

Feed Conversion Efficiency in the Salmon Industry

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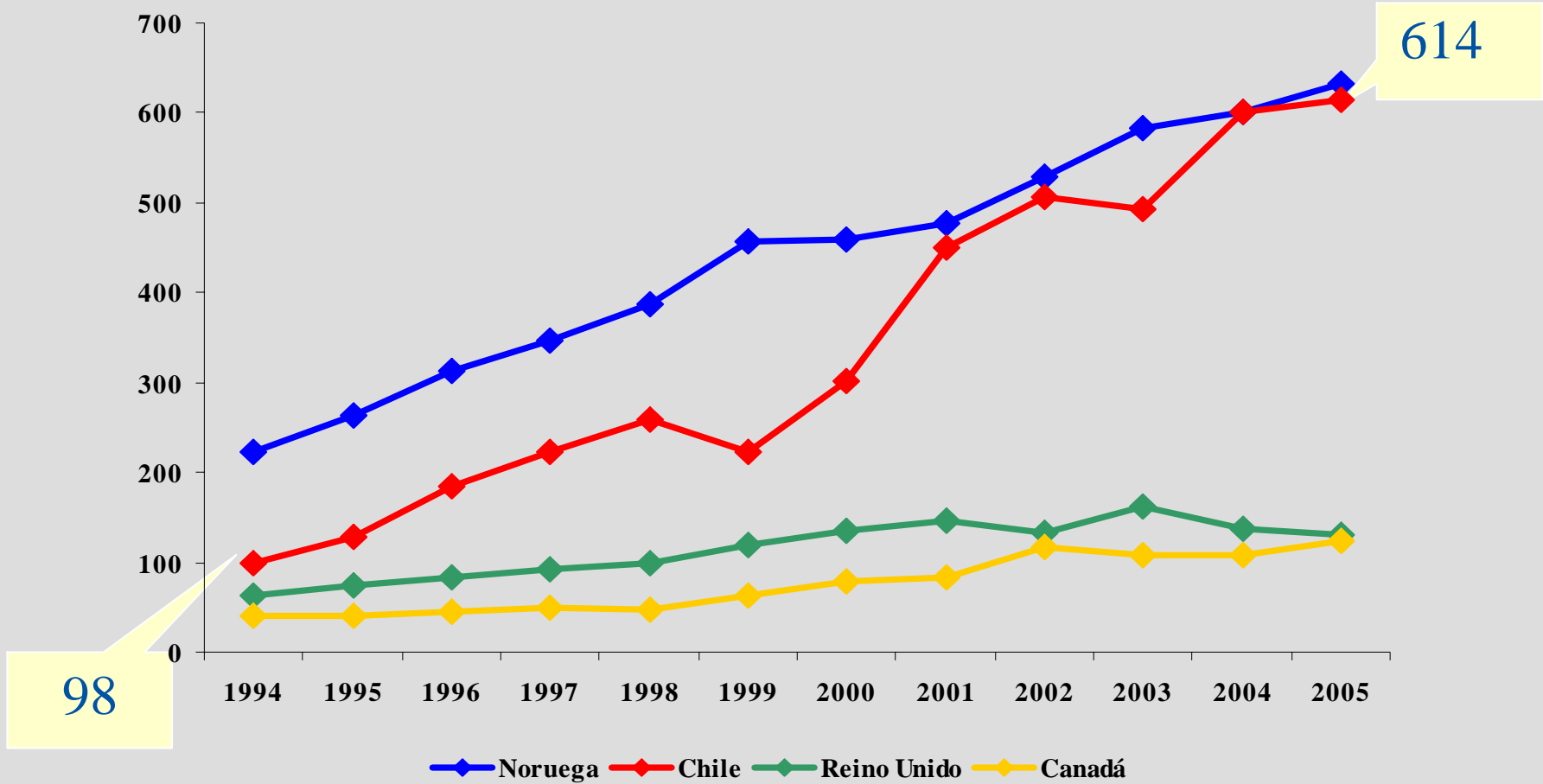
**Steering Committee Salmon Dialogue
November 2006**

Estimating FCE (fish to fish)

- How many fish there are? – Yearly salmon production
- How much does each fish eat? – Feed Conversion rate
- How much fish products go into feed? Feed dietary inclusion rate of fish oil and fishmeal.
- Do not double count – fishmeal produced has fishoil as a subproduct or viceversa.
- How many pelagic fish are required to produce the fishmeal or fishoil? - Transformation rate.
- Regulated fish quotas exist for all pelagic species in Chile. Resilience of the institutional regulatory framework?

