

FISH FEEDING IN THE CHILEAN SALMON FARMING: CONVERSION RATES

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In order to impress the public opinion (or for other non declared purposes), the Chilean environmentalist circles have chosen to develop publications with respect to activities related to the use and management of natural resources that have a common denominator: They contain abundant information, they hurriedly and alarmingly conclude respect to them and frame the set with a showy title, generally ironic¹. We can see again that case in the publication “Piranha-like Salmon: Conversion rates in the Chilean salmon farming industry” by the Terram Foundation².

The most discouraging thing of the present case is that the publication mentioned before refers to matters that have been under discussion with that and other environmental groups by almost a year, since 2005. In effect, figures given by Terram have been discussed, clarified and discussed again in long working meetings, with ample and plural participation of different representatives of NGOs and the salmon farming and fish flour exporter industry. Much of the information transferred to the publication has been given by the own salmon farming industry, and its different derivations and consequences clarified again and again.

Conversion rates: First Showy Statement

We must insist again that perspectives with respect to conversion factors can follow different lines of thought, depending on the objective pursued. Thus, for example, if we want to measure the efficiency of food transformation by salmons, we use what we call the food – salmon conversion rate. If complementarily we want to evaluate the use rate of fish flour by salmons, we use the flour – salmon conversion rate. We may also require to evaluate the fish oil – salmon conversion rate, for which we will use an oil – salmon conversion rate.

Next, the lines of thought of our analysis based on updated data from the industry and also coincident with ranges shown by diverse scientific studies throughout the world:

First level of analysis (kg of food by kg of salmon):

According to the productive efficiency currently reached in Chile for salmon production, and from information that salmon food producers have, to obtain 1,000 kg of salmon, 1,350 kg of food are required (food – salmon meat conversion factor of 1.35). In other producing countries as Norway, the average conversion rate reached is slightly lower (more efficient) reaching approximately 1.2.

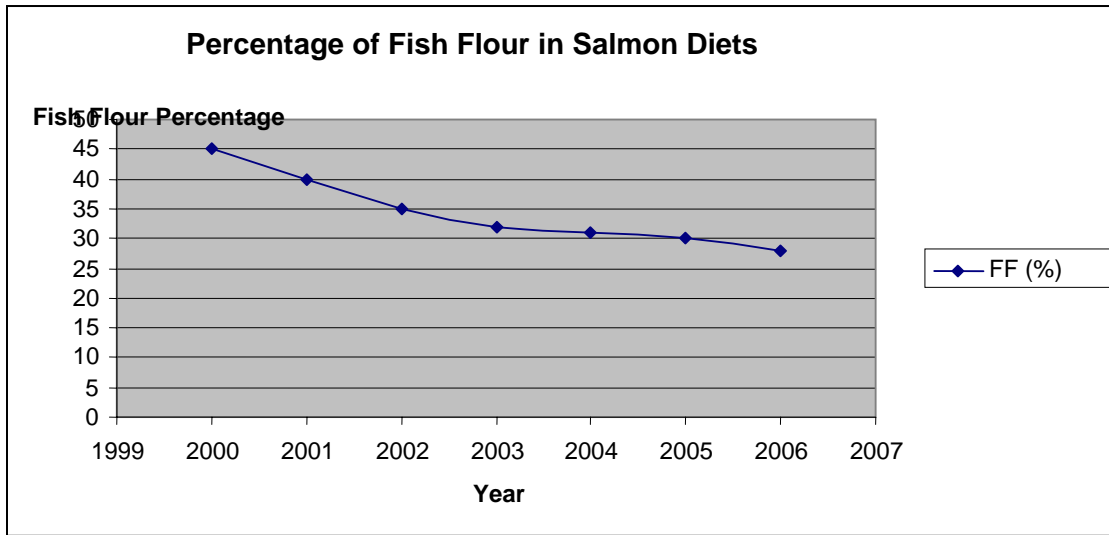
¹ Ley de Bosque Nativo: Depredación Velada (Terram, octubre de 2005); Celulosa: la nube negra del sector forestal (Terram, agosto del 2004); Recursos Pesqueros: ¿Patrimonio Nacional o Privado? (Terram, diciembre del 2003) ¿Conoce Santiago a Transantiago?, (Terram, Junio 2005).

² Salmón tipo piraña: Tasa de conversión en la industria salmonera chilena. Serie APP, N° 34, Julio 2006.

