

## General Structure and Economic Analysis of Fish Farms in Ordu Province - Turkey

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### Summary

In this study, economic analyses and general structure of fish farms in 2009 Ordu, which has an important position in aquaculture sector in Turkey, researched. The data used in the study were obtained from face to face interviews, surveys and observations. In the study, the fish farms which were registered to the provincial directorate of agriculture in Ordu and make production actively were evaluated. The farms were analyzed under three groups having  $\leq 10$ , 11-30 and  $> 31$  ton/year capacities considering their annual productions by 2009. General profiles of the producers were presented according to the groups. Production and economic structures of the fish farms were researched and the differences between the fish farms were tried to be revealed. The solution offers were also tried to be presented to solve the problems by determining the faults seen at the production structure of the farms.

**Keywords:** Economic analysis, Ordu province, Fish farms

## Ordu İlindeki Su Ürünleri Yetiştiricilik İşletmelerinin Genel Yapısı ve Ekonomik Analizi

### Özet

Bu çalışmada, Türkiye’de su ürünleri yetiştiriciliği sektöründe önemli bir konumda bulunan Ordu ilindeki su ürünleri yetiştiriciliği yapan işletmelerin 2009 yılı içindeki ekonomik analizleri ve genel yapıları incelenmiştir. Araştırmada kullanılan veriler, yüz yüze görüşmelerle, anket ve gözlem yoluyla elde edilmiştir. Çalışmada Ordu ilinde Tarım İl Müdürlüğü’ne kayıtlı bulunan ve aktif olarak üretim yapan işletmeler değerlendirilmeye alınmıştır. İşletmeler, 2009 yılı itibarıyla, yıllık üretimleri göz önünde bulundurularak, kapasiteleri  $\leq 10$ , 11-30 ve  $> 31$  ton/yıl olmak üzere üç grup altında incelenmiştir. Üreticilerin genel profili gruplara göre değerlendirilmiştir. İşletmelerin üretim ve ekonomik yapıları temel alınarak işletme grupları arasında farklılıklar ortaya konulmuştur. Ayrıca işletmelerin sorunları tespit edilerek çözüm önerileri sunulmuştur.

**Anahtar sözcükler:** Ekonomik analiz, Ordu ili, Yetiştiricilik işletmeleri

### INTRODUCTION

Fishery authorities agree concerning the idea that recently catching has reached it’s maximum level with 100 million tons over the world. Thereby, protection of existing stocks becomes much more important for providing higher fertility, instead of increasing the catching in sea and inland waters <sup>1</sup>.

In parallel with population growth fishery requirement has been increasing as well. The aim is to enhance

aquaculture. Promotion of aquaculture largely depends upon evaluation of existing water sources to optimum level. Establishment of fish farms expedient to present water and enlarging the scope of old fish farms in order to benefit from the existing water source is the most important point <sup>2</sup>.

In Turkey, approximately 74% of fishery production is done through capture fisheries. Even though fish culture



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is rapidly increasing, still stays about 26%. In addition, it is seen that increasing aquaculture through capture fisheries is impossible. Therefore, aquaculture has great significance on supplying the increasing demand<sup>3</sup>.

In Turkey, aquaculture shows steady increase. Hence, fish farms are provided product, fingerling and organization supports within the scope of fish farms supports. In addition, fish farms, agricultural insurance premium support are also provided. Furthermore, farmers are able to use low interest investment and establishment credits. These kinds of supports enable fish farms to enlarge and farmers to establish new ones. Ordu has an essential role in terms of aquaculture. The amount of fingerling support by Provincial Directorate of Agriculture is the proof of it. In 2008, (only for fingerling) 399.608 €, support was provided to Ordu Province<sup>4</sup>.

Rainbow trout culture has been extended almost all regions in the country and this is essential not only for employment but for also improvement of underdeveloped areas. Concordantly, it is necessary to make constitutional and bio-technical analysis of trout farmers and reveal the problems and their solutions<sup>5</sup>. Especially fish farms should be monitored and their data should be updated firstly about production amount, technical installation, pest control and struggling with diseases and then about other constitutional features for actual and effective projection of planners or units related to subject<sup>6</sup>.

The purpose of this study is to explore general structure, economic analysis and annual performances (in 2009) of fish farms produced in Ordu.

## MATERIAL and METHODS

The material of this study was primary data obtained from fish farms in inland and marine through observation and survey. In survey, farms were to respond questions about general structure, physical and technical features and economic structure of their businesses.

In the study, complete inventory method was applied as a sampling method. Three farms in research area did not want to conduct the survey. Also farms which do not make aquaculture are out of evaluation. Herewith, of 42 licensed 23 farms (Fig. 1) were applied survey and their aquaculture activities were evaluated.

Farms were categorized into three as; farms with  $\leq 10$  tons yearly production, between 11-30 tons yearly production and more than 31 tons yearly rearing. Surveys were applied to owners of farms or administrators of those in order to evaluate 2009 year activities. Capital structure of them was designated through classification in terms of capital functions.

As a business, analysis method standard process was conducted. In this context, operation cost and rearing expenses were determined and then gross profit, net profit, expenses cost, production expenses, margin, capital asset interest, and profitability rate were confirmed. For the confirmation of these rates and amounts; *Gross Production Value (output value)* is defined as gross profit obtained from whole business or one part of business activities (fish sale, fingerling, food and etc.)<sup>7</sup>. *Expenses cost* is the total of standby and variable expenses of business<sup>7</sup>.

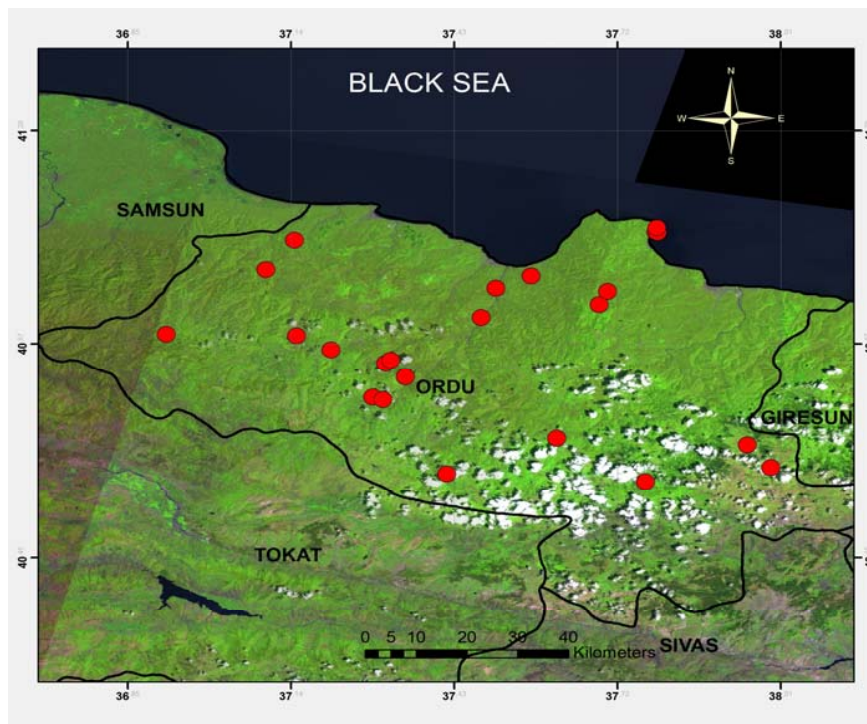


**Fig 1.** Map showing the investigated fish farms are located in the area

**Şekil 1.** Çalışmada incelenen işletmelerin bulundukları noktalar

*Rearing cost* is assessed through adding actual capital interest value to expenses cost value <sup>8</sup>. *Gross Product* is assessed through subtracting variable expenses from sales of reared fish. *Net profit* is assessed through subtracting expenses cost from gross products. *Amortizations* (annual depreciation share) is assessed by direct line method. The value of stock is estimated to its estimated economic life <sup>7,9</sup>. The calculation of depreciation share is as following:  $AP:S/n$  (AP: Annual depreciation share, S: stock value). *Standby capital Interest* is obtained by multiplying annual interest rate to half of machine or homestead value. Annual interest rate is 10% in this calculation. *Profitability* is defined as the rate of expenses profit to actual capital rate. This is a criterion used in evaluation of yearly activities and comparing with each other <sup>7,10</sup>. For the calculation of profitability rate <sup>7,9,10</sup> are used. Profitability rate which conveys the relationship of total investment capital and its income is calculated by adding debts to net profit and rating it to total capital <sup>7,9</sup>. *Rate of Return on Investment*:  $[(\text{Net profit} + \text{debt interests}) / (\text{Investment capital})] * 100$ . The height of the rate shows business is profitable or efficient economically <sup>7,9</sup>. *Capital Turnover Rate*: It is the rate of gross rearing value means annual endorsement to investment capital. For the calculation:  $\text{Capital Turnover Rate} = (\text{Gross production value} / \text{Investment capital}) * 100$  <sup>7,9</sup>. When lowness of capital turnover is compared with farmer's gross rearing rate, it is clear that farmer has relatively more investments. He should either reduce investment capital or increase gross rearing value. For the analysis of the data SPSS and Excel programs are used.