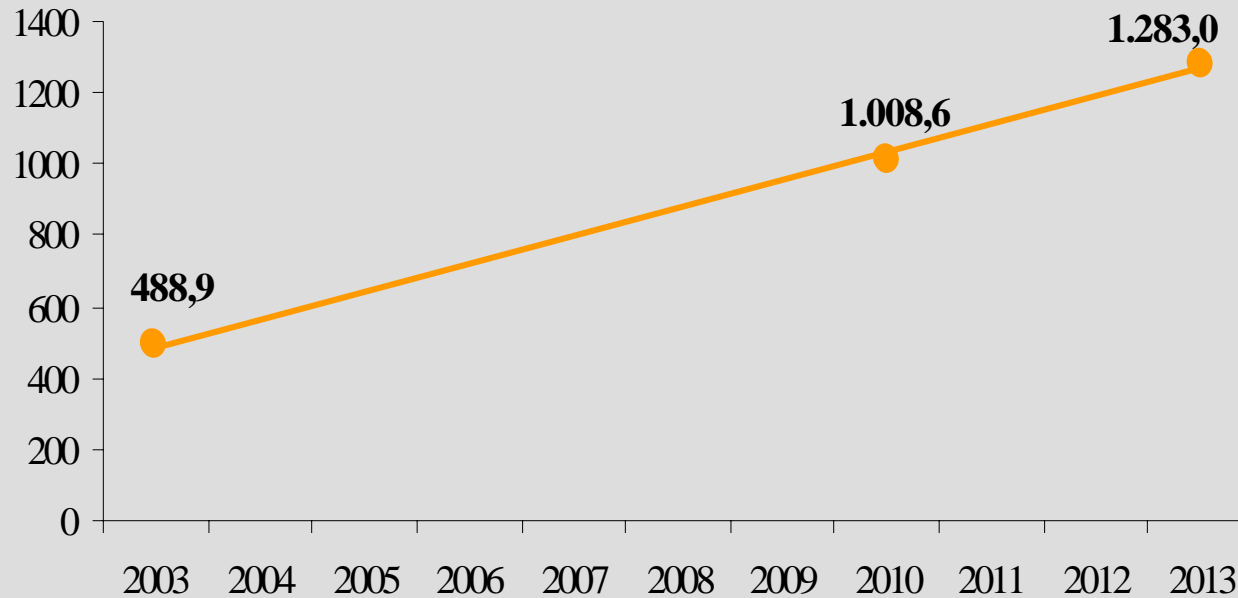
I. The Chilean Case

World Salmon Production (thousand tons)



Source: SalmonChile

Estimated Salmon Production (thousand tons)



Estimated Growth for Chile: 162%

Source: SalmonChile

Feed Conversion Rate (kg)

Calculated salmon economic FCR

Period 1983-1985	> 2.0
Period 1986-1990	1.7
Period 1991-1995	1.6
Period 1996-2000	1.5
Period 2001-2003	1.4
<u>Current 2003</u>	<u>1.3</u>

(range 1-1.5)

Source: Tacon (2005)