Salmon food ingredients (Intesal 2006)	g/kg	Percentage
Fish flour	200 - 280	20 - 28
Corn and Wheat Gluten	130	13
Soybean Flour	120	12
Other flours	150	15
Fish Oil	160 - 200	16 - 20
Soybean Oil	50	5
Wheat	120	12
Others	40	4
Total	1000	100

Year	FF (%)
2000	45
2001	40
2002	35
2003	32
2004	31
2005	30
2006	28

Fish flour (FF) is being replaced mainly by Corn and Wheat Gluten and Soybean Flour.



Second level of analysis (kg of flour to kg of salmon):

1. Conversions and fish flour yields from fish with high protein content, mainly mackerel.

In order to produce 1,350 kg of food, 378 kg of fish flour are required (using a 28% of flour in the food formula). (For the case of 20% of flour use, 270 kg are required). In order to produce those 378 kg of fish flour, 1575 kg of whole mackerel from fishing are required (this is a conversion or percentage yield of 24%). In the case of using 20% of formula, 1125 kg of mackerel are required.

As conclusion, to produce 1000 kg of salmon, 1,575 kg of mackerel are required, using a 28% of flour in the food formula and 1,125 kg of mackerel in case of using a 20% of fish flour. So, the conversion rate from kg of fish to kg of salmon can vary, depending on percentage of use of fish flour in the formula, between 1.575 and 1.125.

2. Conversions and fish flour yield from fish with low protein content, mainly anchovy.

1000 kg of salmon require 1350 kg of food (food – salmon meat conversion rate of 1.35).

In order to produce 1350 kg of food, 378 kg of anchovy flour are required, using a 28% of flour in the food formula and 270 kg using a 20% of flour in the formula. In order to produce those 378 kg of fish flour, 1718 kg of whole anchovy from fishing are required (this is a conversion or yield percentage of 22%). Likewise, to produce 270 kg of fish flour (20% of flour in the formula), 1227 kg of whole anchovy from fishing are required, keeping the conversion or yield rate at 22%.

Therefore, to produce 1000 kg of salmon between 1718 and 1227 kg of anchovy are required. That is, the conversion rate from kg of anchovy to kg of salmon is between 1.718 and 1.227, depending on the formula used.

It is necessary to add fish oil to salmon food, additional to that contained in the kilos of Mackerel or Anchovy necessary to provide the amount of flour to complete the diet, thus we must follow the line of reasoning N° 3.

Third level of analysis (kg of oil to kg of salmon):

Given the fish flour production mentioned in the line of reasoning N° 2, and the oil content in fish (5% in the case of mackerel and 7% in the case of anchovy) an amount between 78.75 (1575x0.05) and 56.25 (1125x0.05) kg of oil is obtained for that item. Since between 160 and 200 kilos of oil are required to prepare one ton of food, between 103.75 (160-(1125x0.05)) and 191.25 kg of oil (270-(1575x0.05)) are additionally required in order to produce one ton of salmon fed with the described formula.

Where does that oil comes from?

We already know that to produce 1,000 kg of whole salmon, 1,350 kg of food are required.

In order to produce 1,350 kg of food, 338 kg of oil (using a 25% of oil in the food formula) and 284 kg of oil are required (using a 21% of oil in the formula), considering the use of 80% of fish oil and 20% of vegetal oil in the formula. Nevertheless, according to we have seen, those percentages can vary, reducing the relative importance of fish oil. Thus:

Table 1

% of fish oil in the oil mixture of the diet	% of oil in the diet	
		25
	Kg fish oil /ton of food	
80	270	227
76.2	258	216

Case: 25% of oil in diet and 80% of fish oil

In the case of flours produced from mackerel, an oil yield of 5% is obtained, reason why to get the 270 kgs of fish oil (80% of 338 kg) that are needed for the previous formula, 5,400 kg of mackerel are required. In the case of a diet with something less of fish oil in the oil mixture (76.2%), 5160 kgs of mackerel are required. In the case of anchovy, which has a greater oil content (7%), 3,860 and 3,086 kg of anchovy are required, respectively.

Therefore, between 5,400 kg and 5,160 kg of mackerel are required to produce the oil necessary to get 1,000 kgs of salmon. Between 1,575 and 1,125 kg of fish (between 78.75 and 56.25 kgs of oil) come from the obtained flour that was already entered in the previous calculation, so that between 4,275 and 3,825 additional kgs of fish are required (between 191.25 and 103.75 kgs of oil) to obtain the total kg of fish oil (and flour non used in this process), reason why the kg of mackerel – kg of salmon conversion rate, for oil, is between 4.27 and 3,82.