## RESULTS

There was 42 licensed fish farms in Ordu. Two of them which were in marine have restrictive injunction. On the one hand, eight farms were broken down actual aquaculture. There were also 6 farms which were preauthorized but not started actual aquaculture yet.

The oldest fish farms in Ordu were founded in 18 years ago while new one were established 5 years ago.

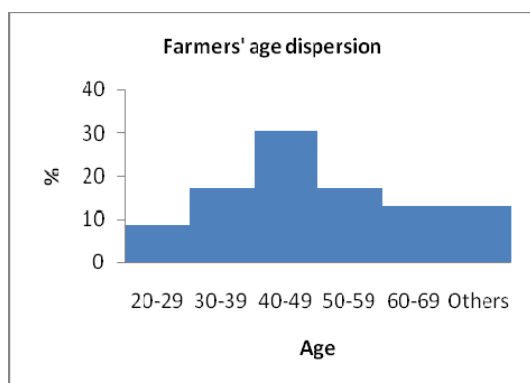


Fig 2. Farmers' age dispersion

Şekil 2. İşletme sahiplerinin yaş dağılımı

In research field, all of the farms in freshwater the rearing were done in concrete ponds; in sea it was in offshore cage. Ages of fish farmers were mainly between 40 and 49 means midlife (Fig. 2). It was found that fish farmers were generally primary school graduated (44.0%) (Fig. 3).

Almost half of (52%) of farmers had alternative income source beyond aquaculture. Crop and livestock rearing (50%) were mostly preferred. Besides this, it was possible to see other occupational groups (Marine fish farmers proclaimed that they had no alternative occupation but except fish culture). While marine fish farms used their all actual capacity, fresh water farms used 76.0% of their capacity. 75% of fresh water farms did not intend to enlarge their capacity. 90.0% of those farms give the reason as lack of water source, 5.0% point out lack of finance and 5.0% inconvenience land structure. Briefly, it was clear that the reason was lack of water source. On the contrary, 67.0% of marine fish farms were positive approach to capacity development.

Moreover, 52.0% of the fish farms had hatchery for the aquaculture. 85.0% of those determine their fingerling was sufficient for further rearing unlike. Those farms also purchase fish from outside. 15.0% of the farms sell their product. On the other hand, 48.0% of the fish farms had not got hatchery. It signifies that these farms were foreign-dependant. Fingerling provided from other provinces or other farms carry diseases risks and it may cause big losses in the future. In addition, 55.0% fresh water fish farms had hatchery in their body.

It is specified that none of the farms in research had agricultural insurance against risks. This is a proof of the farms were unaware of future risks afterwards there can be great loss in the region due to diseases, turbidity, chemical wastes, flood and etc.

Fish farmers were asked that how long they can continue their operations in any kinds of economic recession. Farms make rearing in inland water and sea fish cage responded as 1 and 1.5 years respectively.

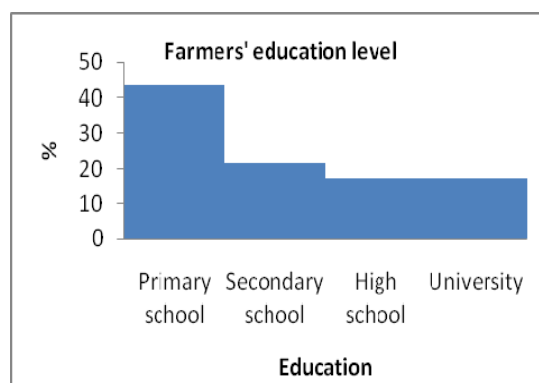


Fig 3. Farmers' education level

Şekil 3. İşletme sahiplerinin eğitim düzeyi

Farmers were questioned that how they evaluate their income obtained from aquaculture. Marine sea cage farms answered that they have no investment since they are small whereas 67.0% maritime farms try to develop their capacity by using their income.

Of farms on inland water 75.0% have no marketing problem in order for their aquaculture amount is limited and for the consumption they use restaurant like fish farms. Unlike the inland water fish farms, coastal side farms have marketing difficulties due to long distance to central settlements and heavy road conditions. Indeed, all of the marine aquaculture encounters marketing problems.

Active capital in farms involves land, building, pond or cage, brood stock, machine and equipment, fish and money capital whereas debit capital includes debts and stocks. [Table 1](#) shows active and debit capital of farms in terms of amount and rate. Among farms with in active capital the biggest margin belongs to fish capital in 16.0%, 29.0%, 67.0% respectively.

Own capital is calculated by subtracting debts from active capital. Even as the margin of debit capital in capital stock is 94.0%, 94.0% and 100%, debts comprise lower percentage of liabilities assets. [Table 2](#) gives values and rates of expenses and production costs. As seen in [Table 2](#) expenses costs are 16.144 €, 25.789 € and 222.323 €. The total fixed cost, part of expenses costs, is 8.285 €, 12.818 € and 28.623 €. Nevertheless, variable costs have the

highest amount among expenses and production costs. Variable costs are ranked as 7.859 €, 12.971 € and 193.700 €. Food cost is the most important outcome component in expenses and production outcomes with 23.1%, 24.5% and 59.1% respectively.

Farms' incomes and rates are shown in [Table 3](#). The biggest income source is shown in the table fish sales. Farms in coastal sites prefer and focus on trout rearing while farms which make rearing in sea cages would prefer sea bass and trout rearing. It is clear from the table that fish species for income source are limited fish eggs and fingerling sales are not income source for those farms. It is a big handicap for them.

Margin, net profit, investment capital profitability ratio, debt interest and standby capital interest of company groups are seen in [Table 4](#). In fact, margin has great importance in terms of monitoring the activities in company analysis <sup>7,10</sup>. As seen in the table the farms in I. group has quite lower margin; yet, differences are occurred in other two groups. Farms' gross margin is calculated as 12.666 €, 47.341 € and 431.300 €; net profit is calculated respectively as 4.381 €, 34.523 € and 402.677 € ([Table 4](#)). It is found that capital turnover rates are 42.0%, 37.0% and 72.0% ranking from smaller to bigger fish farms.

The profitability rates specifying the relationship between total investment capital and net profit are 14.0%, 12.0% and 22.0% for first, second and third group farms respectively.

**Table 1.** Capital structure of the investigated farms (€)

**Tablo 1.** İşletmelerde sermaye yapısı (€)

| A. ACTIVE CAPITAL                | I. GROUP     | %          | II. GROUP     | %             | III. GROUP    | %          |
|----------------------------------|--------------|------------|---------------|---------------|---------------|------------|
| <b>I. LANDLORD'S ASSETS FARM</b> |              |            |               |               |               |            |
| Land                             | 14843        | 33.3       | 52500         | 43.6          | 0             | 0          |
| Building                         | 8937         | 20.0       | 33125         | 27.5          | 0             | 0          |
| Pond or cage                     | 20750        | 46.7       | 34750         | 28.9          | 164000        | 100        |
| <b>TOTAL LANDLORD'S ASSETS</b>   | <b>44531</b> | <b>100</b> | <b>120375</b> | <b>100.00</b> | <b>164000</b> | <b>100</b> |
| <b>II. TENANT'S ASSETS</b>       |              |            |               |               |               |            |
| Machine and equipment            | 15           | 0.1        | 0             | 0             | 23750         | 3.4        |
| Brood stock                      | 1316         | 10.7       | 625           | 1.1           | 18000         | 2.6        |
| Fish                             | 9344         | 75.7       | 51250         | 95.0          | 575000        | 82.9       |
| Cash                             | 1563         | 12.7       | 813           | 1.6           | 76900         | 11.1       |
| Material capital                 | 94           | 0.8        | 1250          | 2.3           | 0             | 0          |
| <b>TOTAL TENANT'S ASSETS</b>     | <b>12331</b> | <b>100</b> | <b>53938</b>  | <b>100</b>    | <b>693650</b> | <b>100</b> |
| <b>B. LIABILITIES ASSETS</b>     |              |            |               |               |               |            |
| Debts                            | 3188         | 5.3        | 10813         | 5.8           | 0             | 0          |
| Own capital                      | 53675        | 94.7       | 163500        | 94.2          | 857650        | 100        |
| <b>TOTAL LIABILITIES ASSETS</b>  | <b>56863</b> | <b>100</b> | <b>171313</b> | <b>100</b>    | <b>857650</b> | <b>100</b> |
| <b>TOTAL ACTIVE CAPITAL</b>      | <b>56863</b> | <b>100</b> | <b>174313</b> | <b>100</b>    | <b>857650</b> | <b>100</b> |

