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REVIEW

General Evaluation of Fish Feed Production in Turkey

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Abstract

The importance of aquaculture sector is increasingly enhanced due to decrease in natural fish stocks, increasing nutritional requirements and qualified protein need. In parallel with the rise, and becoming an important value, of aquaculturesector, significant developments have occurred in fish feed production as well. It is a fact that the most important cost elements within aquaculture are feeds and usage costs of the feeds and these are effective as much as 70% in production. Substantial and great developments are observed for fish feed production industry and thus raw material, additives, feed machine manufacturers and suppliers recently. With this study, it was detected that there were 28 fish feed production plants in to 8 mounts, that generally extruder feed production technology was used and that majority of production systems were imported. It was recorded that fish feed production plants produced 355.387 tons of feed as from 2013. It was observed that 85% of feed production was regionally in Aegean Region and concordantly, supplier companies were centered in this region.This study can be recommended in terms of being an important source for academic and private sector employees studying and working in fish feed production and fish feeding subjects.

Keywords: Turkey, fish feed production, feed technology, raw material suppliers, feedmill suppliers.

Introduction

Recently, inexpensive protein and energy source requirement are increasing day by day, importance of fish meat is collaterally enhancing. As a valuable animal protein source, fish contains 17-21 percent of protein. Due to these reasons, importance of aquaculture, saltwater and inland waters is enhancing, fishery is considered as the sector of future in world food platforms (FAO, 2014; Özdemir, 2013). It is known that there is a decrease in natural fish stocks due to overfishing and pollution. On the otherhand culture of fish is encouraged for increase of aquaculture production. Aquaculture sector has proven itself to have a potential to satisfy this gap with its increasing production volume particularly in the recent two decades. By the current situation, aquaculture corresponds to approximately 40% of total aquaculture production in the world. It is possible to state that similar ratio was obtained in our country as well, 235.133 tons out of 537.345 tonsof aquaculture total production for 2014 was of fish culture (TUIK, 2014).

The most important subject in aquaculture as in other aquaculture systems is feeding. Living organisms need feeding and its activity is the most important factor determining all vital activities of a living. Feeding is important for biological structure for life as well as being effective on producing period and costs. Acquirement of a sustainable growth of the aquaculture depends on continuity of qualified feed production (origin of feed raw materials, nutrient content, digestibility of nutrients, processability of the raw material, supply-continuity of sources, its price, feed formulation and production techniques etc). Moreover, care must be taken for principle of producing products that are non-risky for human health, qualified and consumable with reasonable prices for environment-friendly aquaculture as well as considering biological-physiological features and requirements of fishes (De Silva and Anderson. 1995; Korkut and Yıldırım. 2003; Yiğit and Yiğit. 2003; Gathlin *et al.,* 2007; Demir. 2011; Yavuzcan *et al.,* 2010).

It was stated in initial studies conducted relating to the subject that fish feed production as compound feed in Turkey was initiated with press pellet systems in 1986-1987, feeds were predominantly produced carp and trout, and that fish feed production with extrusion system was initiated in 1998, and it was also

stated that there was no obvious information relating to fish feed production capacity in this period (Polat, 1999). Turkeyand aquaculture has records for "fish feed" firstly in 1999 with 38.415 tons of production amount in feed industry, and according to General Directorate of Food and Control records, 300.000 tons of fish feed was produced in our country in 2012 and 355.387 tons in 2013 (TUYEM, 2014; GKGM, 2015).Therefore production having increased recently and production of businesses for their own fishes change the amounts in fish feed production. This factor concerning majority of production should be followed. To this end, it is always important that raw materials constituting the first stage of feed production are known and rations are prepared. Accordingly, an important study was conducted with general status, production systems and production prediction for today of fish feed industry in Turkey. According to the study, it was stated that fish feed production for 2015 was expected to be 454.284 tons. It is of remark that expected production amount is resembling with the present aquaculture production (Yıldırım, 2008).