Case: 21% of oil in diet and 80% of fish oil

In the case of flours produced from mackerel, an oil yield of 5% is obtained, reason why to get the 227 kgs of fish oil (80% of 284 kgs) that are needed for the formula of 21% oil in diet, 4,540 kgs of mackerel are required. For the case of a diet with something less of fish oil in the oil mixture (76.2%), 4,320 kgs of mackerel are required.

Therefore, 4540 kgs of mackerel are required to produce the 227 kgs of oil necessary to produce 1,000 kg of salmon. Between 1,575 and 1,125 kg of fish (between 78.75 and 56.25 kg of oil) come from the obtained flour that was already entered in the previous calculation, so that between 2,965 and 3,415 additional kgs of fish are required to obtain the total kgs of fish oil (and flour non used in this process), reason why the kg of mackerel – kg of salmon conversion rate, for oil, is between 2.965 and 3.415.

Additionally, it should be noticed that the fish oil production, considered an excess of the flour production, was usually burned in boilers until 20 years ago.

What can we conclude from all this? First, that there are no single conversion factors or rates. Values depend on the question that we want to respond. Second, the values of conversion rates are quite lower than those shown by Terram. Third, that additionally, the diet which is intended to develop could be further optimized by using mackerel fish flour, which supplies a greater protein yield, contributing a part of total oil required and to replace the additional oil needs with anchovy oil, for example to complement the diet lipid content. These possibilities to optimize diets, by reducing kilos of raw materials necessary to produce the same product or with similar characteristics, is a permanent process, which happens according to the experience that has been developed to prepare high value balanced diets.

This context can be further optimized, line on which the salmon industry has been working strongly to partly replace the fish flour and oil by vegetal flours and oils. At this moment it is possible to replace until a 30% each one of them, further lowering the needs of our sector by this material. It is an important technological advance that an efficient species on protein transformation as salmon advance still more in this line, allowing to generate a greater demand for vegetal products such as lupine and canola, two species farmed in the IX and X regions.

Other showy statements

In the same mentioned article there is a set of asseverations that try to relate the salmon production to sustainability of pelagic fisheries lacking any foundation and lead to an erroneous perception in the public opinion that is necessary to clarify. Indeed, in the presentation of that article, it is stated that in the medium term, “practically all the production of the South Pacific reducing industry, will be destined to supply the Chilean salmon farming, generating an enormous pressure over the fishing biomass, which could even lead to a collapse”, matter which is later considered again in this work.

The article, after reviewing the salmon industry demand for fish oil and flour, adds that “inevitably an enormous pressure will be generated over the already exploited fishing biomass”, connecting immediately this asseveration with this other: “an increase of salmon farming in Chile could accentuate the excessive exploitation of fisheries”.

What would any reader have to understand from these two asseverations? Obviously, the salmon industry causes a greater fishing so that there is more fish flour and oil available for salmon production foods.

The deceit unmasked

What it does not show nor analyze this work, is that in Chile there is a regulation system for pelagic fisheries, which, according to the resource status, sets maximum capture quotas by resource unit, distributed among the diverse shipbuilders that operate in those fisheries.

Behind the setting of these quotas, the fishing authority counts on a set of monitorings and studies that estimate the biomass of the resource, its aging structure, reproductive potential and distribution, among others, within a great effort that is soon included in predictive models allowing to project its evolution and therefore to set the volume of

capture that protects its peak and sustained efficiency in biological and economic terms. Therefore, vessels of authorized companies fish what is allowed to be fished and in the established amounts, with appropriate control measures.

That is why it is said that the extractive fishing activity is highly regulated and with restricted access to the main fisheries, which although a restriction for entering the fisheries, allows to project a stabilization of the capture levels and, consequently, to assure a permanent activity.³

Certainly, the salmon farming industry does not capture anchovy, sardines or mackerel with vessels, nor participates in investigations that will generate the scientific ground to determine the global quota, nor participates in the final decision that leads to the application of this quota.

It is clear that the State is responsibly in charge of the complex administration of these resources, supporting its decision making process on scientific information, for which it appeals to investigators and qualified centers and various approaches covering from the biomass estimation through expensive prospection cruises for acoustic determinations, estimations of reproductive stock and analyzes based on the own captures, to specific studies that aim to establish age of fish, physiological condition, behavior and distribution, etc. Consequently, nor is possible to accept that there are no regulations or control targeted to assure the sustainability of the extractive fishing. To regulations and aforementioned monitoring and investigation efforts, control of the operations and captures is added, based on the FAO's Code of Conduct for Responsible Fisheries, which have a wide international recognition, reason why Chile has supported the application of regulations and principles compatible with the sustainable use of marine resources, using tools as the Code mentioned.⁴

Given the previous comments, Could it be seriously and reasonably stated that this industry contributes "to accentuate the excessive exploitation of these fisheries"? Is perhaps the single fact that this industry is **one** of the requesters of fish flour and oil that makes it responsible for a situation like that? How would it be explained then that captures in Chile do not have any correlation with the sustained development of the salmon farming production?