**Table 2.** Expenses and production costs of farms (€)**Tablo 2.** İşletmelerde işletme ve üretim masrafları (€)

| VARIABLE COSTS              | I. Group     | %          | II. Group    | %          | III. Group    | %          |
|-----------------------------|--------------|------------|--------------|------------|---------------|------------|
| Procurement of fingerling   | 1434         | 18.3       | 3167         | 24.4       | 55000         | 28.4       |
| Food                        | 3719         | 47.3       | 6313         | 48.7       | 131250        | 67.8       |
| Temporary labor             | 475          | 6.0        | 1359         | 10.5       | 0             | 0          |
| Veterinary and medicine     | 94           | 1.2        | 125          | 1.0        | 2500          | 1.3        |
| Food                        | 1672         | 21.3       | 1438         | 11.1       | 3125          | 1.6        |
| Electricity                 | 402          | 5.1        | 569          | 4.3        | 625           | 0.3        |
| Marketing                   | 63           | 0.8        | 0            | 0          | 1200          | 0.6        |
| <b>TOTAL VARIABLE COSTS</b> | <b>7859</b>  | <b>100</b> | <b>12971</b> | <b>100</b> | <b>193700</b> | <b>100</b> |
| FIXED COSTS                 |              |            |              |            |               |            |
| Permanent labor             | 313          | 3.8        | 3125         | 24.4       | 10125         | 35.4       |
| Family labor                | 4375         | 52.8       | 2013         | 15.7       | 0             | 0          |
| Debt interest               | 478          | 5.8        | 156          | 1.2        | 0             | 0          |
| Land rent                   | 243          | 2.9        | 47           | 0.4        | 0             | 0          |
| Water rent                  | 176          | 2.1        | 234          | 1.8        | 5125          | 17.9       |
| Maintenance                 | 546          | 6.6        | 1000         | 7.8        | 3750          | 13.1       |
| Amortizations               | 2101         | 25.4       | 6091         | 47.5       | 9388          | 32.8       |
| Standby capital interest    | 53           | 0.6        | 152          | 1.2        | 235           | 0.8        |
| <b>TOTAL FIXED COSTS</b>    | <b>8285</b>  | <b>100</b> | <b>12818</b> | <b>100</b> | <b>28623</b>  | <b>100</b> |
| <b>TOTAL EXPENSES COSTS</b> | <b>16144</b> | <b>100</b> | <b>25789</b> | <b>100</b> | <b>222323</b> | <b>100</b> |

**Table 3.** Gross production value (GPV) and income source out of aquaculture of the investigated farms (€)**Tablo 3.** İncelenen işletmelerin yetiştiricilik dışı gelir kaynakları ve toplam üretim değeri (€)

| AQUACULTURE INCOME               | I. Group     | %          | II. Group    | %          | III. Group    | %          |
|----------------------------------|--------------|------------|--------------|------------|---------------|------------|
| Trout                            | 20400        | 99.4       | 56250        | 93.3       | 250000        | 40         |
| Sea bass                         | 0            | 0          | 0            | 0          | 375000        | 60         |
| Sea bream                        | 0            | 0          | 0            | 0          | 0             | 0          |
| Fingerling                       | 125          | 0.6        | 4062         | 6.7        | 0             | 0          |
| Fish eggs                        | 0            | 0          | 0            | 0          | 0             | 0          |
| <b>TOTAL</b>                     | <b>20525</b> | <b>100</b> | <b>60312</b> | <b>100</b> | <b>625000</b> | <b>100</b> |
| INCOME SOURCE OUT OF AQUACULTURE |              |            |              |            |               |            |
| Retirement                       | 866          | 22.3       | 0            | 0          | 0             | 0          |
| Crop                             | 1759         | 45.3       | 5000         | 100        | 0             | 0          |
| Livestock                        | 281          | 7.2        | 0            | 0          | 0             | 0          |
| Tradesman                        | 156          | 4.0        | 0            | 0          | 0             | 0          |
| Hotel, guest house or else       | 0            | 0          | 0            | 0          | 0             | 0          |
| Interest income                  | 0            | 0          | 0            | 0          | 0             | 0          |
| Others                           | 825          | 21.2       | 0            | 0          | 0             | 0          |
| <b>TOTAL</b>                     | <b>3887</b>  | <b>100</b> | <b>5000</b>  | <b>100</b> | <b>0</b>      | <b>0</b>   |
| <b>TOTAL FAMILY INCOME</b>       | <b>24413</b> | <b>100</b> | <b>65313</b> | <b>100</b> | <b>625000</b> | <b>100</b> |

## DISCUSSION

Compared with farmers in other provinces, the dispersion of farmers' ages has similarities. In the study done in Trabzon, the ages of farmers are between 40 and

49<sup>11</sup>. In Tokat it is between 28 and 57<sup>12</sup> in Samsun for sea cage farmers it is between 42 and 49, coast business it is 47-50<sup>13</sup>. In Sivas it is between 25 and 57<sup>14</sup>.

When credit use concern is considered, it is seen that 52.0% of fish farmers' used credit in setting up process.

**Table 4.** Gross margin, net profit, rate of return on investment and standby capital interest rates of farms**Tablo 4.** İşletmelerin brüt kar, net kar, yatırım sermayesi ve sabit sermaye faiz oranları

| Gross Margin (€)                 | I. Group<br>12666 | II. Group<br>47341 | III. Group<br>431300 |
|----------------------------------|-------------------|--------------------|----------------------|
| Net profit (€)                   | 4381              | 34523              | 402677               |
| Rate of return on investment (%) | 8.2               | 20.4               | 47.0                 |
| Debt interest (€)                | 319               | 1081               | 0                    |
| Standby capital interest (€)     | 1484              | 6788               | 16400                |

Another study done in trout farms in Erzurum has proved 5 of the farms used credit in setting up or culture process <sup>15</sup>. Nevertheless, in Sivas, shows that 14.3% of farms were set up by using Source Use Support Fund (SUSF) and 85.7% from own capital <sup>14</sup>. Concerning studies done in Tokat, Samsun, Sivas and Erzurum, it is stated that the problems of obtaining loan such as high loan rate, low loan amount, difficulty in collateral surety and reimbursement in short time are common problems of business managers in Ordu.

When the education level of fish farmers are taken into consideration, it is obvious aquaculture has similarities in the country. The research in Sivas shows that 36.9% of owners are graduated from primary school and the education level is low <sup>12</sup>. In Samsun they are mostly graduated from primary school and high school <sup>13</sup>. It is reported that 53.8% of rainbow trout farmer owners in Black Sea Region are graduated from primary school <sup>16</sup>. In another research in Mediterranean Region 39.92% of farmers are graduated from primary school. Emre et al.<sup>6</sup> and Karatas et al.<sup>15</sup> signify in their studies, a considerable part of entrepreneurs have formation about aquaculture and most of them have insufficient experiences in fish rearing. Therefore, some troubles may occur in those businesses. In their study <sup>14</sup>, it is stated that 42.9% of farmer owners are primary school graduated and their education level is low.

According to, Adigüzel and Akay <sup>12</sup> it is indicated in their study, apart from fish culture 52.6% of company managers have different occupations as public staff, other agricultural activities and works of tradesman. In another study <sup>13</sup> it is claimed that 54.2% of sea cage farms and 60% of coastal fish farms have different occupations beside aquaculture. Dogan and Yıldız <sup>17</sup> confirmed in their study that 33.3% of farmers they studied on have income from aquaculture only; 33.3% of deal with commerce in different fields; 21.6% do farming. Karatas et al.<sup>15</sup> proclaimed that 42.8% of fish farmers have no adding income source but in aquaculture area; 57.2% have income source from agriculture and commerce aboard aquaculture income. Thereunto, the majority of coastal trout farmers in Ordu serve their products in their own restaurants to their customers. Similarly, in other study done by Dogan and Yıldız <sup>17</sup> it is seen that many farmers have considerably high income in same way.

21.1% of farms in Tokat implied that for why there is lack of water source, they have difficulty in aquaculture rearing and hence, they are not able to develop their capacity <sup>12</sup> 57.1% of sea cage fish farms and 25.0% of inland aquaculture farms in Samsun indicated that they would like to reduplicate their capacity <sup>13</sup>.

For a successful aquaculture proper hatchery planning is a necessity <sup>18</sup>. Adigüzel and Akay <sup>12</sup> suggest that 63.1% of the farms have a separate hatchery structure and 10.5% of them use their ground floor as hatchery. Karatas et al.<sup>15</sup> emphasize that 9 of the farms they work on are able to produce fish eggs and fingerling for their own needs. They predicate 64.3% of the farms have separate hatchery and 35.7% have hatchery at their ground floor.

