Preliminary note on the impact of rising feed ingredient prices on aquafeed with special reference to Asia and Europe

Mohammad R. Hasan

Aquaculture Management and Conservation Service (FIMA)
FAO Fisheries and Aquaculture Department, Rome, Italy
Mohammad.Hasan@fao.org

Overview of aquaculture and impact in relation to soaring feed prices

Approximately 220 species of aquatic animals and plants are currently cultured worldwide, in a vast range of contexts and culture systems; from subsistence to commercial, extensive to intensive. In 2006, global aquaculture production reached 66.7 million tonnes, increasing at an annual rate of 9 percent/year with Europe accounting for only 3.2 percent of total reported global aquaculture production and Asia approximately 92 percent. The Asian contribution to total world aquaculture production drops to 24 percent in terms of quantity and 29 percent in terms of value when China is excluded, and therefore, currently aquaculture production is overwhelmingly concentrated in China.

The future pressure on demand for feed ingredients and fish feeds in its different product forms however, will depend on what proportions of fed and non-fed aquaculture are going to contribute to total aquaculture production, type of aquaculture species requiring aquafeeds and their farming intensities. Fed aquaculture includes mainly crustacean and finfish where farm-made or complete commercial diets are used to varying extents and non-fed aquaculture which does not depend on feeds includes mainly filter feeding finfish, molluscs and other invertebrates and aquatic plants.

Between 2000 and 2006, the production of crustaceans grew at an average annual growth of 24.5 percent, while finfish and molluscs grew at an average growth of 7.0 percent and 5.0 percent, respectively. All other sectors, namely, amphibians, invertebrates and aquatic plants showed a slowing down in their percentage annual production growth during the same period. If the recent trend of decreasing annual growth continues in the non-fed aquaculture sectors, while maintaining an increase in total aquaculture production in Asia, the pressure on demand for feed and their ingredients may significantly increase.

Globally, the main aquatic groups that tend to rely more on complete diets for their production are marine finfish, crustaceans and diadromous fishes. Between 1996 and 2006, the production of these groups increased by 30, 22 and 8 percent/year, respectively. Increasing pressure to improve production of freshwater finfish through intensification is also evident. Freshwater finfish production increased by 9 percent during the same period. In 2006, carps and other cyprinids, tilapias and catfishes accounted for 30, 5 and 3 percent, respectively, of global production. In addition, there are significant increases in growth, albeit from a smaller production base, of a number of carnivorous finfish and crustacean species over the same period. These include oriental river prawn, mandarin fish and Japanese eel. Thus, there is a trend in moving away from low to high-value species and these will rely heavily on complete commercial feeds, especially as the use of trash fish as aquaculture feed is unlikely to be sustainable due to the declining supply and its unacceptability due to the increasing consumer's concern. Though carps and tilapia are considered as low value species and understood to be cultured in less intensive systems and depending more on farm-made aquafeeds, their production in bulk will still place great stress on many of the land-based feed ingredients such as soybean, corn, rice, vegetable oils.

The pressure on aquafeed ingredients should also be viewed within the context of land and water resource limitations throughout many of the aquaculture producing countries in Asia. In these circumstances and pressure to increase fish production, improvement of productivity of such low (and high) value fish through intensification is inevitable. This trend to increase productivity of low

value herbivores and omnivores by switching from extensive to semi-intensive practice depending on farm-made aquafeeds, is illustrated by the trends in increasing use of aquafeed and number of farms dependent on aquafeeds. According to a recent estimate, based on seven leading aquaculture producing countries, 19.3 million tonnes of farm-made aquafeeds were used against 10.3 million tonnes commercial feeds during 2003-2004 in Asia alone (De Silva and Hasan, 2007). It is also predicted that the usage of farm-made aquafeeds may go up to 30.7 million tonnes over the next five years representing a growth of 60 percent increase from current level (De Silva and Hasan, 2007). However, an increasing trend to use complete commercial diets in semi-intensive farms is also evident. In two case studies carried out in India and China for different carp species, it was recorded that 74 and 46 percent of semi-intensive farms, respectively, use industrial feeds compared with farm-made feeds (Rola and Hasan, 2007). China and India together accounted for 90 percent and 92 percent of world's and Asia's carps and other cyprinids production, respectively, indicating a trend of mainstay of low value species in semi-intensive farms is complete commercial feeds as opposed to farm-made feeds. Overall, these trends suggest that an increasing trend towards intensification and consequent increasing dependency on complete commercial feeds.

