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Fishmeal

The Continuing Demand for Sustainable Fishmeal and Fish Oil in Aquaculture Diets

by Andrew Jackson, Technical Director, International Fishmeal and Oil Organisation

Throughout its history, aquaculture has made use of fishmeal and fish oil to feed not only carnivorous and omnivorous fish, but even herbivorous fish, particularly in their early stages when they need high protein levels.

The reason why they have proved so popular in aquaculture is that both fishmeal and fish oil have unique nutritional properties.

In the case of fishmeal these properties include a high protein level, ideal amino acid profile, high digestibility, lack of anti-nutritional factors, high palatability and wide availability.

For fish oil they include high palatability, rich in essential omega 3 fatty acids and limited other users. This has meant that

these two marine derived ingredients have been shown to consistently produce the most economically efficient diets, while also resulting in healthy animals which in turn yield healthy seafood products.

However, as aquaculture expanded worldwide, it absorbed increasing volumes of both fishmeal and fish oil. This has led some people to the view that the future growth of aquaculture will be limited by a shortage of marine ingredients.

Conversely, others have predicted that concern over the sustainability of fishmeal and fish oil, as well as rising prices, will result in decreased use of these ingredients in aquafeeds in the future.

In this article I intend to examine the drivers behind the use of fishmeal and fish oil and try and answer the question

as to what role they will play in future aquaculture diets

Production

Production of fishmeal and fish oil has remained relatively stable over recent years (see Figure 1).

Since 1980 annual fishmeal production has varied between five and seven million tonnes while that of fish oil has been between 1 and 1.5 million tonnes (see Figure 2). The clear drops in production in 1998 and 2003 were caused by El Niños in South America which caused sharp reductions in catch from fisheries in this region, notably that of anchovy, the world's single largest fishery.

The more recent decline since 2004 has been caused principally by two factors

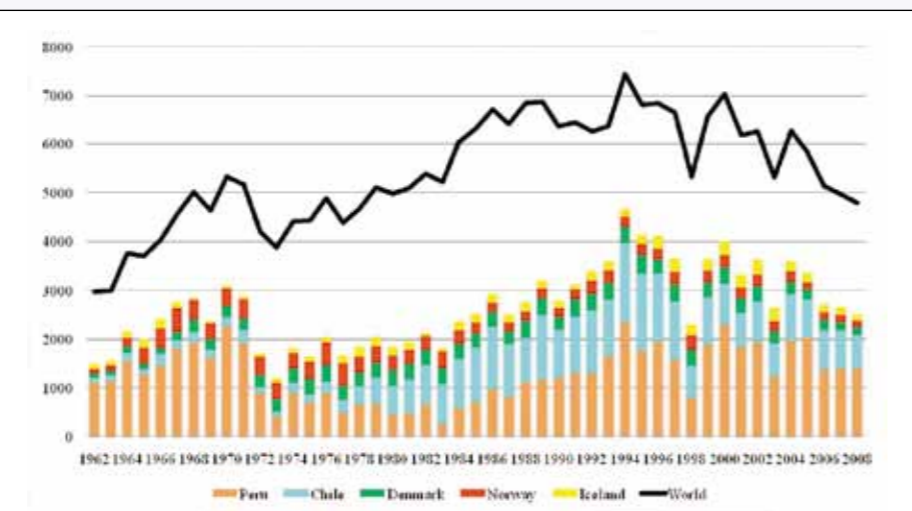


Figure 1: Historical production of fishmeal ('000 tonnes)

- one being the move to more precautionary quota setting, particularly in Europe and South America and the second being the increasing use of species such as mackerel, herring and even anchovy for direct human consumption.

The setting of more precautionary quotas may in time result in higher catches, but the trend towards increasing use of catches for human consumption is likely to persist.

Therefore, the outlook for future availability of fishmeal and fish oil is that supplies are likely to remain tight, particularly since there are unlikely to be any new resources to be exploited.

However, the one growth area in terms of supply is the use of fisheries by-products such as viscera, heads, frames and filleting waste for the production of fishmeal and fish oil.

The higher prices now being achieved for protein meals and food/feed oils, plus increasingly stringent rules on the disposal of fisheries waste, has resulted in more and more of this raw material being made available for processing. IFFO now estimates that nearly 25% of the global production of fishmeal comes from fisheries waste – this includes meals coming from aquaculture by-products.