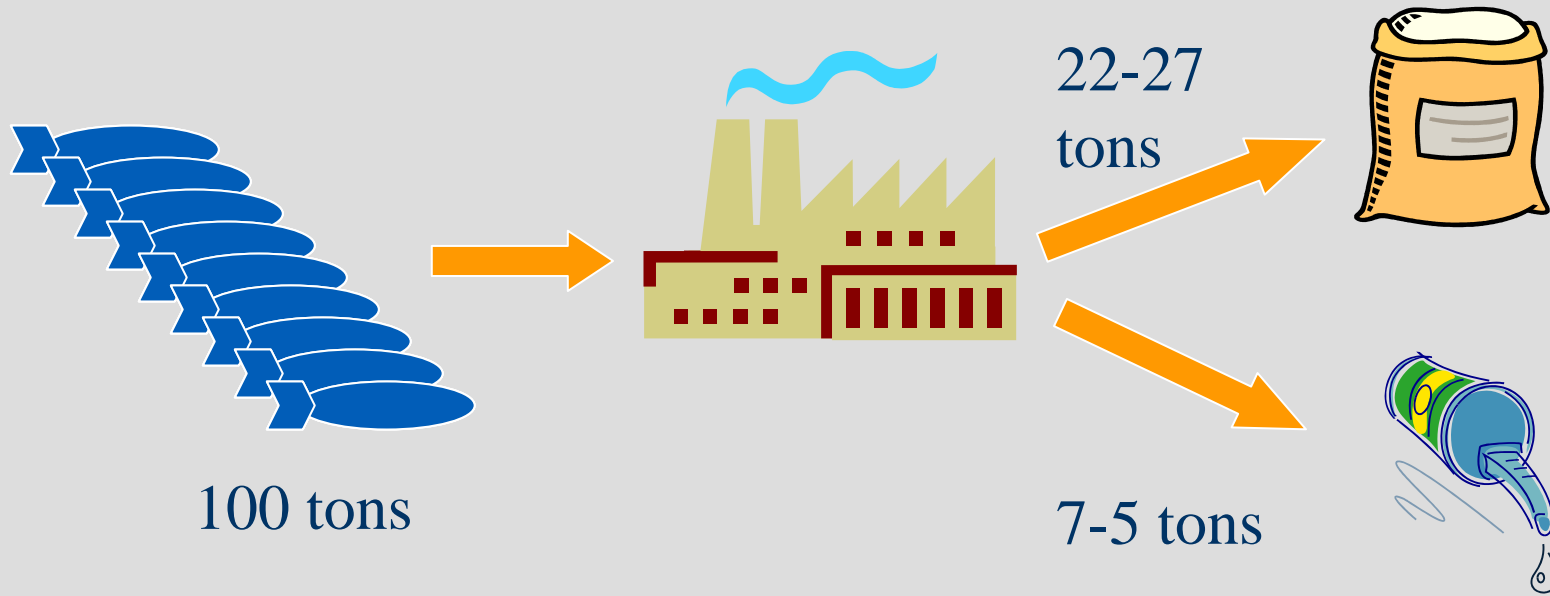
Fishmeal and fish oil dietary inclusion rates (%)

	1985	1990	1995	2000	2005(a)	2005(b)
Fishmeal	60	50	45	40	35	30
Fish Oil	10	15	25	30	35	20

(a) Tacon estimate

(b) Salmon Chile/industry

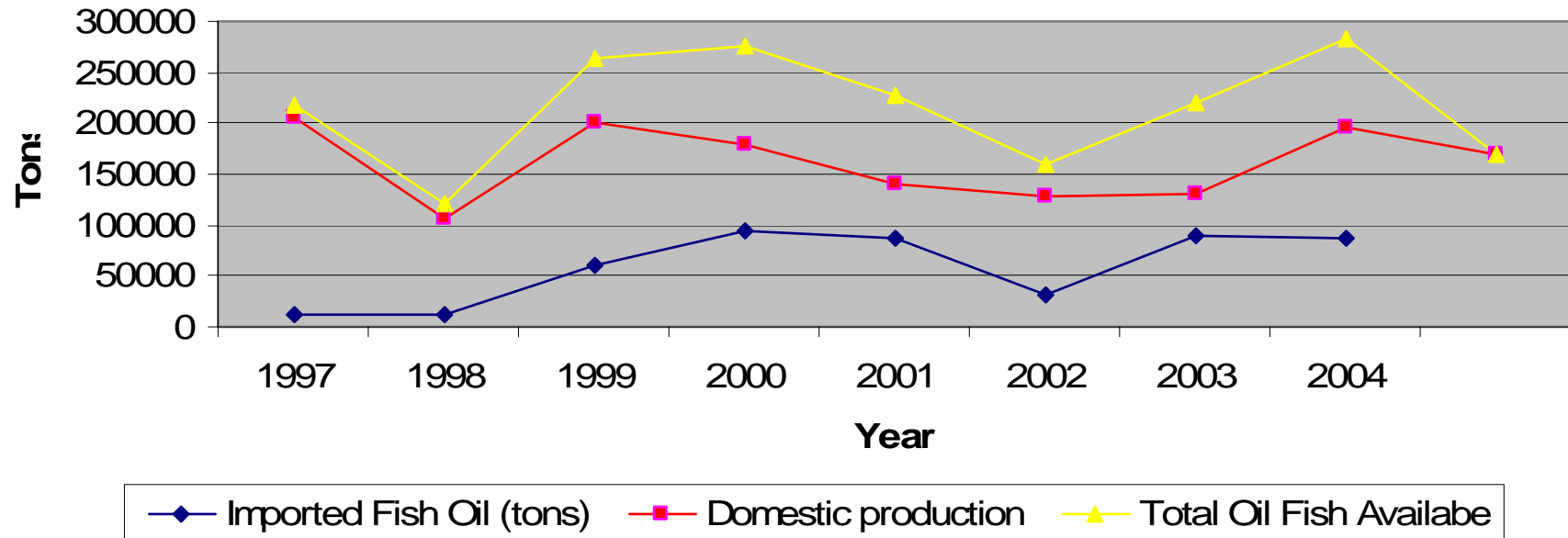
Transformation (Pelagic Fish/ Fishmeal and Fishoil) in Chile