Fish feed production is carried out in 28 plants approximately satisfying the need of aquaculture sector of our country. In a previous study conducted on the subject, number of plants making fish feed production was stated as 15 plants (Yıldırım, 2008). Accordingly, it is seen that fish feed industry has almost doubled since 2008. This situation is an important indication of how fast aquaculture and feed industries develop in Turkey.These feed plants containproportionately more numbers in particularly West Anatolia in Turkey. Number of plants capable of producing feed with extruder is increasing day by day along with plant combining generally pellet press and extruder and expander production systems and continuing their works with only pellet press.

Raw material is the most important part constituting main nutrient source of the feeds. Compound feeds are formed by combining at least two materials or feed substances in certain ratios. Raw materials contain other elements such as protein, oil, carbohydrate, starch, cellulose, moisture, ash, vitamin, mineral etc. in terms of nutrients. In general, raw materials preferred for fish feeds must be more particular with respect to other feed groups. Digestive systems and sensitivity of physiology of fishes necessitate this. Particularly digestible energy, starch values and mineral substance groups are highlighted in this respect. Vitamin/mineral premixes, antibiotics, antitoxins-antimold substances, ethoxyquin, BHA, BHT, Vitamin E and Vitamin C, enzymes, emulgators and pigment substances are within additives (Korkut *et al*., 2004; Kutlu and Çelik, 2010).

Material and Method

This studywas conducted in 8 months. The aim of collecting data on operation of fish feed production in Turkey, a questionnaire comprising 60 questions was prepared for 28 fish feed producing plants and individual interviewswere performed with a responsible person for each plant. Each prepared survey form has been filled in one to one interviews.These questions (number of 10) were about commercial information feed mills, 30 of these questions the physical properties of factories and not considered in this study. Other 20 questions were about assessment of production and feeds of the feed fish factories. According to main scope of questions were given Table 1. The main topics of the questionnaire are; the distribution of the places where factories producing fish feed, various fish feed produced in factories, their production capacity and used materials, used technologies, presence of R&D (research and development) units, the number of employees in factories as an aquaculture engineer, various producers which supply of raw materials and feed mills. Thus, current statuses of the fish feed plants were attempted to be evaluated. In line with own records of feed machine and equipment manufacturers and suppliers and feed raw material and additive manufacturers and suppliers, and information obtained with interviews, distributions in Turkey were reported. For all data SPSS 15.0 package program was used in evaluation of questionnaires. In statistics, the Kolmogorov–Smirnov Z test used and applied. Insteed of Excel, SPSS software used for the test results.

Results

The main object in the study is aqua feed named as compound feed among feed types and comprising at least two raw materials or additives and having a guaranteed structure. Feed groups in conformity with regulations and most commonly used in commercial and aquaculture will be mentioned (Ergül, 1988; Karabulut *et al.*, 2000; Korkut *et al*., 2004; Kutlu and Çelik, 2010).

There are 198 feed production plants throughout Turkey and annual production amount thereof was determined as 5.119.186 tons (TUYEM, 2014; GKGM, 2015). Distribution of total activity capacity of these compound feed production plants throughout the country is as follows: 24% for Central Anatolia, 21,6% for Marmara, 18,4% for Aegean, 11,4% for Mediterranean, 10,7% for Black Sea, 7,4% for Eastern Anatolia and 6,5% for Southeastern Anatolia Region. Only feed plants producing fish feed are incorporated into this study. Accordingly, interviews were performed with only 28 feed plants, however, 25 plants were evaluated because two of the feed plants had stopped their operation, and one's capacity was below 1 ton/hour. Accordingly, 60% of plants producing fish feed were seen to be in Aegean Region (İzmir 7; Aydın 3; Muğla 4; Afyon 1), 12% in Black Sea Region (Trabzon 1; Sinop 1; Samsun 1), 8% in Marmara Region (Tekirdağ 1; Kırklareli 1), 4% in