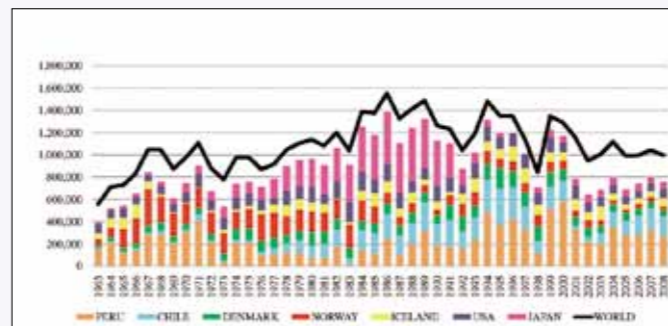


Figure 2: Historical production of fish oil (tonnes)

Table 1 shows the production of fishmeal by country in 2007 with an indication as to the main raw material sources used.

In conclusion, on the supply side production of fishmeal and fish oil is likely to remain relatively constant except for periodic downturns due to El Niños in the South Pacific.

Consumption

Since the early days in the 1950s, fishmeal has been developed and promoted as a high protein feed ingredient in complete diets for farmed animals, initially in the diets of poultry and pigs (see Figure 3). But by the 1980s intensive aquaculture, particularly salmon and trout farming, had started to grow strongly and require significant volumes of fishmeal. By 2008 nearly 60 percent of global supplies of fishmeal were being used in aquaculture while pig usage had decreased to 31

Table 1: Fishmeal production by the ten largest producing countries, 2007

Country	tonnes ,000	Raw Material
PERU	1,407	Anchovy
CHILE	770	Anchovy, Jack Mackerel, Sprats, by-products
THAILAND	428	Various species & by-products including Tuna
USA	252	Menhaden, Pollock by-products
CHINA	204	Anchovy, various species, by-products
JAPAN	200	Tuna by-products, sardines, various species
NORWAY	172	Herring, Sprat, Blue Whiting, by-products
DENMARK	166	Sand eel, Bue Whiting, Herring, Sprats, by-products
ICELAND	152	Herring, Blue Whiting, by-products
SOUTH AFRICA	88	Pilchards, Anchovy & by-products
OTHERS	1,131	Various species, by-products
TOTAL	4,970	

Around 24% of production comes from fisheries by-products

"This article examines the drivers behind the use of fishmeal and fish oil and tries to answer the question, 'what role will they play in the future of aquaculture diets?'"



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Fishmeal

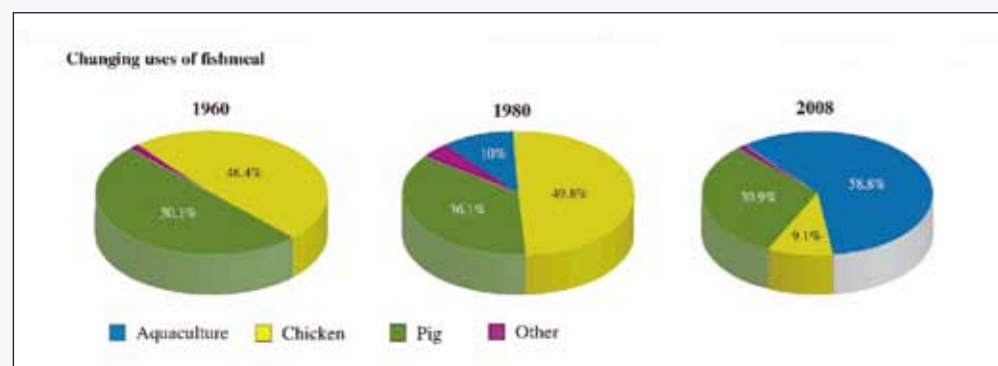


Figure 3: The changing pattern of global fishmeal usage

percent and poultry was under 10 percent.

The very rapid drop in the fishmeal usage in poultry diets since the 1980s can be attributed to nutritionists finding alternative ingredients that gave equivalent performance at a lower cost. The reduction in its usage in pig diets was much slower because most of the fishmeal was in weaner diets for young pigs, and this has proved much harder to replace.

Sprayed dried milk proteins are obviously good alternatives but their price is usually even higher than that of fishmeal.

So this increasing market-share being taken by aquaculture has led some to speculate that growth in aquaculture will soon be constrained by the availability of fishmeal.

However, this rather simplistic view treats aquaculture as a single market. This is a bit like regarding agriculture as a single market but, as we have already seen, there are different drivers in the case of poultry and pigs.