None of the farms in research have food unit. Moreover, they consume convenience food (for adult fish pellet, for fingerling granule). Most of the farms claim that the main problem in food procurement is high cost of food. According to research, dry food is utilized similarly <sup>12-16,19</sup>.

Meanwhile, fish farmers had not organized as a farmer's union yet in Ordu. It seems that they were unaware of this issue. Farmers investigated had no membership to such unions and others; however, most of them have willingness to be united <sup>12,14,16,19</sup>.

Under any kinds of troubles (diseases and etc.) during rearing period, Provincial or District Directorate of Agriculture is the first address for the farmers. Other organizations are second steps. Trabzon Central Fisheries Research Institute and Universities plays an information desk role. In Trabzon farmers follow the same ways for their problems <sup>20</sup>.

Concerning the similar research, marketing seems one of the main problems and according to farms, high demand and lower supply and lower fish sales prices lead to marketing problem <sup>20</sup>. The most important ones can be supposed as high food prices, diseases (fungal or parasite and etc.), turbidity and flood, marketing problems, obtaining loan problems and so on.

According to Adigüzel and Akay <sup>12</sup> research, the biggest capital in Tokat was building and pond capital (40.9%). Unlike this, fish capital stands at 26.0%. In accordance with

research done in Kırklareli, farms sort into three groups and biggest capital is again fish capital (31.0%, 26.0% and 26.0% respectively) <sup>19</sup>.

According to Adıgüzel and Akay <sup>12</sup> food cost is 28.0% of expenses costs. Cetin and Bilgüven <sup>21</sup> suggest that food cost is the highest outcome component in trout farms with 61.5. For Yavuz et al. <sup>22</sup> it is 63.4% and for Aydın and Sayılı <sup>23</sup> it is 50.9%. When the general results are taken into consideration, farms in Turkey have almost the same structure at all.

In research done in Kırklareli similar results are estimated as 21.0%, 29.3% and 14.2% <sup>24</sup>. Provincial profitability rate of trout culture fish farms in South Marmara Region is 64.0% <sup>21</sup>. In Tokat the concerned rate is calculated as 37.9% <sup>8</sup>. Though, throughout Turkey the rate is found as 28.8% <sup>25</sup>. Farms under research have rather low profitability rate; thereby, it is possible to indicate those farms concerned are unprofitable.

This is a proof that farms turnover rates are notably in good position. The lowness of capital turnover rate predicates company owner transfers income obtained from the facility to other fields. In South Marmara this rate is 48.9% and it is 59.0% in Thracian Region <sup>21,24</sup>.

According to research in Yene River in Kırklareli done margin in three facility groups is estimated as 24.973 €, 42.073 € and 32.373 €; net profit as 16.213 €, 31.132 € and 20.996 € respectively. Taking into account that I. and II. Group fish farms show similarities to farms in Kırklareli, but gross margin and net profit values are different <sup>19</sup>.

Ordu has pretty convenient structure for aquaculture. It is necessary to protect existing water source and utilize the water consciously in order to improve rearing. It is highly essential to promote fishery to farmers and provide adequate support policies for the improvement of aquaculture.

For the year 2030, aquaculture production estimated lower limit and upper limit respectively as, between 189.222 and 380.842 ton <sup>26</sup>. Such a scenario would have important functions fish farms in Ordu.

In research, it is pointed out that most of the farms are family business farms. It conveys a great importance to employee fishery technician/engineer or fishery technology engineer in the company for the sustainability and rapid improvement of aquaculture so then under any diseases problem quick and deliberate solution can be achieved. More often monitoring and high quality product serving should be supported. Owing to Black Sea Region climatic conditions, water discharge and quality can show differences time to time (water used in fish farms). Necessary structural measurements should be taken against potential flood and overflow. Against turbidity resulting from excessive precipitation settling tank and

system should be installed. Agricultural Insurance against risks and formulation of farmer's union within Ordu is very significance for the sustainability of the fish farms.

It is indicated that farms rantability is not high; thence, different methods to improve efficiency would be necessary. One of the ways is to reduce food outcomes, part of variable costs. In other words, decrease in feed conversion ratio and decrease in consumption will increase the efficiency. In accordance with the results, supports for fingerling and fish sales can bring farms to a certain level.

The other way to improve efficiency is to establish hatchery and sell fish eggs and fingerling. Thus, gross production value would be extended as well. In line with it, farms will be provided sufficient conditions to work efficiently. Fish farmers have great effort not to contract debt or loan credit from any organizations or institutions. However, it means they take any risks for new investments.

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## The Forecast of the Future Production Amounts of the Some Fish Species Being Cultivated in Turkey

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### Summary

In this study, current output of some fish species which are commonly cultivated in Turkey, such as Seabream (*Sparus aurata*), Seabass (*Dicentrarchus labrax*), Rainbow trout (*Oncorhynchus mykiss*) and Carp (*Cyprinus carpio*) is estimated for the future until 2008-2030. The year 2030 is taken as base since it provides parallelism with The Food and Agriculture Organization of the United Nations and the results of European Union. Current output of seabream, seabass, salmon, carp of the Turkish Statistical Institute of 1986-2007 and additionally, total aquaculture cultivation extents of Turkey were used for this purpose. Using the Genstat for Teaching Package Program on these data, autoregressive modeling was made with the Method of Time Series Analysis. Box-Cox Transformation was applied for the data which do not comply with the normal distribution. Autocorrelation coefficients were calculated, the statistical significance of these coefficients were controlled at the level of 5% and tested whether they were stable or not. As a consequence, the probable estimation values determined for the species of Seabream, Seabass, Salmon and Carp are respectively, 70015, 88050, 126272 and 1391 ton for 2030. The total probable cultivation estimation value of Turkey was found as 284337 ton/year.

**Keywords:** Aquaculture, Fish, Future production, Forecast, Box-Cox transformation

## Türkiye’de Yetiştiriciliği Yapılan Bazı Balık Türlerinin Üretim Miktarlarının Tahmini

### Özet

Bu çalışma, Türkiye’de yaygın olarak yetiştiriciliği yapılan Çipura (*Sparus aurata*), Levrek (*Dicentrarchus labrax*), Alabalık (*Oncorhynchus mykiss*) ve Sazan (*Cyprinus carpio*) gibi bazı balık türlerinin gelecekteki üretim miktarları 2008-2030 yılına kadar tahmin edilmiştir. 2030 yılı Birleşmiş Milletler Gıda ve Tarım Örgütü ve Avrupa Birliği sonuçlarına paralellik sağlaması açısından esas alınmıştır. Bu amaçla, Türkiye İstatistik Kurumu’nun 1986-2007 yıllarına ait Çipura, Levrek, Alabalık, Sazan üretim miktarları ve ilaveten Türkiye toplam su ürünleri yetiştiricilik miktarları kullanılmıştır. Bu verilere Genstat for Teaching Paket Programı kullanılarak Zaman Serileri Analiz Yöntemiyle otoregresif modellemesi yapılmıştır. Normal dağılıma uymayan verilere Box-Cox dönüşümü uygulanmıştır. Otokorelasyon katsayıları hesaplanmış, bu katsayıların %5 seviyesinde istatistik açıdan anlamlılığı kontrol edilmiş ve kararlı olup olmadıkları test edilmiştir. Sonuçta, 2030 yılı için Çipura, Levrek, Alabalık ve Sazan türleri için tespit edilen olası tahmin değerleri sırasıyla 70015, 88050, 126272 ve 1391 tondur. Türkiye toplam yetiştiricilik olası tahmin değeri ise 284337 ton/yıl olarak bulunmuştur.

**Anahtar sözcükler:** Yetiştiricilik, Balık, Gelecek üretim, Tahmin, Box-cox dönüşümü

### INTRODUCTION

Time series is a series of measurements observed in due course. If we have data about the previous years, we can make estimations about the coming years by using these data with the help of the time series and make plannings, accordingly. Since it develops models

that estimate the variables in the future, the analysis of the time series is important. Time series are used for examining one or a few more incidents which vary according to time <sup>1,2</sup>. Some of the application areas of the time series are economy <sup>3</sup>, commerce <sup>4</sup>, sociology <sup>5-7</sup>,



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meteorology<sup>8</sup> and ecology<sup>9-11</sup>.

Aquaculture is a basic industry that meets a great part of the world's food necessity. Aquaculture sector has been determined by FAO (The Food and Agriculture Organization of the United Nations) as the most rapidly growing food sector in the world<sup>12,13</sup>. Cultural fish breeding is increasing in Turkey and other part of the world<sup>14</sup>. The production of aquaculture, that is provided by cultivation in the world, has reached to 55 million ton. This proportion meets nearly 37% of the world aquaculture production. The aquaculture, that is provided by cultivation in Turkey, has been determined to be 140 thousand ton. The culture studies on aquaculture come to the forefront as a significant sector in meeting the prudential food necessity. Thus, the protection of the species that are in danger of extinction as a result of excessive fishing and enabling their continuity could only be possible through cultivation.