Table 1. The Questions in the Study

Institutional structure of the factory
Existing operating capacity of the enterprise (ton/year)
Capacity of production systems (ton/hour)
The amounts of produced fish feed
Units at the factory
Number of employees at the factory
Fish feed production quantities of fish species according to the latest 5-year
Feed technology used in factories
Products other than fish feed in factory
Types of fish feed produced in the factory
Distribution according to the type of manufactured feed
The raw materials used in fish feed production
Locations of supply of raw material
Companies and locations that provide the fish feed machines
Used raw material kinds
Existence of R&D unit
Number of fisheries engineer
Working areas of aquaculture engineer employees
Source of knowledge of factory equipments

Mediterrenean Region (Antalya 1), 8% inSoutheastern Anatolia Region (Gaziantep 1; Kahramanmaraş 1), 4% in Eastern Anatolia Region (Erzurum 1) and 4% in Central Anatolia Region (Kayseri 1),(Figure 1, 2).

It is seen that fish feed production plants in our country are predominantly in Aegean Region. The main reason for this may be considered as more common presence of aquaculture in this region. Moreover, the fact that the produced feeds are commonly bass, seabream and trout feeds supports the predominance of this region in aquaculture stage. Distributions of production capacities (hour), raw material groups and type of usage thereof utilized in feed production and feed production systems (used feed production technology) of feed plants evaluated in the study are given in Figure 3, 4, 5.

As can be understood from the above graphics, majority of feed-producing plants prefer extruder feed production technology. As known, this technology enables feed production and heat and pressure as well as enabling the production of feeds with high oil content. Thus, it provides easily digestible and low FCR values-containing feed use, thereby supporting an economical production (Korkut and Yıldırım. 2003; Yiğit and Yiğit. 2003; Korkut *et al*., 2004). Furthermore, it is also seen that feed plants use particularly expander and pellet press systems collectively. This kind of application was determined as 5%, more common in regions other than Aegean Region. Predominantly raw material group was utilized in feed production. It was determined that directly meats of products such as fish meal, shrimp, squid etc. were used in moist feed category in some feed production plants, and these were more preferred in brood stock feeds. It was observed that wasters obtained in processing technology was utilized as raw material. It was stated that this application was more common in Aegean Region.

All fishfeed production plants are private sector businesses and majority of these businesses are constructions having integrating features such as aquaculture, processing, packaging, importation and exportation. Distribution of aquaculture engineers working in feed plants with R&D structuring is given in Figure 6, 7.

As majority of aquaculture species is carnivore, proteins constitute a major part of feeds used in feeds. Majority of this protein necessity was satisfied by fish meal. Moreover, fish oil is also anirreplaceable source for satisfaction of essential fatty acids. The most preferred raw materials in fish feed rations along with fish meal are soybean meal, corn gluten meal and wheat gluten considered as high protein sources. Moreover, substances such as fish oil, soybean oil, colza oil, canola oil are used. It was observed that there were a number of companies for provision of these and possibly alternative raw materials. Evaluation results obtained relating to those predominantly directed to fish feed production are given in Figure 8.

Distribution of totally 30 raw material suppliers in Turkey in accordance with regions is as given in Figure 8. It is known that generally raw material supplying companies are in this region as additive suppliers. Accordingly, it was determined that supplier companies were predominantly in Aegean Region and there was a similar appearance for additives as well. All of these companies were within Turkey and 80% of them worked in cooperation with foreign countries. Also, it was determined that 5% of supplied raw material was organic-certified.

