Universidad Austral de Chile

Instituto de Acuicultura

Current status of Chilean aquaculture regarding GHG emissions

Sandra Marín

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Bergen

GHG initiatives in Chilean aquaculture

- Two salmon and 1 mussel companies estimated their carbon footprint
  - Motivation: Granelle 2 Law (France)

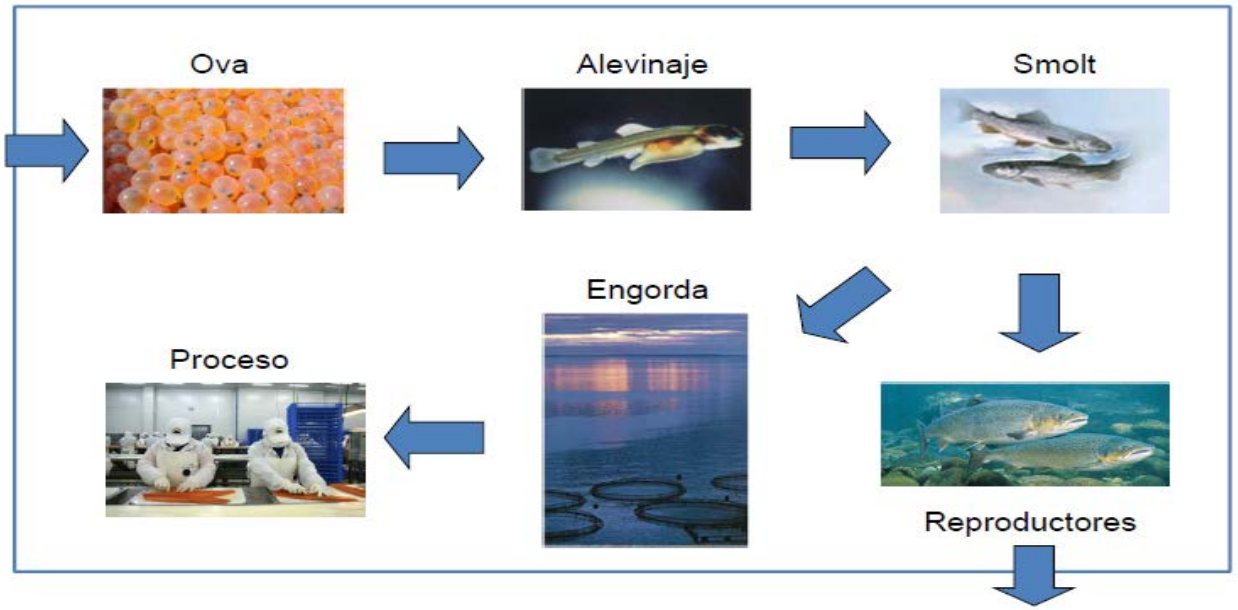
- One company producing fish meal and fish oil
  - From coal-fired plant to a plant based on a renewable energy source (biomass from timber industry)
  - Motivation: increasing its productive capacity (carbon credits allowed to carried out the project)
  - The new energy source produces 19.235 ton of reduction of CO_2e / year

- One project funded by chilean government
  - focused on generating a tool to calulate CO_2 emissions using a compartmental approach (different parts of the productive cycle)

- No new initiative has been reported. GHG emissions are not longer a short term necessity

Productive cycle of salmonids

(Modified from Garay, 2012)



- The final product of each of these stages can be achieved through different ways, and that diversity makes the difference in the productivity of the salmon producer company

- Higher costs are associated to the growing up phase in seawater, because of the feeding processes

- Feeding is also the mayor contribution of GHG emissions from intensive production systems, such as salmon cultivation

- Dependence on raw material from fish will continue, there is a limit in fish meal and fish oil replacement, therefore fish feed production need to be more fuel and energy efficient to compensate from the posibility of not reducing GHG emissions related to raw material being used

Transportation is an important issue in Chile: fish feed distribution, fish processing and final product distribution

- No enough motivation among companies to estimate GHG emission and to look for strategies to reduce them

- Can we take advantage of the practices that result in higher productivity to promote changes that allow reduction of GHG?

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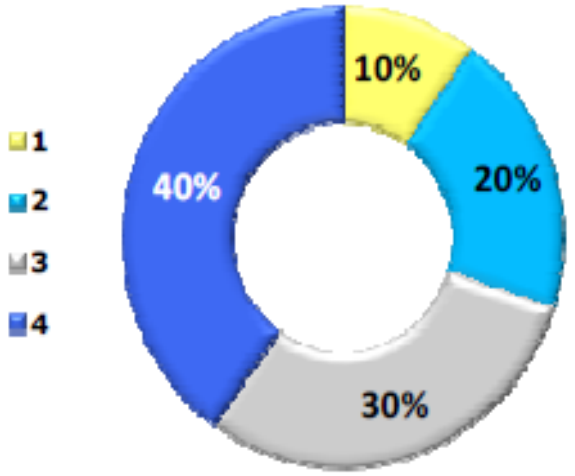
Feed source (what does source mean?)