In the case of Chile a pelagic biomass yields for fishmeal and fishoil are between 22 and 27% and 7 and 5% respectively, according to different sources (estimates) (Exapesca, Sernapesca 1990-2005).

Total fish oil availability in Chile

Domestic Production and Imported Fish Oil (tons)



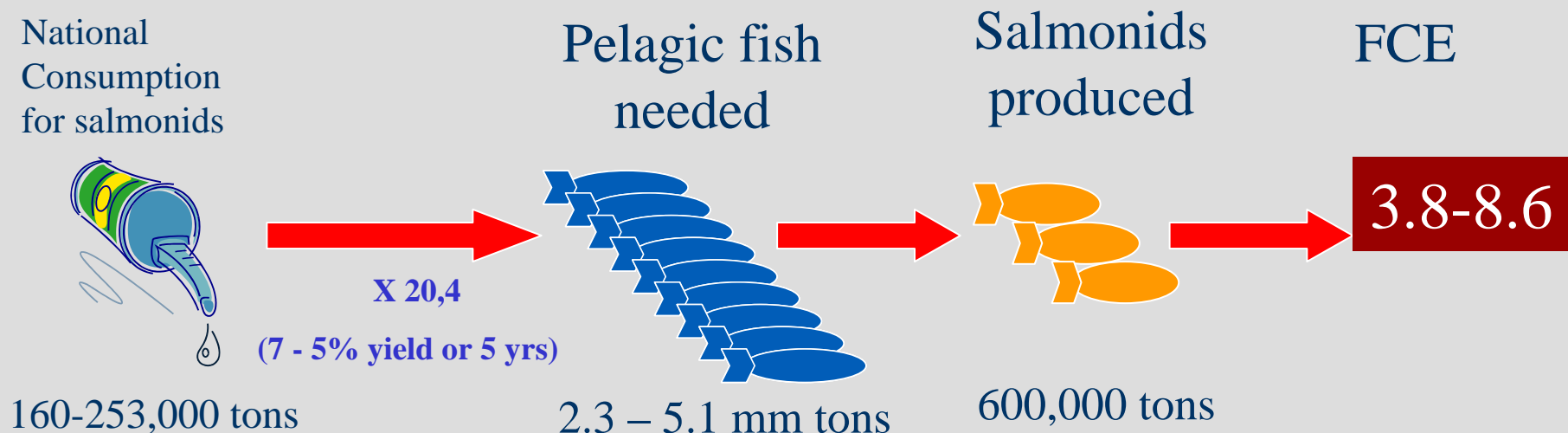
Comparison between Conversion Rates

CF	Fundación TERRAM		Chilean Salmon Industry	
	2004	2013	2004	2013
Salmon Production (ton)	601,000	1,283,000	601,000	1,283,000
Required Feed (ton)	850,000	1,814,559	811,350	1,732,050
Estimated EFCR	1.41	1.41	1.35	1.35
% FM in Feed	40%	35%	33%	20%
% FO in Feed (<u>vegetable oil substitution</u>)	30%	35%	20%	10%
Total FM in Feed (ton)	340,000	635,096	267,746	346,410
Total FO in Feed (ton)	255,500	635,096	162,270	173,205
Pelagic Fish to produce FM in Chile (ton)	1,307,600	2,352,206	1,217,027	1,574,591
Conversion Factor Fish to Fish Meal	26%	26%	22%	22%
Conversion Factor Fish to / Fish Oil	5%	5%	7%	7%
Fish Oil produced as Fish Meal by product (ton)	65,380	117,610	85,192	110,221
Additional Fish Oil necessary for fish feed (ton)	189,070	517,485	77,078	99,723
Pelagic Fish necessary to produce additional fish oil (ton)	3,792,000	10,349,707	1,101,114	1,424,621
Total Fish to produce Fish Meal, Oil and additional Fish Oil (ton) (<u>total yearly catches in Chile</u>)	5,100,000	12,701,913	2,318,141	2,999,212
Total CF	8.6	9.90	3.86	2.34