Feed production increasing recently in our country caused the highlight of machines to make production on a sensitive subject such as fish feed, subsidiary industry and companies manufacturing or

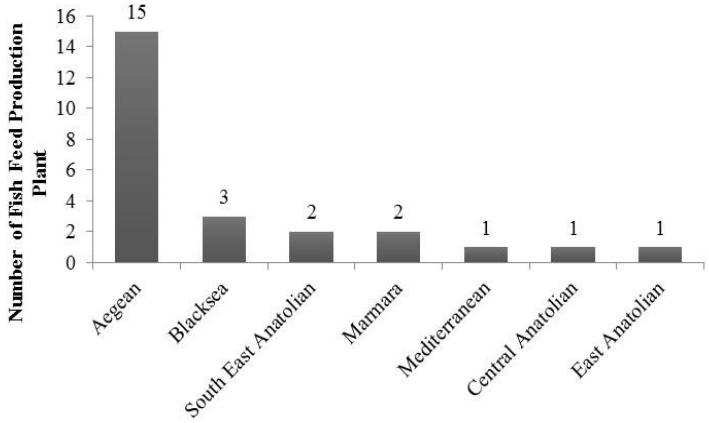

Figure 1. Regional Distribution of Fish Feed Production Plants.

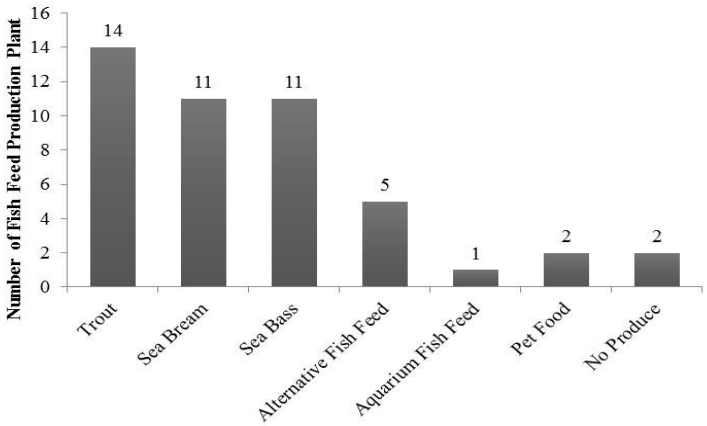

Figure 2. Distribution of Feed Type for Species in Feed Plants.

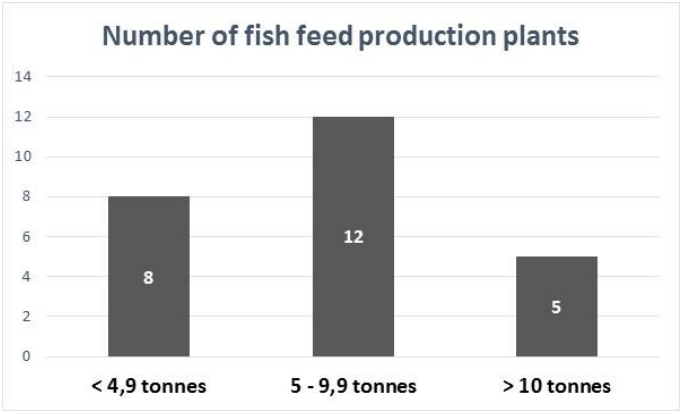

Figure 3. Distribution of Production Capacities of Feed Plants.

importing these machines. To that end, evaluation results of companies making production within boundaries of our company are given in Table 2.

There are currently totally 18 feed production machines, feed provision systems, plant installation and software suppliers in Turkey, 8 of these businesses are in Aegean Region, 3 in Marmara Region, one in Central Region and one in Southeastern Anatolia Region. 25% of these support machine and plant installation with domestic production, and the countries supporting foreign companies having suppliers in Turkey are respectively;Norway, Denmark, USA, Germany and China (Table 2).