The species that are commonly cultivated in Turkey, primarily from sea fish are; Gilthead seabream, European seabass, and from freshwater fish; Rainbow trout and Common carp.

Today, while the production of alternative fish species has started, the species in question still have an economic significance. The production amount of Gilthead Seabream from 1986, in which aquaculture cultivation in Turkey was statistically recorded, to 2007 respectively increased from 86 ton to 33500 ton; and the production amount of Rainbow Trout, on the other hand, increased from 990 ton to 61173 ton. However, the production amount of Common Carp decreased from 2050 ton to 600 ton. For Seabass, on the other hand, the first statistical data belongs to 1987 and it is 25 ton; the production amount of the same species reached to 41900 ton in 2007<sup>15</sup>. Such kind of information help understand the consumption preferences of people and the status of the sub-sectors that develop together with these productions. Therefore, it is necessary that the cultivation amount of the species being cultivated from past until today and the data directed at production be constituted and leaning on these data, their status in the future be determined<sup>16</sup>. For this purpose, the contingent production amount estimations until 2030 has been calculated by applying time series analysis into the production amount values of some fish species, which were regularly cultivated between 1986-2007, in the study.

## MATERIAL and METHODS

The data, used in the study are gained from the secondary data of TUIK 1986-2007. Applying the Time

Series Analysis Method to the data with the help of Genstat for Teaching Packet Program, Box-Cox transformation was performed and as a result, the contingent estimations of the fish species, being cultivated in Turkey the most, was made considering that optimistic, pessimistic and current conditions would continue until 2030. Similarly, the estimation studies of FAO and European Union (EU) are made by targeting the year 2030. Therefore, the year 2030 was taken as base in order to provide parallelism with these institutions.

The autoregressive modelling of all data was made, and for that, Genstat computer program was used. Firstly, whether the data was convenient for the normal distribution was checked and the ones with skew distribution were rendered into normal distribution with the help of Box- Cox transformation. The statistical parameters of the data, being rendered into normal distribution were recalculated. And then the correlogram calculation was made; determining the numbers (k) of the ones, exceeding the estimated limits, partial autocorrelation coefficients were calculated for them. The meaningfulness of these coefficients were controlled statistically at the level of 5% and were tested whether they were constant or not.

### Box - Cox Transformation

In order to render the series with skew distribution into normal distribution, Box- Cox transformation could be applied<sup>17</sup>. In this method, the data which are found to be not symmetrical as a result of the skewness coefficient calculation, is applied with,

$$y_i = \frac{x_i^\lambda}{\lambda} \quad \lambda \neq 0$$

$$y_i = \log x_i \quad \lambda = 0$$

transformation.

Here,  $y_i$  is the new data with a skewness removed,  $x_i$  is the data with original skewness,  $\lambda$  is the parameter to render the  $y_i$  data into zero skewness.  $\lambda$  could be estimated with the method of trial-and-error. Box- Cox transformation could only be applied for the positive data<sup>18</sup>.

### Linear Autoregressive Model

In the linear autoregressive models (AR), also known as Markov models, the connection of any data with the prior data is searched. The general expression of the models is as follows;

$$x_i = \sum_{j=1}^m \alpha_j x_{i-j} + \varepsilon_i$$

Here,  $x_i$ : is  $i$ 's data,  $\alpha_i$ : autoregressive coefficients, which are the parameters of the model,  $\varepsilon_i$ : is the random variable with a normal distribution, being time independent, having an average of zero and a variance of  $\sigma^2$ ,  $m$ : shows the degree of the model. The  $m$ 's degree is depicted with the Markov model, AR ( $m$ ) and it connotes that the data embraced is dependent on the previous observation data <sup>19,20</sup>. The autoregressive constants of the model could be calculated by the method of autocorrelation function <sup>21</sup>.

$$\rho_k = \sum_{i=1}^d \alpha_i \rho_{k-i}$$

Here,  $\rho_k$ : are defined as the autocorrelation coefficients of the series,  $k$ : is defined as the delayed step (lag),  $d$ : is defined as the model degree,  $\alpha_i$ : are defined as the autoregressive constants.  $r_k$  autocorrelation coefficients of the series are used for  $\rho_k$  values.

$$r_k = \frac{A}{B * C}$$

Here;

$$A = \left[ \frac{1}{N-k} \sum_{i=1}^{N-k} x_i x_{i+k} - \frac{1}{(N-k)^2} \left( \sum_{i=1}^{N-k} x_i \right) \left( \sum_{i=1}^{N-k} x_{i+k} \right) \right]$$

$$B = \left[ \frac{1}{N-k} \sum_{i=1}^{N-k} x_i^2 - \frac{1}{(N-k)^2} \left( \sum_{i=1}^{N-k} x_i \right)^2 \right]^{\frac{1}{2}}$$

$$C = \left[ \frac{1}{N-k} \sum_{i=1}^{N-k} x_{i+k}^2 - \frac{1}{(N-k)^2} \left( \sum_{i=1}^{N-k} x_{i+k} \right)^2 \right]^{\frac{1}{2}}$$

$r_k$ : is the correlation coefficient of the  $k$ 's series,  $N$ : length of the series,  $x_i$ :  $i$ 's observation value,  $x_{i+k}$ :  $i+k$ 's observation value. In literature, the diagram, that shows the alteration of  $r_k$  according to the  $k$  value (delayed) is called correlogram. Whether the calculated  $r_k$  values are meaningful or not is examined through Anderson tolerance limits.

$$TL(r_k) = \frac{-1}{N-k} \pm z \frac{\sqrt{N-k-1}}{N-k}$$

Here,  $TL(r_k)$ : is the limit of  $r_k$ 's coefficient,  $z$ : is the critical value (for 95% meaningfulness level,  $z = 1.645$ ) from standardised normal distribution table. In case that  $r_k$  values are statistically meaningful, it is understood that the terms, having a  $k$  delay between the data in the series are dependent on each other <sup>8,17</sup>. The first  $d$  item

of  $\alpha$  value could be calculated by being regulated in the form of matrix.

$$\vec{\alpha} = \vec{R}_m^{-1} \cdot \vec{\delta}_m$$

$$\vec{\alpha} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \vdots \\ \alpha_m \end{bmatrix} \quad \vec{\delta}_m = \begin{bmatrix} \delta_1 \\ \delta_2 \\ \vdots \\ \delta_m \end{bmatrix}$$

$$\vec{R}_m = \begin{bmatrix} 1 & \delta_1 & \delta_2 & \cdots & \delta_{m-1} \\ \delta_1 & 1 & \delta_1 & \cdots & \delta_{m-2} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ \delta_{m-1} & \delta_{m-2} & \delta_{m-3} & \cdots & 1 \end{bmatrix}$$

The determination of the calculated  $\alpha$  value, on the other hand, is tested on condition that the  $b$  absolute values of the roots of;

$$1 - \alpha_1 \beta - \alpha_2 \beta^2 - \cdots - \alpha_m \beta^m = 0$$

equation is smaller than 1.

The determination could be tested by the conditions;

For AR (1);  $-1 < \alpha_1 < 1$

For AR (2);  $\alpha_1 + \alpha_2 < 1$ ,  $\alpha_2 - \alpha_1 < 1$ ,  $-1 < \alpha_2 < 1$  <sup>20</sup>.

## RESULTS

The data, used in the study are gained from the secondary data of TUIK 1986 - 2007 ([Table 1](#)).

$\lambda$  values, used for Box - Cox transformation, descriptive statistics, parameter of model, Durbin-Watson and Determination coefficient are given in the [Table 2](#).