* Terram considers Jack Mackerel, Salmonchile uses anchovy for it's calculations.

Another way of calculating the FCE in Chile

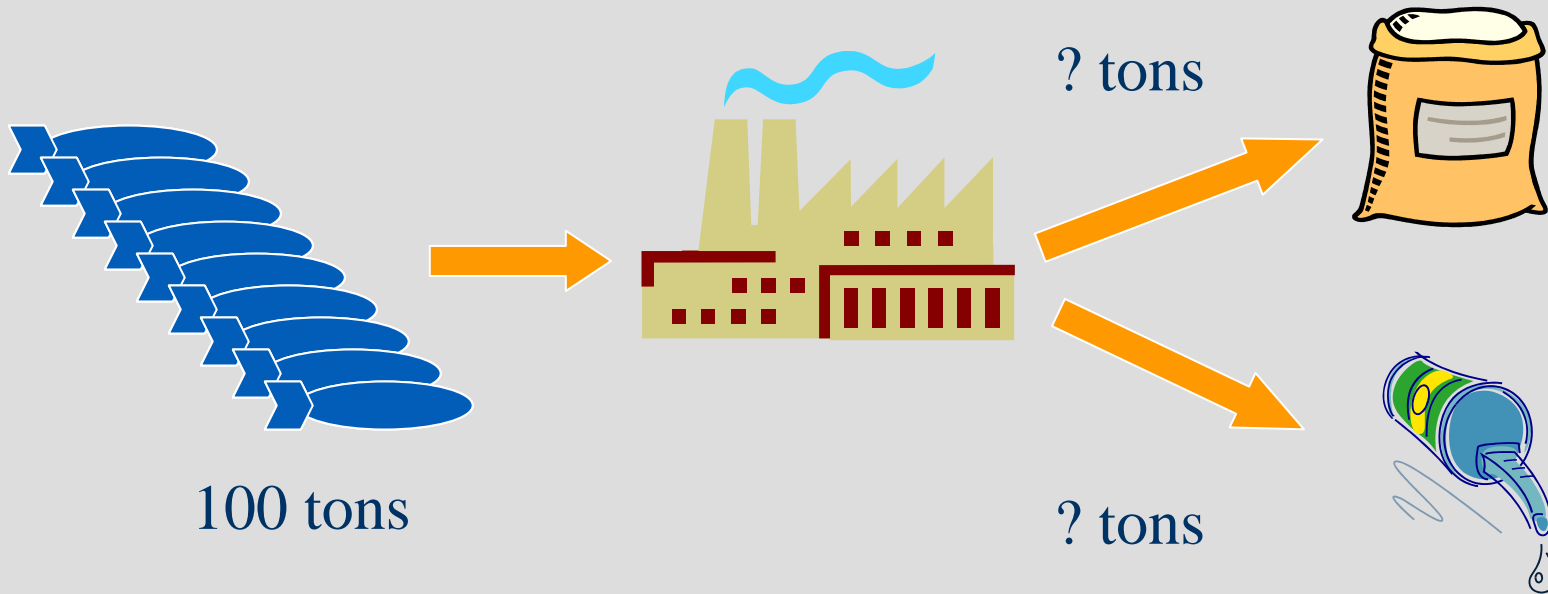
- Considering the previous figures, and knowing that the FCE is determined through FO, we have that (for 2004):



These figures are consistent with the FCE estimated with the dietary inclusion methodology. They depend on the national consumption figure and the transformation coefficient.