Discussion

Recently when balanced and healthy

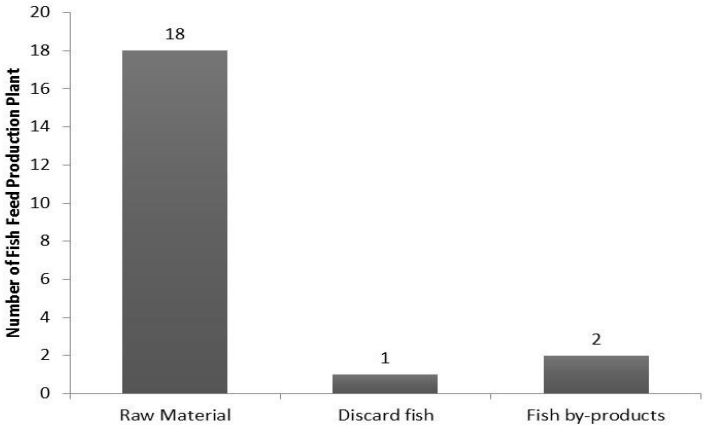

Figure 4. Distribution of Materials Used in Feed Plants.

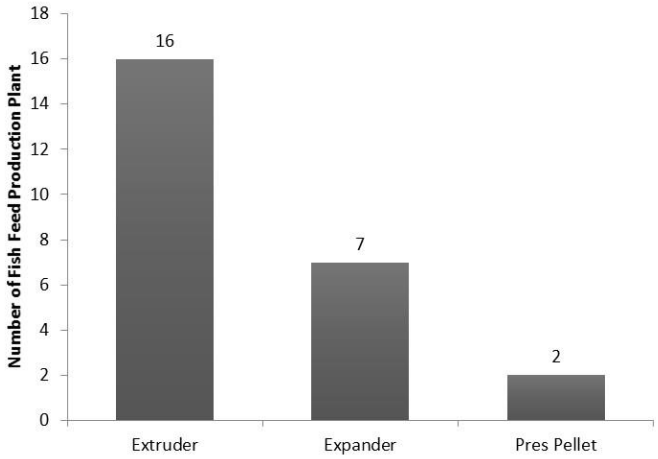

Figure 5. Distribution of Technologies Used in Feed Plants.

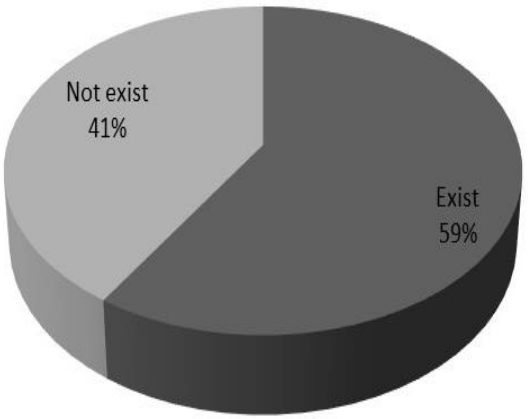

Figure 6. Distribution of R&D Presence in Feed Plants.

nourishment is a development level, considering that 50% of daily protein required for balanced and healthy nourishment is taken from meat(by ruminant), poultry animal meat, milk, egg and processed products thereof, it is concluded that feed industry has an important function for development of animal husbandry, animal quality and efficiency.

Many fish feed manufacturers are extremely important for aquaculture plants. Because, feed production for specific species is very difficult for aquaculture. The challenges in the economic and sustainable supply of high quality raw materials is the

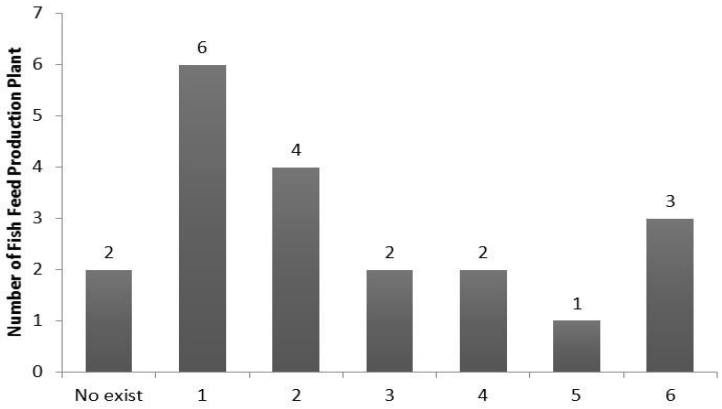

Figure 7. Distribution of Aquaculture Engineers Working in Feed Plants.