It is supposed to cut zero on the 1st or the 2nd delay, and then fluctuate around zero for a stable autocorrelation function. On the correlogram of the variable obtained from the data of Seabream, Seabass, Salmon and Carp, it is seen that autocorrelation values cut zero. The result diagram of these fish are as they are given in [Fig. 1](#), [Fig. 2](#), [Fig. 3](#) and [Fig. 4](#), respectively and stability of the variable is understood from the correlogram ([Table 3](#)). Anderson tolerance limits are given in [Table 2](#). Consistence conditions were controlled with the help of autocorrelation functions and it was seen that the parameters of the chosen models provide the consistence

**Table 1.** Current Output of the Analysed Fish (Ton) (TUIK, 1986-2007)**Tablo 1.** İncelenen Balıkların Üretim Miktarları (Ton) (TÜİK, 1986-2007)

| Year | Gilthead Seabream | European Seabass | Rainbow Trout | Common Carp |
|------|-------------------|------------------|---------------|-------------|
| 1986 | 34                | 0                | 990           | 2050        |
| 1987 | 65                | 25               | 1105          | 2100        |
| 1988 | 100               | 5                | 1765          | 2200        |
| 1989 | 798               | 51               | 2471          | 1033        |
| 1990 | 1031              | 102              | 3212          | 1025        |
| 1991 | 910               | 777              | 4146          | 364         |
| 1992 | 937               | 808              | 6396          | 251         |
| 1993 | 1029              | 3158             | 6848          | 544         |
| 1994 | 6070              | 2229             | 6977          | 288         |
| 1995 | 4847              | 2773             | 12689         | 424         |
| 1996 | 6320              | 5210             | 18510         | 780         |
| 1997 | 7500              | 6300             | 28500         | 800         |
| 1998 | 10150             | 8660             | 34630         | 950         |
| 1999 | 11000             | 12000            | 38570         | 900         |
| 2000 | 15460             | 17877            | 44533         | 813         |
| 2001 | 12939             | 15546            | 38067         | 687         |
| 2002 | 11681             | 14339            | 34553         | 590         |
| 2003 | 16735             | 20980            | 40868         | 543         |
| 2004 | 20435             | 26297            | 45082         | 683         |
| 2005 | 27634             | 37290            | 49282         | 571         |
| 2006 | 28463             | 38408            | 57659         | 668         |
| 2007 | 33500             | 41900            | 61173         | 600         |

**Table 2.** Autoregressive calculation results and the chosen model (N= the number of year, used in the estimation, k = lag, ATL (LL; UL) = Anderson tolerance limit (Lower Limit; Upper Limit), se = standard error, AR (1), AR (2) = parameter, R<sup>2</sup> = Determination coefficient, D-W = Durbin-Watson test)**Tablo 2.** Otoregresif hesap sonuçları ve seçilen model (N= tahminde kullanılan yıl sayısı; k = gecikme, ATL(LL; UL) = Anderson tolerans limiti (Alt Limit; Üst Limit), se = standart hata, AR (1), AR (2) = parametre, R<sup>2</sup> = Determinasyon katsayısı, D-W = Durbin-Watson testi)

| Parameter          | Total Production of Aquaculture-in Turkey (Thousand Ton) | Gilthead Seabream (Ton) | European Seabass (Ton) | Rainbow Trout (Ton) | Common Carp (Ton) |
|--------------------|----------------------------------------------------------|-------------------------|------------------------|---------------------|-------------------|
| $\lambda$          | 0.502                                                    | 0.414                   | 0.400                  | 0.451               | 0.310             |
| N                  | 22                                                       | 22                      | 22                     | 22                  | 22                |
| Average            | 47.933                                                   | 9.892                   | 11.578                 | 24.456              | 0.857             |
| Standard Deviation | 44.096                                                   | 10.162                  | 13.593                 | 20.522              | 0.556             |
| Skewness           | 0.675                                                    | 0.936                   | 1.083                  | 0.277               | 1.504             |
| Kurtosis           | 2.271                                                    | 2.831                   | 2.913                  | 1.606               | 4.201             |
| k                  | 2                                                        | 1                       | 2                      | 2                   | 1                 |
| ATL(LL;UL)         | - 0.406; 0.306                                           | -0.397; 0.303           | -0.406;0.306           | - 0.406; 0.306      | -0.397; 0.303     |
| Constant(se)       | 31.500(16.500)                                           | 8.010(5.44)             | 8.540(3.440)           | 12.180(8.090)       | 0.560(1.130)      |
| AR(1)(se)          | 0.242(0.250)                                             | -0.301(0.224)           | -0.343(0.263)          | 0.349(0.247)        | -0.119(0.241)     |
| AR(2)(se)          | -0.134(0.248)                                            |                         | -0.164(0.253)          | -0.109(0.245)       |                   |
| R <sup>2</sup>     | 0.867                                                    | 0.201                   | 0.224                  | 0.14                | 0.354             |
| D-W                | 2.207                                                    | 2.069                   | 2.292                  | 1.972               | 2.229             |

conditions. Accordingly, since  $-1 < \alpha_1 = -0.301 < 1$  for the Seabream cultivation with a model degree of AR (1),  $\alpha_1 = -0.343 + \alpha_2 = 0.164 < 1 \Rightarrow -1 < -0.278 < 1$ ,  $\alpha_2 = 0.164 - \alpha_1 = -0.343 < 1 \Rightarrow 0.507 < 1$ ,  $-1 < \alpha_2 = 0.164 < 1$  for the Seabass with a model degree of AR (2),  $\alpha_1 = 0.349 + \alpha_2 = -0.109$

$< 1 \Rightarrow -1 < -0.240 < 1$ ,  $\alpha_2 = -0.109 - \alpha_1 = 0.349 < 1 \Rightarrow -0.458 < 1$ ,  $-1 < \alpha_2 = -0.109 < 1$  for the Salmon with a model degree of AR (2) and  $-1 < \alpha_1 = 0.560 < 1$  for the Carp with a model degree of AR (1), consistence conditions are provided. Results of the established models are given in [Table 2](#).

**Table 3.** AC and PAC correlograms for the data of European seabass, Gilthead seabream, Rainbow trout and Common carp  
**Tablo 3.** Levrek, Çipura, Alabalık ve Sazan verilerinin AC ve PAC Korelogramları

| k  | European seabass |        |        |       | Gilthead seabream |        |        |       | Rainbow trout |        |        |       | Common carp |        |        |       |
|----|------------------|--------|--------|-------|-------------------|--------|--------|-------|---------------|--------|--------|-------|-------------|--------|--------|-------|
|    | AC= $r_k$        | PAC    | Q-Stat | Prob  | AC= $r_k$         | PAC    | Q-Stat | Prob  | AC= $r_k$     | PAC    | Q-Stat | Prob  | AC= $r_k$   | PAC    | Q-Stat | Prob  |
| 1  | 0.215            | 0.215  | 1.1145 | 0.291 | -0.024            | -0.024 | 0.0144 | 0.905 | 0.353         | 0.353  | 3.0054 | 0.083 | -0.106      | -0.106 | 0.2715 | 0.602 |
| 2  | 0.116            | 0.073  | 1.4562 | 0.483 | 0.186             | 0.186  | 0.8955 | 0.639 | -0.008        | -0.152 | 3.0071 | 0.222 | 0.212       | 0.203  | 1.4126 | 0.493 |
| 3  | -0.074           | -0.119 | 1.6026 | 0.659 | -0.084            | -0.078 | 1.0837 | 0.781 | 0.001         | 0.067  | 3.0071 | 0.391 | 0.116       | 0.164  | 1.7762 | 0.620 |
| 4  | 0.019            | 0.052  | 1.6128 | 0.806 | 0.046             | 0.010  | 1.1437 | 0.887 | -0.425        | -0.529 | 8.1346 | 0.087 | -0.308      | -0.350 | 4.4782 | 0.345 |
| 5  | 0.228            | 0.251  | 3.1780 | 0.673 | 0.056             | 0.090  | 1.2389 | 0.941 | -0.387        | -0.010 | 12.660 | 0.027 | 0.030       | -0.106 | 4.5053 | 0.479 |
| 6  | 0.004            | -0.124 | 3.1786 | 0.786 | 0.015             | -0.001 | 1.2459 | 0.975 | -0.101        | -0.072 | 12.990 | 0.043 | -0.103      | 0.051  | 4.8479 | 0.563 |
| 7  | 0.164            | 0.156  | 4.1086 | 0.767 | 0.028             | 0.006  | 1.2728 | 0.989 | 0.016         | 0.159  | 12.999 | 0.072 | -0.263      | -0.209 | 7.2319 | 0.405 |
| 8  | -0.053           | -0.061 | 4.2112 | 0.838 | -0.146            | -0.143 | 2.0643 | 0.979 | 0.137         | -0.099 | 13.694 | 0.090 | 0.053       | -0.092 | 7.3348 | 0.501 |
| 9  | -0.068           | -0.117 | 4.3954 | 0.884 | 0.123             | 0.120  | 2.6693 | 0.976 | 0.072         | -0.197 | 13.902 | 0.126 | -0.064      | 0.080  | 7.4973 | 0.585 |
| 10 | -0.102           | -0.077 | 4.8543 | 0.901 | -0.060            | -0.010 | 2.8250 | 0.985 | -0.003        | -0.079 | 13.902 | 0.178 | 0.043       | 0.091  | 7.5783 | 0.670 |
| 11 | -0.157           | -0.102 | 6.0440 | 0.870 | 0.153             | 0.089  | 3.9508 | 0.971 | 0.075         | 0.171  | 14.175 | 0.223 | 0.084       | -0.091 | 7.9214 | 0.720 |
| 12 | -0.025           | -0.055 | 6.0775 | 0.912 | -0.197            | -0.177 | 6.0395 | 0.914 | -0.000        | 0.038  | 14.175 | 0.290 | -0.004      | -0.052 | 7.9223 | 0.791 |
| 13 | -0.146           | -0.092 | 7.3578 | 0.883 | 0.003             | -0.029 | 6.0401 | 0.945 | 0.000         | 0.012  | 14.175 | 0.362 | -0.020      | -0.051 | 7.9455 | 0.847 |
| 14 | -0.052           | -0.020 | 7.5442 | 0.912 | -0.067            | 0.010  | 6.3455 | 0.957 | 0.072         | -0.117 | 14.537 | 0.411 | -0.002      | -0.052 | 7.9458 | 0.892 |
| 15 | -0.147           | -0.079 | 9.2919 | 0.862 | -0.111            | -0.150 | 7.3456 | 0.947 | -0.023        | -0.013 | 14.578 | 0.482 | -0.155      | -0.179 | 9.8840 | 0.827 |
| 16 | -0.172           | -0.097 | 12.155 | 0.733 | -0.142            | -0.183 | 9.3057 | 0.900 | -0.094        | -0.028 | 15.426 | 0.494 | 0.044       | 0.060  | 10.075 | 0.863 |
| 17 | -0.132           | -0.056 | 14.271 | 0.648 | -0.123            | -0.040 | 11.130 | 0.850 | -0.066        | 0.064  | 15.952 | 0.527 | -0.077      | 0.026  | 10.798 | 0.867 |
| 18 | -0.097           | 0.020  | 15.772 | 0.608 | -0.082            | -0.062 | 12.204 | 0.837 | -0.057        | -0.035 | 16.476 | 0.559 | 0.010       | -0.028 | 10.815 | 0.902 |
| 19 | -0.007           | -0.025 | 15.783 | 0.672 | -0.032            | 0.021  | 12.452 | 0.865 | -0.055        | -0.102 | 17.204 | 0.576 | 0.009       | -0.106 | 10.836 | 0.929 |
| 20 | -0.015           | 0.041  | 15.893 | 0.723 | -0.041            | -0.108 | 13.274 | 0.865 | -0.006        | -0.071 | 17.221 | 0.639 | 0.000       | 0.010  | 10.836 | 0.950 |

