

Compound Aqua feeds in a More Competitive Market: Alternative protein sources for a more sustainable future

Albert G.J. Tacon

Aquatic Farms Ltd

49-139 Kamehameha Hwy

Kaneohe, Hawaii 96744 USA

Abstract

The finfish and crustacean aquaculture sector is still highly dependent upon marine capture fisheries for sourcing key dietary nutrient inputs, including fish meal and fish oil. This dependency is particularly strong within compound aquafeeds for farmed carnivorous finfish species and marine shrimp.

Results are presented concerning the responses received from a global survey conducted between December 2006 and October 2007 concerning the use of fish meal and fish oil within compound aquafeeds using a questionnaire sent to over 800 feed manufacturers, farmers, researchers, fishery specialists, and other stakeholders in over 50 countries. On the basis of the responses received, it is estimated that in 2006 the aquaculture sector consumed 3724 thousand tonnes of fish meal (68.2% total global fish meal production in 2006) and 835 thousand tonnes of fish oil (88.5% total reported fish oil production in 2006), or the equivalent of 16.6 million tonnes of small pelagic forage fish (using a wet fish to fish meal processing yield of 22.5% and wet fish to fish oil processing yield of 5%) with an overall fish-in fish-out ratio of 0.70. At a species-group level, calculation of small pelagic forage fish input per unit of farmed fish or crustacean output showed steadily decreasing fish-in fish-out ratios for all cultivated species from 1995 to 2006, with decreases being most dramatic for carnivorous fish species such as salmon (decreasing from 7.5 to 4.9 from 1995 to 2006), trout (decreasing from 6.0 to 3.4), eel (decreasing from 5.2 to 3.5), marine fish (decreasing from 3.0 to 2.2) and to a lesser extent shrimp (decreasing by 1.9 to 1.4 from 1995 to 2006. Net fish producing species in 2006 (with fish-in fish-out ratios below 1), included herbivorous and omnivorous finfish and crustacean species, including non-filter feeding Chinese carp (0.2), milkfish (0.2), tilapia (0.4), catfish (0.5), and freshwater crustaceans (0.6).

On the basis of increasing global fish meal and fish oil costs, it is predicted that dietary fish meal and fish oil inclusion levels within compound aquafeeds will decrease in the long term, with fish meal and fish oil usage increasingly being targeted for use as a high value specialty feed ingredient for use within higher value starter, finisher and broodstock feeds, and by so doing extending supply of these much sought after and limited feed ingredient commodities.

Aquaculture, the farming of aquatic plants and animals, is no different from any other terrestrial farming activity in that production is totally dependent upon the provision and supply of nutrient inputs. In the case of farmed aquatic plants and bivalve mollusks (29.2 million tonnes or 43.7 % of total global aquaculture production in 2006, these nutrient inputs are usually supplied in the form of dissolved mineral salts or wild planktonic food organisms, respectively. However, in the case of the other 37.5 million tonnes or 56.3 % of aquaculture production in 2006 (mainly fish and crustaceans), these nutrients are either supplied through the consumption of natural food organisms produced within the culture system for the target species or through the direct external application of feed inputs. Feed inputs may include the use of industrially compounded aquafeeds, farm-made aquafeeds, or the use of natural food organisms of high nutrient value such as forage/trash fish and natural/cultivated invertebrate food organisms; feeds and feeding usually representing the largest operating cost item of most fish and crustacean farming operations. Clearly, if the finfish and crustacean aquaculture sector is to sustain its current growth rate of 8.5% per year (the sector growing over 115-fold from 322,765 tonnes in 1950 to 37,109,751 tonnes in 2006, then it follows that the supply of feed inputs will also have to grow at similar rates so as to meet demand. Nowhere is this supply more critical than with the current dependency of the export oriented fish and crustacean aquaculture sector upon capture fisheries for sourcing feed inputs, including fish meal and fish oil

Results are presented concerning the responses received from a global survey conducted between December 2006 and October 2007 concerning the use of fish meal and fish oil within compound aquafeeds using a questionnaire sent to over 800 feed manufacturers, farmers, researchers, fishery specialists, and other stakeholders in over 50 countries. On the basis of the responses received, it is estimated that in 2006 the aquaculture sector consumed 3,724 thousand tonnes of fish meal (68.2% total global fish meal production in 2006) and 835 thousand tonnes of fish oil (88.5% total reported fish oil production in 2006), or the equivalent of 16.6 million tonnes of small pelagic forage fish (using a wet fish to fish meal

processing yield of 22.5% and wet fish to fish oil processing yield of 5%) with an overall fish-in fish-out ratio of 0.70.