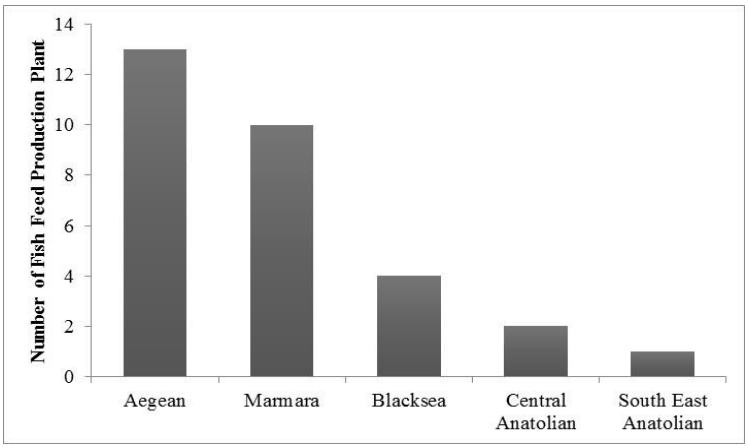

Figure 8. Distribution of Raw Material Supplier Companies.

main difficulty in aquaculture.

Turkey has a rapidly growing aquaculture, as well as an aquafeed industry. Fish feed industry has 15 fish feed plant in 2008 and it increased to 28 in 2015 (Yıldırım, 2008). This number will reach 30 and above in next few years.

Feed industry in terms of efficiency in animal products is a crucial genetic industry serving as a bridge between plant production and animal production. Moreover, it is a genetic industry branch preventing by-products of industries, called as waste, such as milling industry, fermentation, vegetable oil and soda industry causing pollution and creating added value in terms of these products along with herbal products to animal proteins. Also Yıldırım (2008), has mentioned soybean products and feed additives were the major imported feed-stuff for Turkey. Besides, the additional and alternative feed materials (by-catch, trash fish and by products, hazelnut- olive cake) should be developed. The most important factor in determining the ongoing and future success of the aquaculture industry is better communications among stakeholders namely farmers, fish feed firms, research and administrative institutions.

The industry is a genetic industry branch preventing the pollution of fermentation by-products and creating added value in terms of transformation of these products to animal proteins. Feed corresponds to approximately 40-70% of animal sector input (Metailler, 1986; Ergül, 1994; Korkut and Yıldırım. 2003; Karahocagil and Ege, 2004; Demir, 2008). Thus, it should be considered that animal husbandry cannot be developed without solving problems of feed sector.

In the questionnaire, there are some answers that fish feed factory owners doesn't want the answers published. According to this, some question didn't answered such as, cost and estimation of amount of total production. Besides, number of answered questions were between 15-20. In according to these answers it was determined that the fish feed industry develops rapidly in parallel as well as the development of aquaculture in Turkey. According to the obtained results, there is no problem in feed production in Turkey. Kolmogorow-Smirnov test has used in raw material and mechanization applications. There is no difference found between Turkey and

Table 2. Companies Providing Feed Production Machines, Feed Provision Systems, Monitoring and Supporting Equipment and Computer Programs (No different for Kolmogorov-Smirnov test; Z=0.428; p=0.993)

Supporting Type	Other Countries	Turkey
Feeding Systems	3	2
Computer Programs (software)	2	7
Feed Processing Machinery	4	9
Feed Provision Systems	3	3

other countries statistically (Kolmogorov-Smirnov Z=0.428; p=0.993).

Turkey follows developed countries on feed around the world closely, and has exhibited development on subjects such as feed technology, feed production and animal feeding science. Component feeds have importance for enhancement of animal product efficiency and thus incomes to be obtained for those dealing with animal husbandry. Turkey ranks first relating to fish feed production among all Mediterranean Region countries.

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