And, in addition, the tendency is opposed

While this article presents this apocalyptic vision, that it seems lack of any ground, the Industry shows a tendency in the exactly opposite sense. Since over ten years ago the successful substitution of proteins and oils from animal origin by vegetal origin materials started, which today represent an important part in the diet, as it is shown above. It is expected they reach replacement levels of 50% for flours and between 50 to 80% for oil.⁵

³ Pesca y acuicultura en Chile: Situación actual y proyecciones. Noticias y actividades, Gemines Consultores, Septiembre, 2004.

⁴ Evaluaciones del desempeño ambiental: Chile, CEPAL/OCDE: 8, Cooperación Internacional. Mayo, 2005.

⁵ How much wild fish does it really take to produce a tonne of salmon?. FIN, Fish meal information network. June 2004.

The introduction of automatic feeding systems has been added, which stop feeding when fish have reached the satiety point, and today they even recycle the remained pellet not used, diminishing potential food losses. It is estimated that in the last ten years the loss has been reduced by over 80% due to the incorporation of these systems.⁶ Thus, the OECD recommendation to which the Terram article alludes, in the sense that the industry avoids excesses of food and increases the proportion of vegetal origin inputs, is an action that has been developed in the industry for several years on a sustainable basis, which is clearly proven by the figures mentioned before. Additionally, it should be added that the industry, through its reducing companies, “gives back” around 43,200 tons of flour and 48,600 tons of high-value salmon oil, from viscera and discards in the productive process, that are commercialized in diverse world markets and mainly aquaculture (Table 2).⁷

Finally, another line of attack to the industry in the referred article is spoiled, added to the erroneous and exaggerated conversion rate of pelagic fishing biomass for salmon meat, categorically and clearly contradicted above, and numerous independent studies consider it lower than half (5:1) or even less than a third (3:1) compared to the stated by TERRAM (Work ordered by the European Parliament in 2004), depending on the pelagic species used. It should be noted that the same NGO stated in 2002 that the conversion rate that today it considers around 10:1, estimated it then in 5:1, which is very revealing about consistency and seriousness of its positions.

What we finally sustain on this subject, is that figures that Terram Foundation has given in its publication, are absolutely out of all range, totally out of the reality and calculations made by our technical teams, by those teams of scientists working for years in the specialized food industry, by the FAO scientists and tens of publications made on this matter. The concentrated food production has been a matter widely studied for decades and any interested in the subject can review the endless lists of bibliographical references existing on the matter.

This obstinate discrepancy of the Terram Foundation with all the bibliographical sources of the world, we think that it is not only lack of technical capacity to analyze the bibliography or lack of suitable personnel available to review Internet, but we think that is something intentional, capricious and also prejudiced. We think that it is a strategy to artificially raise a subject at a level that causes alarm, commotion and that allows to generate an efficient disinformation network like a booby trap system.

The worst damage is not caused to the attacked sector. The worst damage is produced to the talking process that have happened between the productive private sector and the NGOs, and eventually to the own Terram Foundation. That damage comes from the loss of credibility for two reasons: To leave a talking process without a signal of displeasure or alarm and the lack of technical and scientific rigor. In fact, where are revisions or support studies by peers? What does Terram announces to us? Which is the great news that will leave consumers astonished? Will not it be just another way to catch attention on a live subject from people relatively disinformed about this matter, and where to obtain a publication on any thing is something that only costs a “click” to the press? Will not it be the denunciation itself part of the tasks which Terram commits to upon receiving financial contributions? Which is the source of its financing? Why does it not put its list of donors under public scrutiny as the environmental NGOs from developed countries do?

⁶ David Ulloa, Stovrik Chile, personal communication. 2006

⁷ Intesal, own elaboration based on information from Pesquera Pacific Star, 2006.

It is a pity that the scandalous and tricky denunciation way be chosen. Chile needs all its scientists and professionals to improve the discussion level and to contribute solutions, not to become it more mediocre and less significant.

Table 2
Production of salmon flour and oil from viscera, discards and mortality in Chile.

Gross production	Tons
Tons salmon production	600,000
Plant discards and mortality to oil production	270,000
Salmon Flour	43,200
Salmon Oil	48,600

Source: Own Intesal elaboration, based on Pesquera Pacific Star Estimations, 2006