to 1,442.06 and 73.82 baht/cubic meter respectively.

The costs and returns analysis of puddle sea bass culture showed that the average cost was 88,912.42 baht/cubic meter consisted of a 86,921.09 baht/cubic meter average variable cost and a 1,991.33 baht/cubic meter average fixed cost. The average yield was 662.40 kilogram/cubic meter. The average sale price was 147.82 baht/kilogram. The average income was 97,915.97 baht/cubic meter and an average net profit of 9,003.55 baht. The findings were consistent with Ruamchat and Nutchanet's study on sea bass culture in ponds, brackish and salt water in Prachuap Khiri Khan Province which found that brackish pond culture incurred expenses equal to 335,127.00 baht/Rai, production cost of 850,784.15 baht and the income of yield was 1,914,250.00 baht.

With regard to sea bass distribution, the aquaculturists sold the fishes to private fishing boats, local merchants, restaurants, resorts and various party hosts. The aquaculturists would sell fishes to consumers who bought fishes directly in the bay. This was similar to the Office of Agricultural Economics' research (2014) which found that aquaculturists sold 70% of yields to regional merchants, 20 % was local merchants and the remaining 10% restaurants. The merchants would distribute 95% or more of the purchase to restaurants.

The analaysis of the planning and area preparation of sea bass cultured in Suratthani Province using SCOR Model showed that Puddle culture had an average area of 5.21 Rai/case. Puddle preparation involved cleaning, slicing off ground and airing of ground. The average release rate was 3,174.46 fishes/Rai and the average feed used was 2,627.00 kilogram/Rai. In the distribution of sea bass, the aquaculturists distributed the fish directly to private fishing boats, local merchants, restaurants, resorts and various party hosts and consumers in area. The results were consistent with that found by

D.A.M. De Silva (2011: 9). He found that the workforce for pond preparation with pond size of 5 Rai was mainly members of the family. Fish with size of 3 inches were released at a rate of 2,000-3,000 fishes/Rai. Feeding was provided 2 times a day. Increased feeding might be considered depending on the size and weight of the fishes. Farm management had to be carried out every day. However in winter, when the water has low temperature, the farm has to be attended more carefully. It may need to use paddle wheel aerator to increase oxygen level in the pond. For marketing, the aquaculturists were connected with the buyers, wholesalers and retailers. The survey in the wholesales market revealed that the

buyer who bought the fishes would send them to the wholesalers in the marketplace. The consumers could buy directly from the wholesalers and retailers. The findings on preparation were also similar to the Samut Prakan Provincial Cooperative Office's analysis of the supply chain of sea bass cultured in puddle which found that fish pond preparation such as cleaning sea bass fish pond, slicing off the ground, drying the ground with air took about 10 days. The release of salt water into the fish pond by pumping it from the irrigation canal and the adjustment of water conditions by adding about 7 bottles iodine solution took about 15 days. Paddle wheel aerators were used to increase the water oxygen level. As for culture maintenance, the fries that were released in the prepared pond were fed with two 20 kilograms sacks of feed in the first day. In the first month, about 180 sacks of feed were used. In the second and third months, the feeding rate was about 220 sacks per month. In the fourth and fifth months it increased to about 360 sacks per month. The aquaculturists would add lime into the ponds to adjust water conditions 2 times per month at a rate of 2 bags per time. They released microbe into pond to adjust water conditions once every 7 days at a rate of liter per Rai. If the fish suffered from diseases, one tank of formalin would be used per Rai. The fishes were sold after having been cultured for 8 months with help of cooperative members. 5 people might be employed to help out with harvesting.

## Recommendations

Commercial utilization aquaculturists and interested persons can utilize the data on costs and returns in order to enhance the costs and returns management in sea bass culture in the province.

## Suggestions for further study

Policy utilization related government sectors can take data to formulate policy to help, reform the sea bass aquaculture and conduct further research.

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