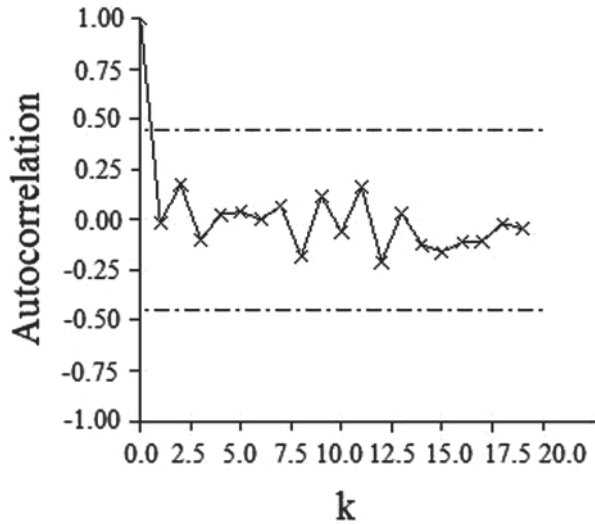


**Fig 1.** Correlogram graphic of Gilthead seabream  
**Şekil 1.** Çipura korelogram grafiği

According to these values, the models of the production amounts of the main fish species, being cultivated in Turkey were resolutely confirmed. In the direction of this model, the contingent optimistic and pessimistic estimations of the species until 2030 were made.

Accordingly, the Gilthead Seabream production was

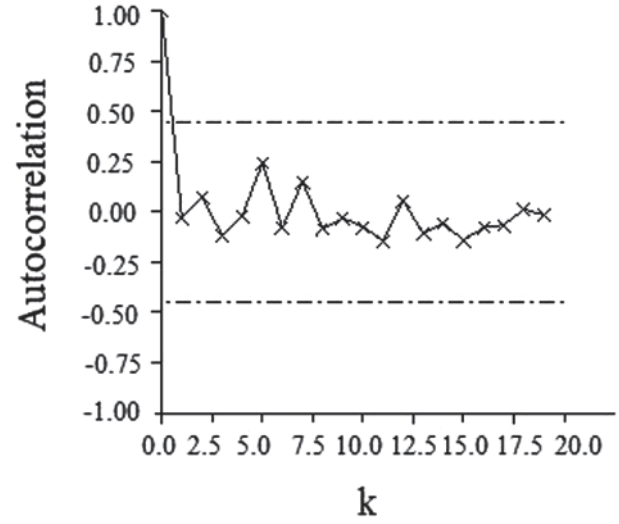


**Fig 2.** Correlogram graphic of European seabass  
**Şekil 2.** Levrek korelogram grafiği

estimated as 30694 ton pessimistically, 35002 ton for the contingent estimation, 39309 ton optimistically, for the year 2008. For the year 2030, these values were respectively calculated as; 49857, 70015, 90173 (Fig. 5). According to TUIK(2008) the Gildhead Seabream production was 31670 ton.

The pessimistic estimation of the production of the

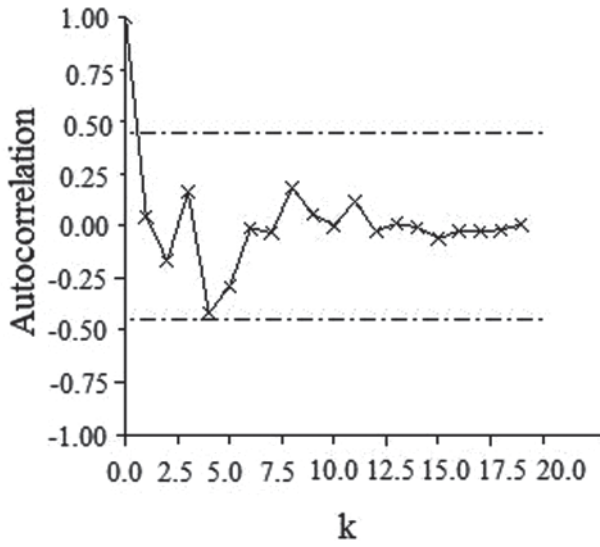


**Fig 3.** Correlogram graphic of Rainbow trout  
**Şekil 3.** Alabalık korelogram grafiği

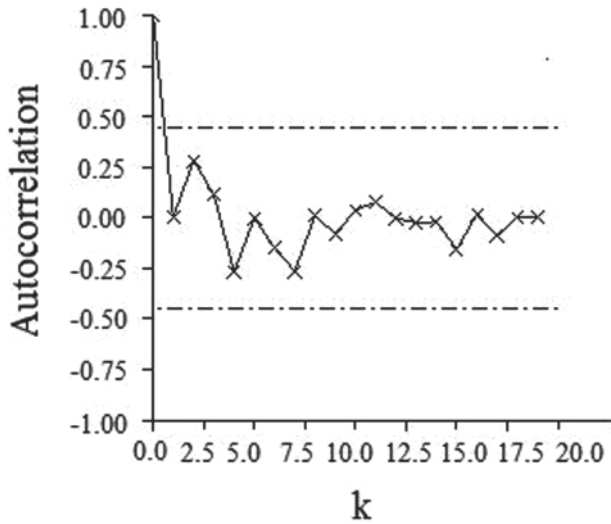


**Fig 4.** Correlogram graphic of Common carp  
**Şekil 4.** Sazan korelogram grafiği

Seabass is 39057 ton, contingent estimation is 44207 ton and the optimistic estimation is 49356 ton for 2008. For the year 2030, these values are determined respectively as; 57075, 88050, 119024 ton (Fig. 6). According to TUIK (2008) the Seabass production was 49270 ton.

The pessimistic estimation of the production of the Rainbow Trout is 58103 ton, contingent estimation is 64229 ton and the optimistic estimation is 70335 ton for 2008. For the year 2030, these values are determined respectively as; 82290, 126272, 170254 ton (Fig. 7). According to TUIK (2008) the Rainbow Trout production was 65928 ton.