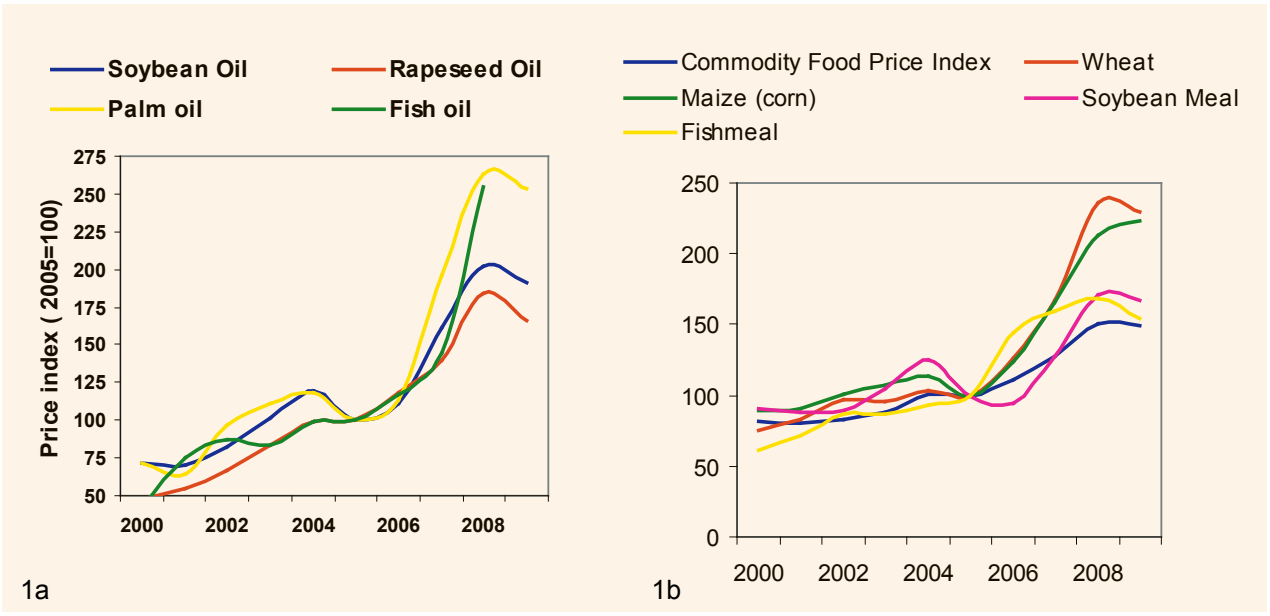
The recent rises in prices of ingredients used for either complete or on-farm feeds will therefore have a major impact on the ability of aquaculture to cope with these price rises. The increase in cost of production is inevitable but if productivity is not improved to offset these costs, fish prices may rise sharply when compared with other protein alternatives.

This preliminary note investigates and evaluates the underlying reasons for the recent dramatic rise in prices of these commodities used in aquafeeds production and its consequences for the aquafeed industry in particular and on demands and expectations on aquaculture in securing current and future fish supplies.