Looking at a breakdown in the consumption of fishmeal by aquaculture (see Figure 4) we can see that the three main markets are salmonids (29 percent) crustaceans (28 percent) and marine fish (21 percent). These, of course, can be further broken down into different markets with varied

drivers – particularly in the case of marine fish which covers a whole range of different species being farmed under many and diverse farming regimes.

We can look at the largest grouping, salmonids, in a bit more detail; during the period 2000-2008 the global production of all farmed salmonids grew by around 47 percent (from 1.5 to 2.2 million tonnes) while the use of fishmeal in this market grew by only around seven percent (770,000 to 820,000 tonnes).

The contrast in these figures is explained by the progressive replacement of fishmeal with other protein rich ingredients, following extensive research by the salmon feed companies. So while the industry has grown strongly and so has aquafeed production, the demand for fishmeal has only grown slightly.

This demonstrates clearly that production growth is possible without increasing fishmeal usage, so long as there is nutrition-

ary research to identify alternative ingredients and optimum inclusion levels.

Much of the increased use of fishmeal in aquaculture has been in feed for species for which there has been less nutritional trial work conducted than for salmonids.

However, with time, this work will be completed, allowing production to grow without demanding more fishmeal. This research will be driven by the cost benefit

to be gained by replacing the fishmeal with cheaper alternatives whilst not impairing performance.

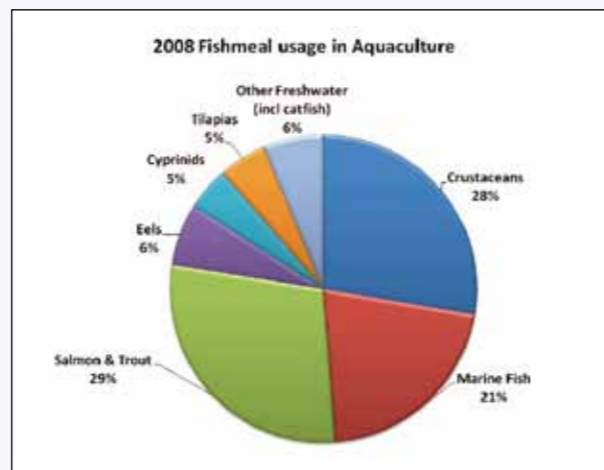


Figure 4: Fishmeal usage in different forms of aquaculture in 2008

The same argument holds true for fish oil

During the 1950s and 1960s fish oil was used largely for the production of margarines by hydrogenation of the fatty acids.

However, with the growth of salmon farming and the realisation that high oil content enabled feed conversion ratios to be reduced and protein levels decreased, greater quantities of fish oil were being used for feed. By 1990 around 16 percent of fish oil was used in aquaculture feeds while 60 percent was still used in margarine (see Figure 5).

Two critical things then happened, firstly more and more margarines were produced from vegetable oils, as this was seen as

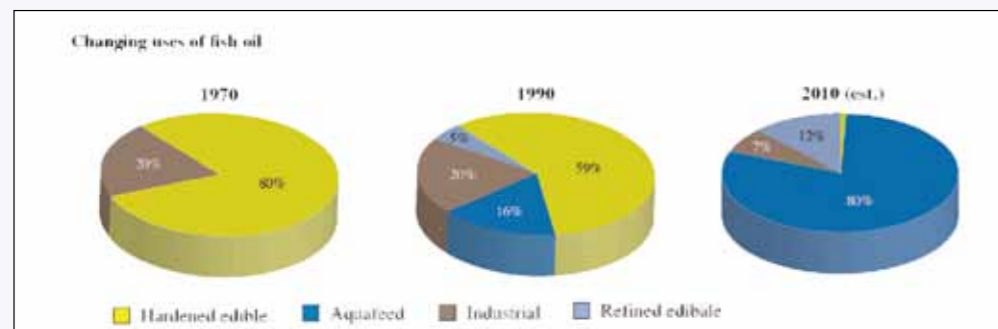


Figure 5: The changing pattern of global fish oil usage

Fishmeal

It is therefore of interest to look at the long-term trends in the price of these four raw materials (see Figure 6).

For most of the period 1999 to 2006 the price of fishmeal remained in the US\$400-600/tonne area but then, mostly as a result of strong demand from China, the price suddenly increased to around US\$1200 causing shockwaves through the market.

This can be clearly seen in the ratio of fishmeal price to soymeal price.