The top consumers of fish meal in 2006 were marine shrimp, followed by marine fish, salmon, Chinese carps, trout, eel, catfish, tilapia, freshwater crustaceans, miscellaneous freshwater fishes, and milkfish (Fig. 1), and this sequence compares very closely with that estimated by IFFO (Jackson, 2007a), except for catfish and Chinese carps. By contrast, the top consumers of fish oil in 2006 were salmon, followed by marine fish, trout, shrimp, catfish, eel, tilapia, freshwater crustaceans, miscellaneous freshwater fishes, and milkfish (Fig. 2), and again this sequence compares almost exactly with that estimated by IFFO (Jackson, 2007a), with the exception of carp (no fish oil consumption in the present study).

Despite increases in the total global consumption of fish meal and fish oil by the aquaculture sector, the average dietary fish meal and fish oil inclusion levels within compound aquafeeds have been steadily declining (with the exception of catfish, for the period between 1995 to 2006), including shrimp from 28 to 20%, marine fish from 50 to 32%, salmon from 45 to 30%, trout 40 to 30%, carp 10 to 5%, catfish 5 to 10% (levels increasing due to the rapid increase in catfish production in Vietnam), eel 65 to 55%, miscellaneous freshwater carnivorous fish 55 to 40%, freshwater crustaceans 25 to 15%, tilapia 14 to 6%, and milkfish from 15 to 3%. In the case of fish oil, these decreases have been as follows, shrimp 2% (no change), marine fish from 15 to 8%, salmon from 25 to 20%, trout 20 to 15%, carp 0%, catfish 1 to 1.7%, eel 8 to 5%, miscellaneous freshwater carnivorous fish 8 to 5%, freshwater crustaceans 2 to 1.5%, tilapia 1 to 0.5%, and milkfish from 3 to 1%.

Clearly, with fish oil prices now being double what they were a year ago, the continued use of fish oil as a relatively inexpensive source of dietary energy in compound aquafeeds (as in the case of salmonid diets which consumed over 55% of the fish oil used by the aquaculture sector in 2006) will no longer be economically sustainable in the long run. It follows from the above, that future dietary inclusion levels and usage of fish oil and fish

meal in aquafeeds and animal feeds in general will decrease in the long run, and be reduced in supplying the necessary minimum essential dietary nutrients for the target species as high value key nutrient additives rather than as major dietary sources of protein and lipid, respectively. We are therefore in agreement with IFFO, in that fish meal and fish oil use in the long term will be increasingly targeted as a specialty feed ingredient for use in higher value starter, finisher and broodstock feeds, and by so doing extending supply and maximizing profit to the ingredient supplier

Dietary substitution of fish meal and fish oil with alternative feed ingredient sources will be considerably easier for herbivorous/omnivorous aquaculture and animal species than for the more nutritionally demanding carnivorous aquaculture and animal species. Notwithstanding the above, fish meal and fish oil are not essential feed ingredients *per se*, but rather have represented cost-effective providers of high quality animal protein and marine lipids packaged in near ideal nutritional proportions for most carnivorous and omnivorous high value aquaculture species.

Notwithstanding the above, it is also important to mention here that as the aquaculture sector grows and matures, then so the production and availability of aquaculture derived fish meals and oils will become increasingly produced and available in the market place, just as they have become available within the terrestrial livestock production sector; animal by-products arising from the rendering industry being the largest source of high quality feed-grade animal protein and lipid available to animal feed manufacturing sector globally, estimated at over 8.5 million tonnes in 2007 in the US alone. Although at present no information is available from FAO concerning the total global production of fish meals and oils produced specifically from aquaculture trimmings and offal, aquaculture derived fish meals have been reportedly produced from the processing of farmed salmon, shrimp, tilapia and more recently catfish. For example, in Chile it is estimated that the production of 600,000 tonnes of salmon yielded 270,000 of processing waste and farm mortalities, which in turn resulted in the production of 48,600 tonnes of salmon oil and 43,200 tonnes of salmon meal.

Finally, on a cautionary note, it is important to ensure that the fish meals and fish oils derived from aquaculture process wastes are not fed back to the same species (intra species recycling) so as to prevent the possibility for the spread of diseases and/or recycling of unwanted environmental and/or dietary contaminants.