Origen Alimento	Peso siembra (g)	Peso Cosecha (g)	N° Grupos	Millones de Peces
1	109	4.046	37	12,5
2	103	4.352	116	40,7
3	394	2.415	2	0,4
4	166	4.737	46	15,8



Productive indicator

	Origen 1	Origen 2	Origen 3	Origen 4
Número de muertos (%) Acum.	25,32	22,41	42,76	13,43
Biomasa Muerta (%) Acum.	16,40	8,06	11,80	5,53
SGR Acum.	0,62	0,68	0,46	0,67
GF3 Acum.	1,73	1,98	1,41	1,97
FCR-E Acum.	1,59	1,49	2,22	1,41
FCR-B Acum.	1,32	1,37	1,88	1,33
Biomasa Cosechada Acum. (Kg) / N°Ingreso Acum.	3,067	3,458	1,337	4,151
Biomasa Cosechada Acum. (Kg) / N°Ingreso Acum./Lapso	0,168	0,206	0,114	0,276

Source: Validation of productive practices in the salmon industry (AAA and SGS, 2012)

Can we take advantage of the practices that result in higher productivity to promote changes that allow reduction of GHG?

Site of origen of smolt

Sitio Origen	Peso siembra (g)	Peso Cosecha (g)	N° Grupos	Millones de Peces
Estuario	132	4.035	53	21,8
Lago	150	4.216	71	27,8
Pisc. flujo abierto	87	4.371	87	38,0
Pisc. recirculación	91	5.274	19	7,8

Indicador productivo	Estuario	Lago	Pisc. flujo abierto	Pisc. recirculacion
Número de muertos (%) Acum.	24,39	20,83	21,66	15,01
Biomasa Muerta (%) Acum.	12,18	10,49	8,04	3,36
SGR Acum.	0,61	0,67	0,68	0,64
GF3 Acum.	1,70	1,93	1,90	1,95
FCR-E Acum.	1,57	1,49	1,47	1,42
FCR-B Acum.	1,37	1,33	1,35	1,37
Biomasa Cosechada Acum. (Kg) / N°Ingreso Acum.	3,039	3,371	3,511	4,482
Biomasa Cosechada Acum. (Kg) / N°Ingreso Acum./Lapso	0,177	0,226	0,201	0,227

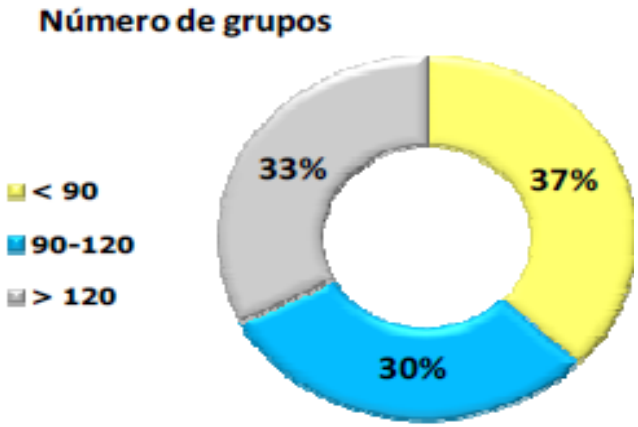
→ High energy demand

Source: Validation of productive practices in the salmon industry (AAA and SGS)

Can we take advantage of the practices that result in higher productivity to promote changes that allow reduction of GHG?

Smolt weight at entry to the seawater

Peso de Ingreso (g)	Peso siembra (g)	Peso Cosecha (g)	N° Grupos	Millones de Peces
< 90	75	4.226	168	75,7
90-120	107	3.993	137	57,6
> 120	168	4.083	148	74,0

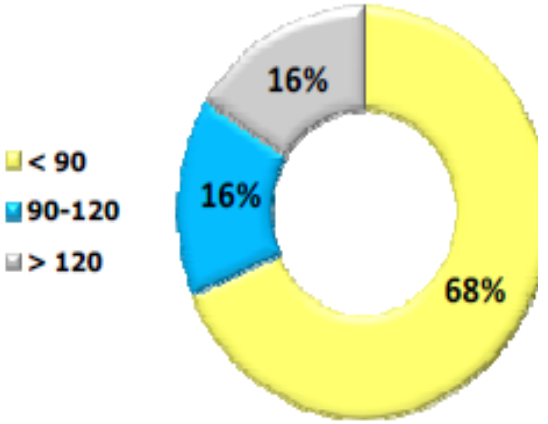


Indicador productivo	< 90	90-120	> 120
Número de muertos (%) Acum.	23,67	23,96	22,36
Biomasa Muerta (%) Acum.	9,42	11,24	11,23
SGR Acum.	0,66	0,62	0,59
GF3 Acum.	1,76	1,71	1,71
FCR-E Acum.	1,53	1,64	1,57
FCR-B Acum.	1,38	1,45	1,38
Biomasa Cosechada Acum. (Kg) / N°Ingreso Acum.	3,260	3,022	3,157
Biomasa Cosechada Acum. (Kg) / N°Ingreso Acum./Lapso	0,182	0,177	0,194