Recent situation of price of major commodity prices

Aquaculture is reliant on a basket of common input ingredients such as soybean, corn, rice, wheat, fishmeal and fish oil for which it competes with other animal protein production sectors such as beef, poultry and pork as well with direct human consumption. Many of these key ingredients traditionally used in recipes for commercial or on-farm aquaculture feeds are internationally traded commodities and therefore aquafeed production is also subjected to any global market shocks and volatility. Since 2005, the basket commodity price index (CPI) rose by about 50 percent (Figure 1a). During the same period, the price of soybean meal, fishmeal, corn, and wheat rose by 67, 55, 284, 225 and 180 percent, respectively. Similarly, the cost of major oils used in the feed industry has increased by about 100 to 156 percent (Figure 1b). The price of these ingredients has increased dramatically since the millennium but the rate of price increase has occurred in two phases: a steady

Figure 1. Price index (2005=100) of key (a) food commodities and grains and fishmeal and (b) plant and fish oils, used for animal feeds and human consumption



gradual increase in prices to around 2004 followed by a dramatic exponential rise and slight fall in latter half of 2008 (Figure 2). The major drivers impacting on the ingredients commonly used in aquafeeds are outlined below.

What are global drivers fuelling price rise of aquafeeds?

The price shocks were an unusual confluence of several primary and secondary factors which disrupted the global demand and supply balance of these commodities, the impact of which was greatest since the millennium. Over the last decade the strong increase in the economic growth, especially in developing countries together with the increase in population size has increased the demand for food. Whilst the economies of advanced economies declined from 3.6 to 2.2 percent/year between 2000 and 2007, the economies of developing, especially Asian countries, grew at a staggering rate of 7 to 10 percent/year during the same period (IMF, 2009, http://www.imf.org/external/index.htm). This increase in disposable income and prosperity was also accompanied by a notable shift in the dietary preferences in these countries as consumers diversified their diets to consume more meat, fish and milk products which consequently increased the demand for grains, the principal ingredients used in animal feeds. The poorer conversation rations of feed to meat of around 2-8:1 compared to fish of around 1-2:1 amplified the demand for these common aquafeed ingredients. In addition, the demand of oils (soybean, rapeseed and palm oil) also increased dramatically in these economies. Moreover, these changes occurred in the most populous countries in the world notably China, having the greatest impact, skewing the global distribution of such commodities. Against this backdrop of sharply rising demand in China as well as in other populous developing economies such as India, the demand for all ingredients used in aquafeeds faced significant upward pressure in price.

These price rises were further compounded by a series of concomitant short-term shocks. Since 2004, however, as world stocks of grains used in aquafeeds began to decline, countries like China that have huge foreign reserves began to stockpile fishmeal and other proteins and oils through imports to secure supplies and this in turn exasperate the prices of these commodities, on the world market since 2004.

This escalation in demand for commodity feed ingredients coincided with the dramatic increase in fuel prices since 2004 peaking at over USD 130/barrel in July 2008 (Figure 2). Since 2005, the price index for crude oil soared to 250 percent but has since slipped back to around USD 50/barrel by the end of 2008. This rise in fuel costs impacted heavily on transportation and production costs of these feed ingredients and other commodities thus increasing their landed cost. The key commodities that impacted on aquafeed ingredients were corn, soybean and fishmeal and oil all of which are largely sourced from the Americas notably, Brazil, United States of America, Chile