II. International Context

Transformation (Fish/ Fishmeal and Fish oil)

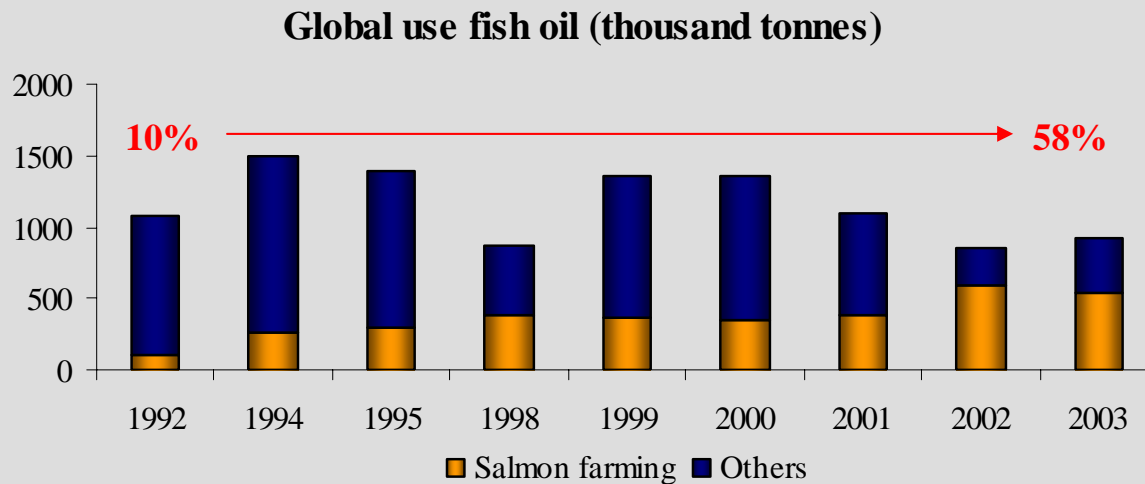
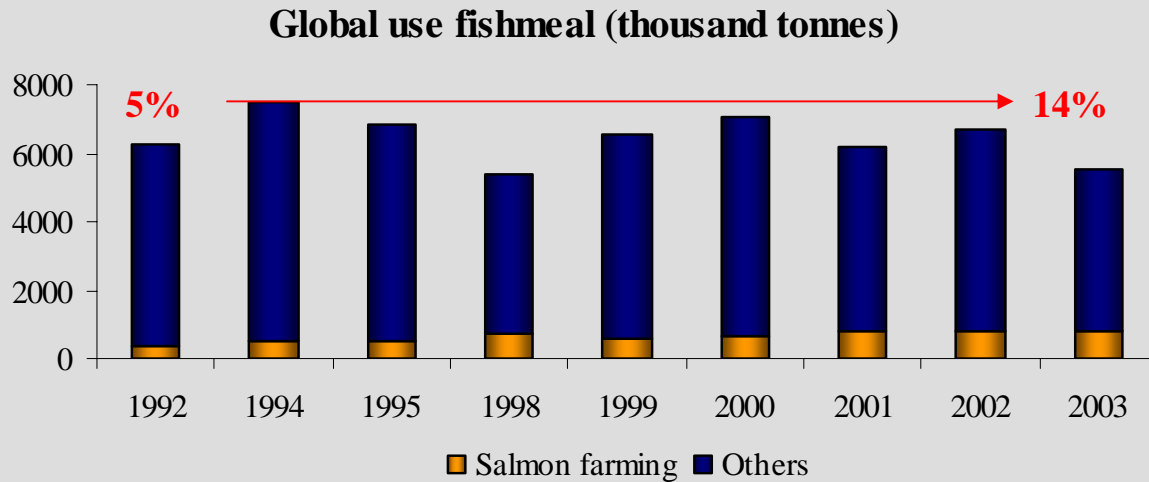


What is the transformation rate for the different regions?

What is the total fishmeal and fish oil use for salmon/aqua culture.

What is the amount of vegetal substitution that will happen in a worldwide scale?.