Source: Validation of productive practices in the salmon industry (AAA and SGS)

Site of origen of smolt and smolt weight at entry to the seawater

Peso de Ingreso Pisc. Recirculación	Peso siembra (g)	Peso Cosecha (g)	N° Grupos	Millones de Peces
< 90	85	5.224	13	6,2
90-120	105	5.424	3	1,2
> 120	150	5.710	3	0,3



Indicador productivo	< 90	90-120	> 120
Número de muertos (%) Acum.	14,60	20,17	7,45
Biomasa Muerta (%) Acum.	3,23	4,65	1,39
SGR Acum.	0,62	0,71	0,76
GF3 Acum.	1,89	2,13	2,49
FCR-E Acum.	1,43	1,38	1,29
FCR-B Acum.	1,38	1,32	1,27
Biomasa Cosechada Acum. (Kg) / N°Ingreso Acum.	4,461	4,386	5,285
Biomasa Cosechada Acum. (Kg) / N°Ingreso Acum./Lapso	0,218	0,259	0,349

- Best combination: Smolt produced by RAS and taken to seawater at 120 g or more
- But producing smolt as big as 120 g using RAS will requiere even more energy.
- Look for renewable energy source

Source: Validation of productive practices in the salmon industry (AAA and SGS, 2012)

Can we take advantage of the practices that result in higher productivity?

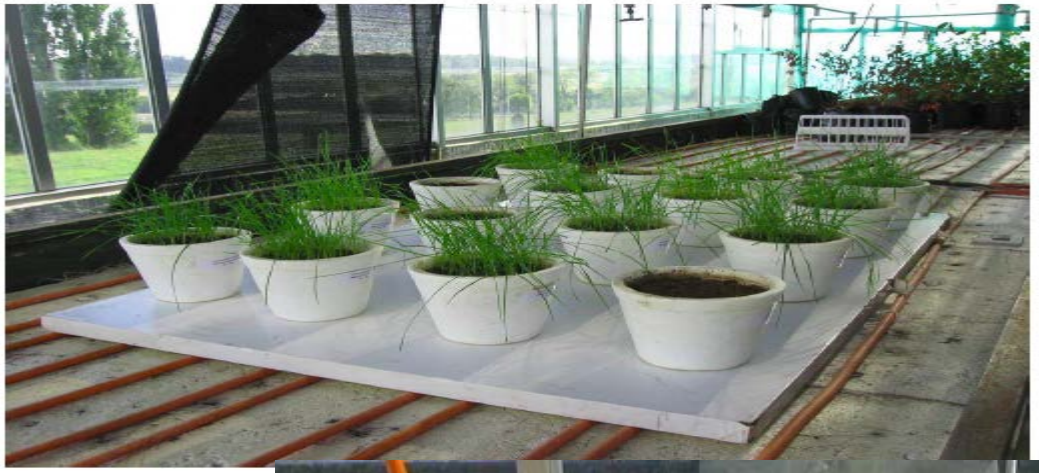
Impact	Practices
Decrease mortality	Vaccine, **feed source**, **origen of smolt**, weigth at entry to seawater
Increase growth	**Feed source**, vaccine, **origen of smolt**
Improve FCR	Vaccine, **feed source**, **origen of smolt**

Source: Validation of productive practices in the salmon industry (AAA and SGS)

- Feed source: may be very related to feed formulation (ingredients, contribution of the different ingredients)
- Origen of smolt: health condition
- Combination of good practices: weight and origen of smolt = quality smolt)

Uses for smolt production waste

Efecto de lodo mortalidad de salmones en la mineralización de N



Seminario de Residuos Valorizables en la Región de Los Lagos, Puerto Montt 17 Mayo 2012

INIA

Evaluación y valorización agronómica de subproductos de la producción ganadera y acuícola

Francisco Salazar Sperberg, Ing. Agr., Ph.D.

Final considerations

- Improvement of feed processing: reducing GHG emissions through renewable energy sources, decrease waste or recycle them

- Reducing FCR in farms:
  - Identify those practices that result in better FCR, it should allow indirectly reduce GHG from the feed production
  - Calculate GHG emission of these practices and look for improvements associated to GHG reduction

- Promote geographical clusters so that GHG from transportation can be decreased