Figure 2. Escalation of crude oil prices over the period of 2000 and 2008

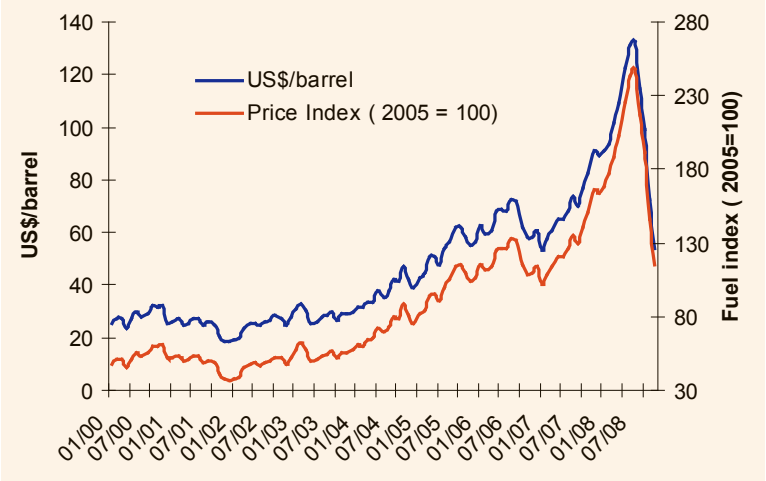
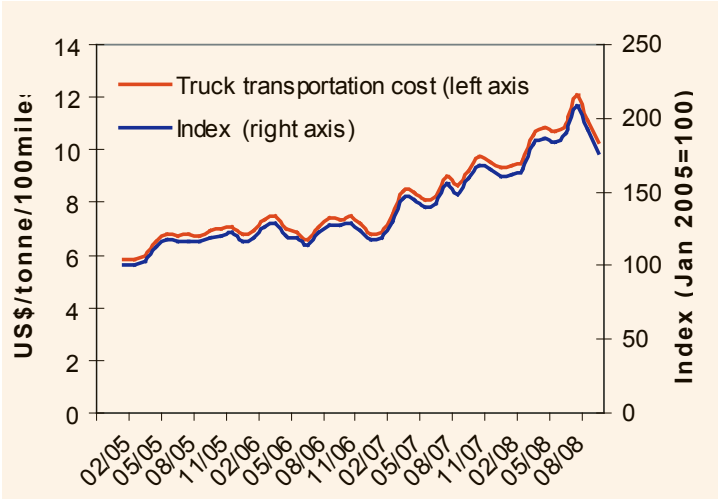


Figure 3. Increase of transportation cost of soybean in Brazil over the period of 2005 and 2008



and Argentina and have to be transported to major markets. In Brazil where production areas can be over 1 000 miles away from sea ports, trucks are predominantly used to transport soybean. The cost of this transportation has escalated due to rising fuel prices and is illustrated in Figure 3. Since January 2005, the cost of land transport has doubled from USD 6/100 miles in January 2005 to over USD 12/100 miles in July 2008 (Figure 3). Similarly, the fuel prices further impacted on the landed costs of feed ingredients due to increased sea freight costs thus total transport costs has increased substantially.

In addition to fuel hikes, the sharp rise in sea freight was compounded by the concurrent increasing demand for dry and container cargo ships mainly by China for transportation of coal, iron ore and grain. The Baltic Exchange Dry Index, an internationally recognised measure of sea freight cost, rose from 5 000 in January 2005 to over 11 000 in July 2008.

In addition to these high base prices due to availability on the global market, competition between aquaculture industries for key ingredients such as fishmeal with cattle, poultry, pigs placed added upward pressure on price. In 2002, aquaculture used 46 percent of the marketed world fishmeal, while pigs and poultry used 24 percent and 22 percent, respectively (FIN, 2007). It is expected that aquaculture may use 56 percent of the market share of fishmeal by 2010.

Factors affecting supplies of key ingredients for aquafeeds

Production was limited due to (i) gradual decline in acreage under cultivation, (ii) uncertainties in water availability for agriculture, (iii) reduction in state research in crop yields, and (iv) adverse weather conditions and disease resulting in crop loss and destruction of infrastructure for fishmeal processing plants. Nonetheless, the demand for ingredients for aquafeeds increased gradually until around 2004, even though farm yields increased supply could not keep pace with demand.

Whilst the production of grains increased, albeit well below demand levels, the supply of fishmeal and fish oil from main producers, such as Peru, Chile and Scandinavian countries, into the world market had reduced putting greater pressure on price. Overall the fish catch going to reduction for fishmeal have been declining in favour of direct human consumption. In addition, lower quotas for fish such as capelin, mackerel and blue whiting in Scandinavian countries contributed to decline in exports from 504 000 tonnes in 2005 to 429 000 in 2008. Similarly, in South America, exports declined from 1.96 million tonnes to 1.51 million tonnes over the same period.