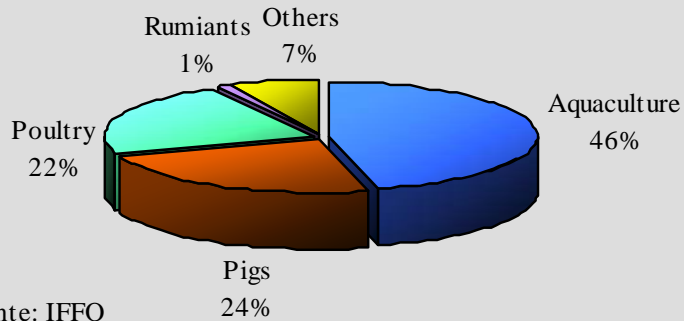
Global use of fishmeal and fish oil



Source: Elaborated by Terram based on FAO (2005)

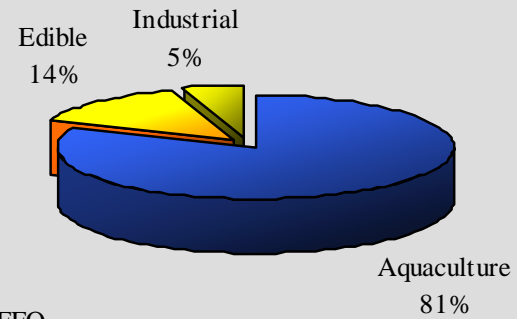
Global use fishmeal and fish oil

Global use fishmeal (2002)



Fuente: IFFO

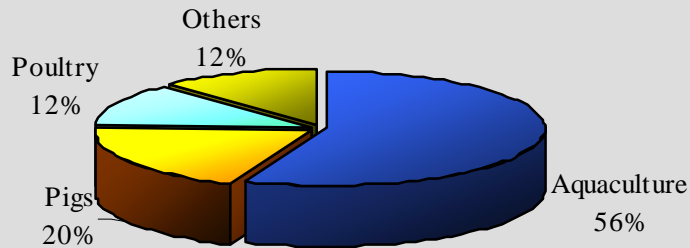
Global use fish oil (2002)



Fuente: IFFO



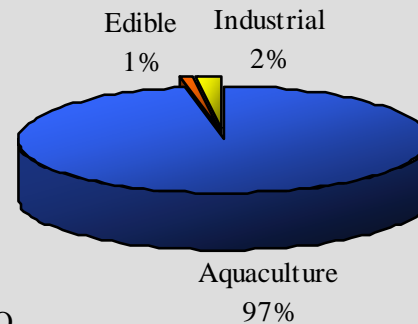
Global use fishmeal (2010)



Fuente: IFFO



Global use fish oil (2010)