The Common Carp production is expected to be

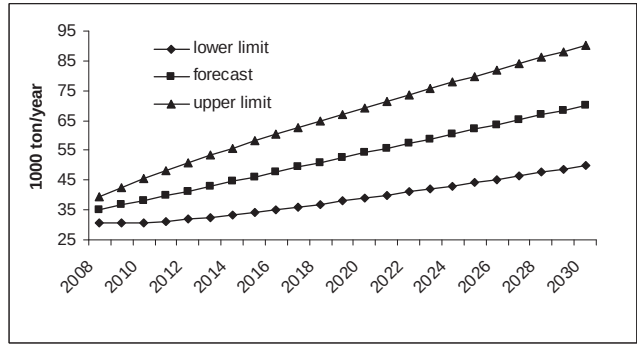


**Fig 5.** Approximate amount of gilthead seabream production by years

**Şekil 5.** Yıllara göre tahmini çipura üretim miktarı

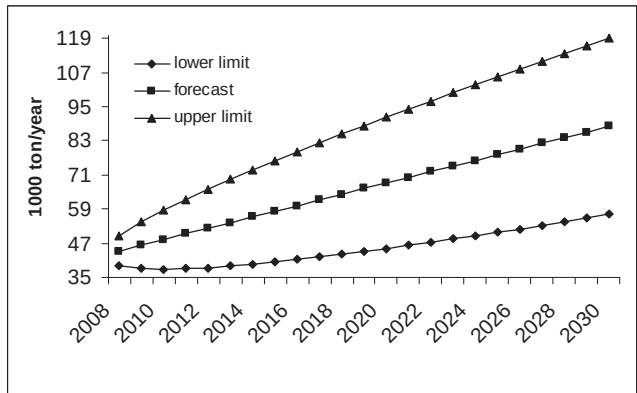


**Fig 6.** Approximate amount of seabass production by years

**Şekil 6.** Yıllara göre tahmini levrek üretim miktarı

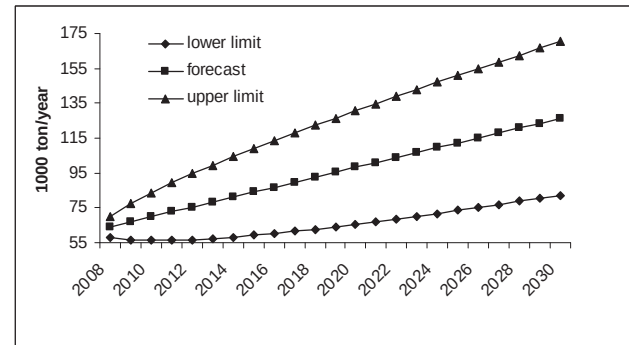


**Fig 7.** Approximate amount of rainbow trout production by years

**Şekil 7.** Yıllara göre tahmini alabalık üretim miktarı

completely over in 2008 according to the optimistic estimation and according to the contingent estimation, it is expected in 2016. Additionally, the contingent estimation is calculated as 530 ton and the optimistic estimation is calculated as 1078 for 2008. It is expected that only the optimistic estimation result shall reach to the value of 1391 for the year 2030 (Fig. 8). According to TUIK(2008) the Common Carp production was 629 ton.

As a result of the modeling study, estimations of 2008

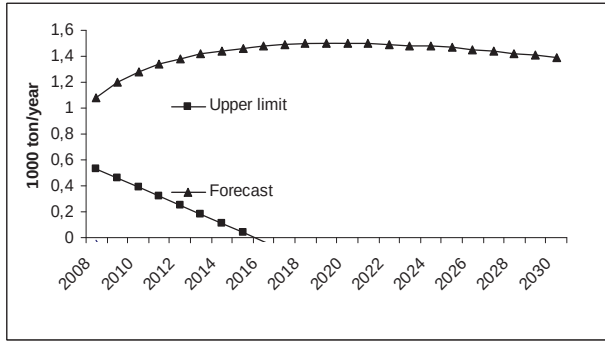


**Fig 8.** Approximate amount of the common carp production by years

**Şekil 8.** Yıllara göre tahmini sazan üretim miktarı

show parallelism with the production results obtained by TUIK (2008).

The pessimistic estimation of the cultivation production in Turkey is 127854 ton, the contingent estimation is 143968 ton, the optimistic estimation is 160098 ton for 2008. For the year 2030, these values are determined respectively as; 189222, 284337, 380842 ton (Fig 9).

## DISCUSSION

World aquaculture production rate is around 143.6 million ton and nearly 36% of this rate is acquired from aquaculture, which means nearly 51.7 million ton<sup>22</sup>. Additionally, while a production of total 176 million ton is expected for the year 2030, 83 million ton of this production is considered to be met by aquaculture. Similarly, according to the data of the Turkish Statistical Institute of 2008, although the aquaculture production decreased at the rate of 16.32% compared to the previous year, the cultivation production increased at the rate of 8.8% compared to the previous year and became nearly 152 thousand ton<sup>23</sup>. The most significant species, being cultivated are; Rainbow Trout with the rate of 43.32% in inland waters, Seabass at the rate of 32.37% and Gilthead Seabream at the rate of 20.81% in the seas. In this context, together with the increase of the aquaculture amount, gained by cultivation, the annually produced feed amount is around 200-300 thousand ton in the direction of FCR (Food Conversion Ratio)<sup>9</sup>.

In this prudential study, as long as the available conditions continue in Turkey in 2030, it is expected to be 284337 ton. With a production of 126272 ton, the Rainbow Trout (*O. mykiss*) shall keep championship in Turkey, in 2030. It is expected that the production of Seabass (*D. Labrax*) shall accelerate and beat the production of Gilthead Seabream (*S. aurata*). Through the end of the 2016s, it is estimated that the production

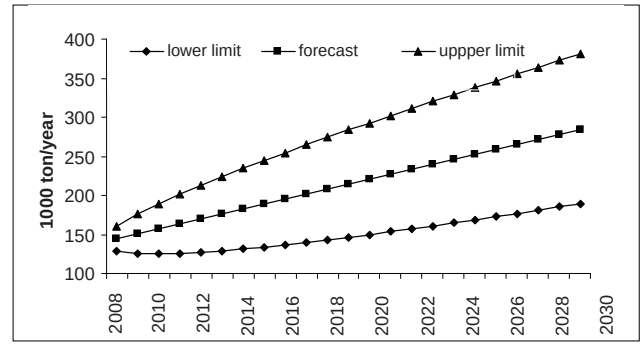


**Fig 9.** Approximate amount of the total production of aquaculture in Turkey by years

**Şekil 9.** Yıllara göre Türkiye tahmini toplam su ürünleri yetiştiricilik miktarı

of Common Carp (*C. carpio*) shall come to an end, or in other words, the production of Common Carp is in danger of extinction. The businesses, making aquaculture cultivation production in Turkey had to close up due to the expenses that arose as a result of the increasing exchange rate after each economic crisis. Indeed, the readily-approved projects for aquaculture business before the crisis could not be opened as a result of the crisis<sup>4</sup>. Increasing feed expenses of Rainbow Trout and Common Carp farms, rapid increase of their businesses, decrease of the purchasing power of the consumer in spite of the increase of the product cost, dropped the profitability of the businesses and some small businesses with low profitability production had to close up<sup>24,25</sup>. It is especially presumed that the businesses, that made Common Carp production would close up, since they are small scale family businesses and they can not simply beat the increasing cost and decreasing demand as a result of the economic crisis.

Following this process, not only in the production amounts of the species in question, but also in the activities of their sub sectors, a change is inevitable. For instance, it could be said that by 2016, the production of Common Carp feed in feed factories shall be abolished and besides, Rainbow Trout and Seabass feed shall gain importance. In such a situation, feed producers shall have to rearrange their target audience in accordance with these results. Similarly, fish producers should arrange their investments by taking these processes into consideration; the Ministry, on the other hand, should organise the presented projects from this perspective, as well.

The culture trainings have approved their significance and efficiency in meeting the food requirement. However, providing the culture conditions like continuity of the ecosystem and the continuity of the culture species is very important within this context. For that reason, the

following issues shall carefully be studied;

The resource management, particularly in inland water fishery, shall be made focusing on the sustainable use of the natural resources.

In all of the aquaculture activities, the problems of sustainability from the aspect of the environment shall be taken into consideration.

In fishery politics, being parallel to EU body of knowledge, it shall be base to carry out the stock determination studies, constitute the balance of resource use in the fishing production, provide the environmental sustainability in the aquaculture activities that are rapidly developing in parallel with the supports, provided recently and the increasing demand and to arrange the administrative structure in accordance with these purposes.

The brood fish, which is necessary for the culture fishing, shall be acquired from the hatch systems, whose egg and especially brood necessity is established and managed by the government.

Since the production of C. Carpio, which is a candidate of fish species to be cultivated the most in the World, in the future, is likely to be completely over in Turkey; studies on Common Carp cultivation shall be made<sup>26</sup>. Any encouragement from the government in this direction, shall be significant for Common Carp production to survive.

Considering the fish consumption amount 8.6 kg/year per person in our country and the world average (13.8 kg/year) and the average of the European countries (28.3 kg/year), it is quite inadequate. The reason of it is that, the fish is not introduced enough, especially in our shoreless cities or that it is transported to these regions with greater costs. Our people, whose income level has fairly decreased in recent years, do not demand the low-priced fisheries compared to other meat types because of this reason, and mostly they can not consume fish due to financial impossibilities<sup>27</sup>. Advertisement and inform studies shall be made in order to increase the consumption.

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