Increased prices and availability has compelled aquafeeds manufactures to mitigate against these uncertainties to secure ingredients. In Europe where aqua farming practices is predominately intensive and in Asia where many economically important species are farmed intensively, it is helpful to understand the structure of the commercial aquafeed industry and the sector segment they serve.

Profile of the aquafeed industry in Western Europe

Unlike Asia, the farming of finfish in Western Europe is exclusively intensive and is dependent and driven by the use of compounded industrial feeds. Four key species such as Atlantic salmon, rainbow trout, European seabass and gilthead seabream dominate European aquaculture. In 2006, the output of these species totalled over a million tonne and accounted for 81 percent of total finfish production in Europe. Moreover, salmon accounted for 54 percent (783 000 tonnes) of European finfish production. Feed manufacturers therefore strategically monitor such developments to position themselves in geographic production hotspots and historically around centres of key raw ingredients e.g. fishmeal and fish oil.

The feed industry in Western Europe has largely followed the market development of Atlantic salmon (and to a lesser extent rainbow trout) which is predominantly concentrated in Norway, Scotland, and to a lesser extent in Faroe Islands and Ireland. These four north European countries collectively accounted for 890 000 tonnes of salmonids in 2006 and over a million tonne in 2007.

The aquafeed industry in Western Europe serving these markets is highly consolidated with three companies, Skretting, Ewos and BioMar, dominating the salmonid feed market sector (Table 1). In 2007, these companies accounted for over 96 percent of the feed used for salmon and trout production in northern Europe providing around 1.3 million tonnes of industrial feeds. In 2007, more than 2.1 million tonnes of feed was used in Western Europe (Table 1). Details on translation of the impact of rising ingredient prices are difficult to obtain due to company confidentiality. In 2004, and 2006, 7 and 13 percent of revenue increases were attributed to higher feed prices and this is largely attributed to higher ingredient costs since raw ingredients account for 75 percent of feed production costs (Nutreco Annual Reports, 2004 & 2006

Table 1. Estimated industrial aquafeeds produced by key feed manufactures3 and their market share

	Market share in 2007 (%)	Production in 2006 (tonnes)	Production in 2007 (tonnes)
North Europe (NE)[1]			
BioMar	23	300 000	316 250
Ewos	30	412 500	412 500
Skretting	43	500 000	591 250
Others	4	37 500	55 000
Total (tonnes)		1 250 000	1 375 000
NE (% of total)		65	65
Rest of Europe (RE)[2]			
BioMar	18	128 250	137 000
Skretting	18	128 250	130 500
Prov imi	9	60 750	65 250
Persus	7	47 250	50 750
Dida q	6	40 500	43 500
Aller aqua	5	33 750	36 250
Feedus	4	27 000	29 000
Others	33	209 250	239 250
Total (tonnes)		675 000	725 000
RE (% of total)		35	35
Total aquafeeds in NE + RE (tonnes)		**1 925 000**	**2 100 000**

1 NE = Norway, Scotland, Ireland and Faeroe Islands
2 RE = >1000 tonnes: Denmark, Finland, France, Greece, Italy, Poland, Spain, Sweden, Germany, Russia, Turkey, Czech Rep., Croatia, Switzerland, the Netherlands
3 Estimates extrapolated from Biomar Annual Report (2000)

available at http://www.nutreco.com/; BioMar Annual report, 2007 available at http://www.biomar.co.uk/)

Profile of the aquafeed industry in Asia

Unlike Europe, aquaculture in Asia is very diverse with over 200 species being reportedly farmed in a range of culture systems using extensive to intensive practices. The trend on the mainstay of national aquaculture output from Asia, however, is similar to Europe. In common with Europe, however, reported aquaculture output at a national level is dominated by a few species/species-groups (Table 2). In ten major aquaculture producing countries in Asia, over 80 percent of production originates from just 3-4 species or species-groups (Table 2). In 2006, around 97 percent or 31 million tonnes of production originated from around 15 or more species/species-groups (Table 2).