Fuente: IFFO

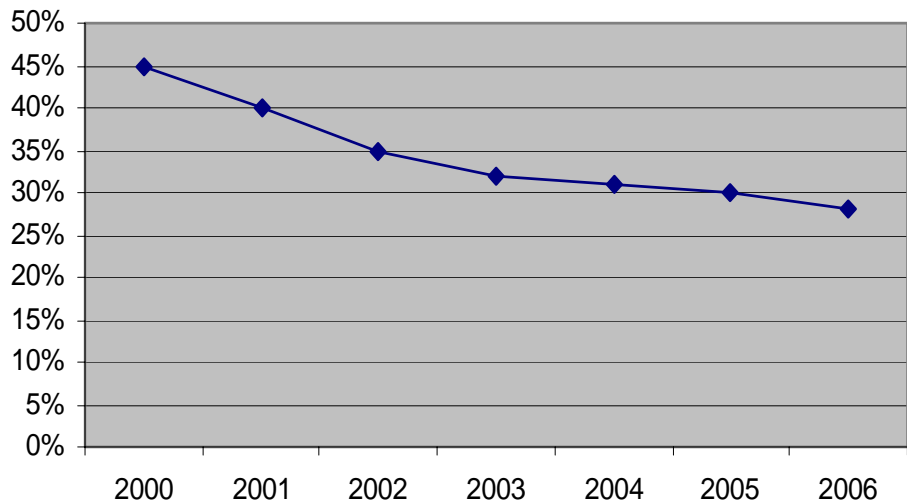
Thank You

Fish meal substitution

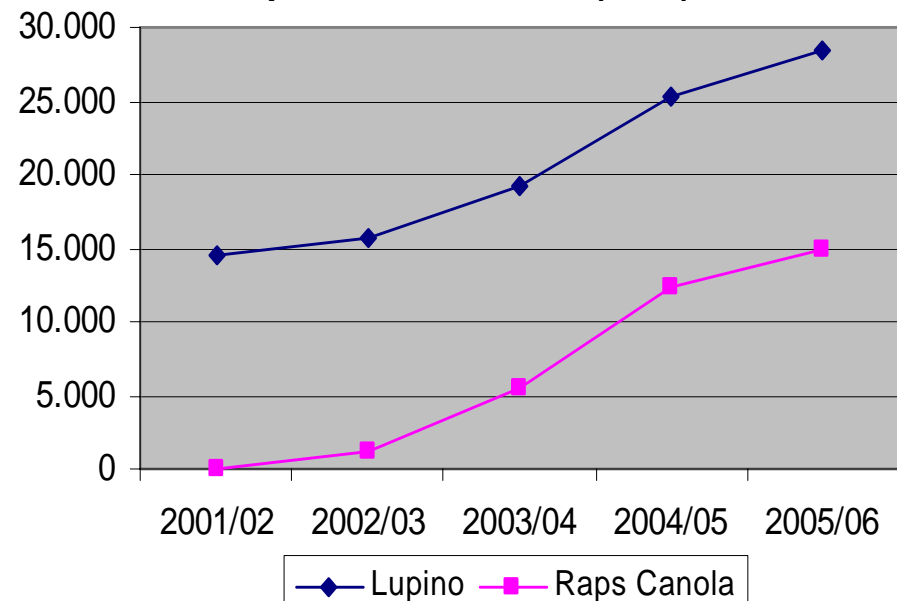
- ✓ The use of fish meal has been reduced over time being replaced by vegetable meals and oils.
- ✓ This has created a big potential for agriculture in southern Chile. The estimates currently express over 220 thousands acres & 3.000 new jobs for agriculture.



Porcentaje de Harina de Pescado en Alimento de Salmones (%)



Superficie sembrada (Hás.)



**Desembarques Pesqueros Mundiales (sólo pesca extractiva)
en el quinquenio 2000-2004 (t.)**

Orden	País	2000	2001	2002	2003	2004
1	China	17.191.615	16.796.259	16.850.304	17.051.813	17.271.363
2	Perú	10.658.620	7.988.613	8.771.362	6.093.776	9.620.598
3	Chile	4.547.850	4.031.605	4.516.337	3.921.967	5.325.953
4	USA	4.760.000	4.981.801	4.984.749	4.988.691	4.995.419
5	Indonesia	4.126.791	4.277.724	4.379.501	4.691.764	4.881.765
6	Japón	5.106.734	4.827.204	4.490.594	4.783.753	4.517.251
7	India	3.726.427	3.817.092	3.745.353	3.720.899	3.624.474
8	Rusia	4.027.308	3.656.187	3.287.725	3.320.590	2.999.619
9	Tailandia	2.997.394	2.833.911	2.842.508	2.849.697	2.845.088
10	Noruega	2.891.791	2.862.154	2.922.985	2.702.184	2.670.547
	Otros	36.829.836	38.256.784	37.768.069	37.702.579	37.710.356
	Total	96.864.366	94.329.334	94.559.487	91.827.714	96.462.433

FAO, 2005



Global FCE?

Item	1992	1994	1995	1998	1999	2000a	2001	2002c	2003	2010
(1) Production	429	543	612	926	1.010	1.112	1.327	1.438	1.508	2.580
(2) FM use	343	522	519	705	607	680	774	775	789	
(2) FO use	108	260	291	388	358	402	386	590	535	
(3) PPH	1.559	2.373	2.359	3.205	2.759	3.091	3.518	3.523	3.586	SalmonChile
PPH oil	64	97	97	131	113	127	144	144	64	
Missing oil	44	163	194	257	245	275	242	446	388	
(4) PPAF	1.068	3.969	4.738	6.266	5.973	6.714	5.896	10.868	9.462	
PPT	2.627	6.341	7.098	9.471	8.732	9.805	9.415	14.390	13.049	
FCE (4,1%)	6,1	11,7	11,6	10,2	8,6	8,8	7,1	10,0	8,7	
FCE (7%)	3,6%	6,9%	6,9%	6,0%	5,1%	5,2%	4,2%	5,9%	5,1%	
PPA	2.627	6.341	7.098	9.471	8.732	9.805	9.415	14.390	13.049	22.446
FCE	6,1	11,7	11,6	10,2	8,6	8,8	7,1	10,0	8,7	8,7

- (1) Source: SalmonChile, 2006 (th tons)
- (2) Source: FAO, 2006 (th tons)
- (3) Fish needed to produce FM: estimated considering 22% yield
- (4) Fish needed to produce missing FO: estimated considering 4,1% yield

**FCE:
Constant**