This rose to unprecedented levels, greater than 6:1, following years

ply is, if anything, above required demand. There is certainly no evidence here that there is insufficient supply to meet the demand of a growing aquaculture industry.

A similar picture can be seen when we look at the price of fish oil, except that in late 2002 the price of fish oil rose sharply at the onset of an El Niño (at a time when the price of other oils was dropping), but as can be seen in the price comparison with rapeseed oil, the ratio soon fell back to the historic figure of around 1:1 (see Figure 7).

In 2008 the price of all oils rose globally and this was particularly true of fish oil. This led many feed formulators to replace fish oil with vegetable oils.

However, in late 2008 it became apparent that the disease problems in the Chilean salmon industry were more serious than many had thought and production volumes have declined sharply. Given the importance of the salmon feed market to fish oil, the combined effect of substitution and reduced demand resulted in the price decreasing rapidly.

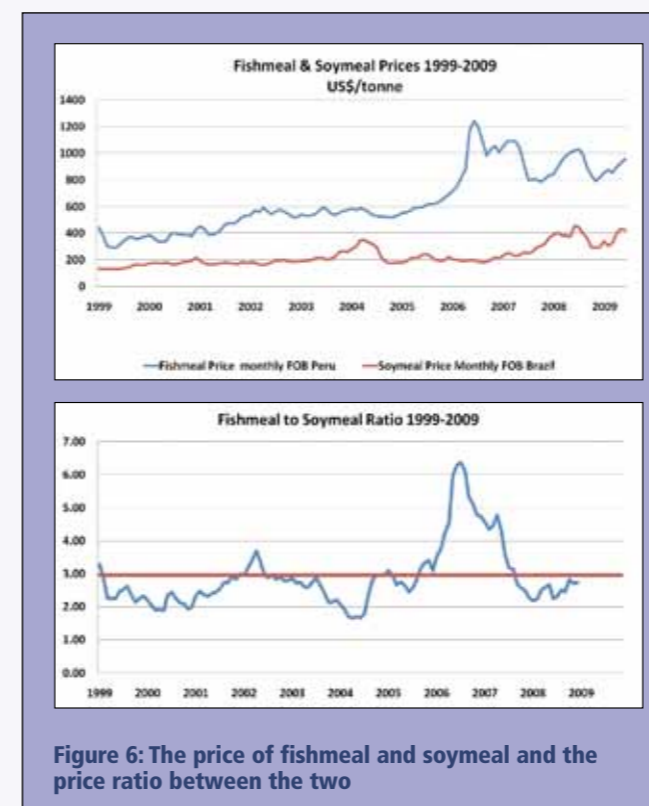


Figure 6: The price of fishmeal and soymeal and the price ratio between the two

more healthy. Secondly salmon farming production really took off. The result was that the price of fish oil fell with the loss of the margarine market. This made it doubly attractive to the salmon feed industry as it was both cheap and ideal for inclusion in feeds.

The result was that by 2000 around 75-80 percent of the global production of fish oil was being used in aquaculture while less than five percent was going for direct human consumption, with the remainder being used in industrial processes such as paints and tanning.

Again since 2000, despite the strong growth in the salmon industry, the total amount of fish oil being used in salmon feed has remained at much the same level of around 550,000 tonnes per annum. The exact amount at any one point in time has been determined by the price of fish oil as compared to alternative oils.

In recent years there has also been a strong growth in the direct human consumption of fish oil in capsules and functional foods, however despite this strong growth it still only represents 10-12 percent of the market.

Price

The main alternative to fishmeal in aquaculture diets is soymeal and the main alternative to fish oil is rapeseed oil.

of being around the historic level 3:1.

However, what then followed was a classic market correction as inclusion levels were adjusted downwards in almost every feed containing fishmeal. The result was a sharp drop in price at the same time as the price for soymeal was increasing.

Consequently, since the beginning of 2008 the price of fishmeal has been relatively low when compared to the price of soymeal, indicating that once again fishmeal represents good value for money and sup-



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Fishmeal

Soon the ratio of fish oil to rape oil hit a low of 0.5:1.

However, once again market forces resulted in a rapid move back to fish oil again, particularly in salmon diets. As was the case with fishmeal, there is no evidence that the aquaculture industry has been restrained by the availability of fish oil.

Since fish have a relatively low nutritional requirement for the omega-3 fatty acids EPA and DHA which are found in fish oil, it is clear that even in salmon diets most of the energy can be supplied in the form of vegetable oil. So market forces will continue to determine the demand for fish oil.