Dependency of feed ingredients and hence vulnerability to price shocks

Mass production of these species in Asia is also dependent on aquafeeds and some species are almost exclusively dependent on commercial aquafeeds and under semi-intensive to intensive conditions. Although the current debate on feed ingredients till largely focuses on the major constraints of the well documented and known finite fishmeal and fish oil recourses, the sustainability of aquaculture is more likely to be linked with availability and accessibility of plant proteins, oils and carbohydrate supplies for aquafeeds. In the coming years, developing countries are more likely to be adversely impacted, if these terrestrial plant ingredients for aquaculture are not produced and sourced locally. The rising prices of key plant ingredients used in the aquafeeds industry on the international market are illustrated in Figure 1. In view of current trends the local competition for these plant-based aquafeed ingredients will also increase as populations and disposable in developing countries increase and as evident demand for meat and milk products which require substantial volumes of grains, etc., continues to rise especially in populous countries.

Table 2. Number and % contribution of major aquatic species/species-groups to national production in ten leading Asian countries in 2006

Country	Number	Total production (thousand tonnes)	Main species/ species - groups production (thousand tonnes)	% contribution
Japan	3	302	293	82
Myanmar	3	575	558	85
Viet Nam	3	1 512	1 466	97
India	3	3 123	3 029	92
Bangladesh	4	893	866	93
Philippines	4	587	569	95
Thailand	4	1 021	991	84
Taiwan province of China	6	217	210	85
Indonesia	6	1 293	1 254	81
China	7	22 650	21 970	80
Total		**32 173**	**31 206**	**97**

Acknowledgements

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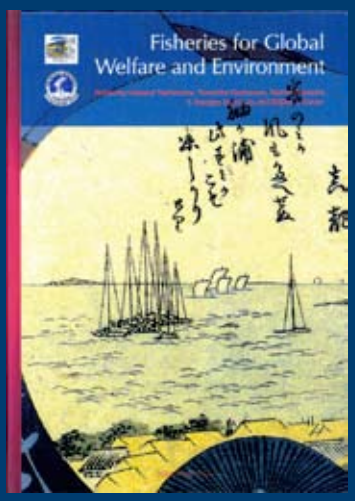

The Fisheries and Aquaculture Department of FAO supported WFC 2008 held at the Pacifico Yokohama in Yokohama, Japan from 20 to 25 October 2008. This huge scientific event, with 1600 registered participants from 63 countries delivered about 726 oral presentations (keynote and oral presentations) and 549 poster presentations and was supported by 6 satellite symposia (2 before and 4 after WFC2008) and 2 training courses on GIS. A major highlight of the WFC2008 was a Commemorative Ceremony graced by the Emperor and Empress of Japan with a taped messaged from Japan's Prime Minister. FAO's Assistant Director General for Fisheries and Aquaculture, Mr Ichiro Nomura, delivered a Plenary Lecture entitled *Fisheries management :status and challenges* while FAN Editor-in-Chief and Fishery Resources Officer Dr Melba B. Reantaso delivered a Keynote Paper at the Aquaculture Session entitled *Meeting the future demand for aquatic food through aquaculture: the role of aquatic animal health.* Both presentations are included as full papers in the Memorial Book of WFC2008 – Fisheries for Global Welfare and Environment – which was released during the conference (available for download at http://www.terrapub.co.jp/onlineproceedings/fs/wfc2008/index.html). Dr Reantaso also gave a Keynote Paper - *International trade and aquatic animal health: what did we learn so far in managing the risks?* – in one of the satellite symposia (5th International Symposium of the Japanese Society for Fish Pathology, held from 18-19 October 2008 at the University of Tokyo, Tokyo, Japan).