The biggest concern with this approach is, however, that the farmed products produced using dietary vegetable oil, rather than fish oil, are going to be much lower in the healthy very long chain PUFAs, EPA and DHA.

Given the growing body of scientific evidence as to the importance of higher intake of these fatty acids and the consumers' growing realisation that seafood is one of the best sources of EPA and DHA, aquaculture could endanger the healthy image of its products with the indiscriminate and excessive substitution of marine oils with vegetable oils.

Sustainability

One of the growing questions that has to be answered by any raw material before inclusion into aquaculture feed is: does it derive from a sustainable source?

This question is equally valid when asked of soymeal and palm oil as it is of fishmeal and fish oil. The immediate question is what does sustainable mean, particularly in the context of fisheries and fisheries management.

The most widely accepted international agreement on fisheries is the Code of Conduct for Responsible Fisheries adopted by the FAO Conference at its Twenty-eighth Session in October 1995.

This code of conduct explicitly states that it was developed to provide a necessary framework for national and international efforts to ensure sustainable exploitation of aquatic living resources in harmony with the environment.

Most of the world's fishmeal and fish oil comes from countries that are signatories to the code, but it is clear that some countries have made more effort to implement it than others. The outcome has been that there is a growing demand for fishmeal and fish oil that demonstrably comes from fisheries that have been managed using the key principles of the FAO Code.

Another important issue has been well publicised reports of fishmeal being adulterated with other protein sources - such as poultry offal meal, and even the use of protein mimics like melamine. These reports have mostly come from Asia where in some areas there have been fewer controls on quality.

Given the importance of these two issues, IFFO decided in 2008 to develop its own Global Responsible Supply Standard (GRSS). This Standard aims

to reassure the value chain that the raw material used is from a fishery managed under the key principles of the FAO Code and that high standards of manufacturing were employed to ensure feed safety and purity. The intention of the GRSS is not to create another eco-label, but to be a business-to-business scheme to give reassurance to the value chain.

The Standard has been developed with the help of a range of different stakeholders including retailers and environmental NGOs. To be compliant the fishery will have to be assessed by a third party and the factory will have to undergo a physical audit to ensure the agreed standards are met.

The development of the GRSS is nearing completion and it is hoped that product will be on the market before the end 2009.

This will then give retailers, processors, farmers and feed producers the means to demonstrate that the marine raw materials they use in the production of their farmed seafood are responsibly sourced and produced.

Conclusion

Fishmeal and fish oil have been and will continue to be vital ingredients in many types of aquaculture diets. Although supplies are likely to remain tight the various sectors of aquaculture will be able to grow by complementing the marine ingredients with ingredients from other sources.

This will result in lower inclusion levels of both fishmeal and fish oil.

Increasingly they will become strategic ingredients used at critical times in the life cycle. The issue of responsible raw material sourcing and production of fishmeal and fish oil will become progressively more important and will be managed through independently-audited certification schemes such as IFFO's Global Responsible Supply Scheme.

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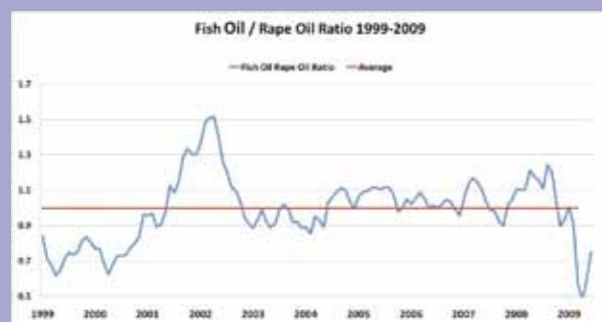
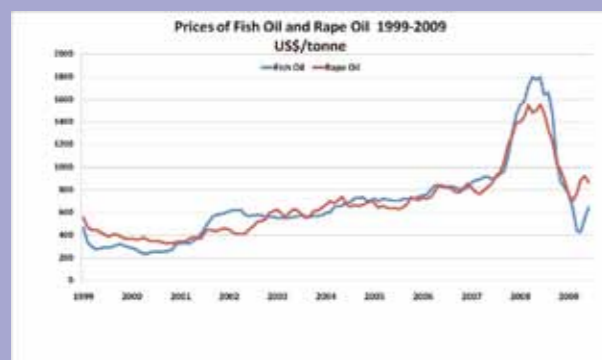


Figure 7: The price of fish oil and rape oil and the price ratio between the two

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