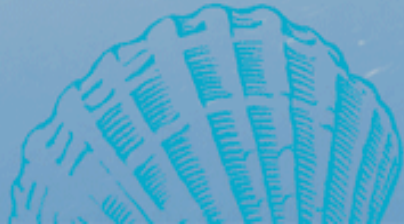
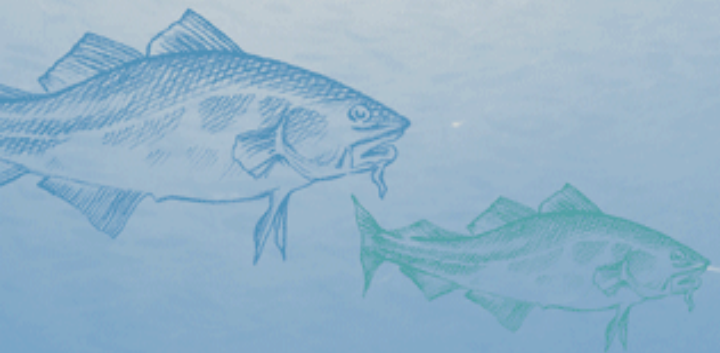





HAVFORSKNINGSINSTITUTTET
INSTITUTE OF MARINE RESEARCH





Feed raw materials going forward, what are the challenges and where are the possibilities?

Ole Torrissen

Given objective

Give insight in the global raw material situation regarding marine resources and which opportunities and obstacles there are.



Food security

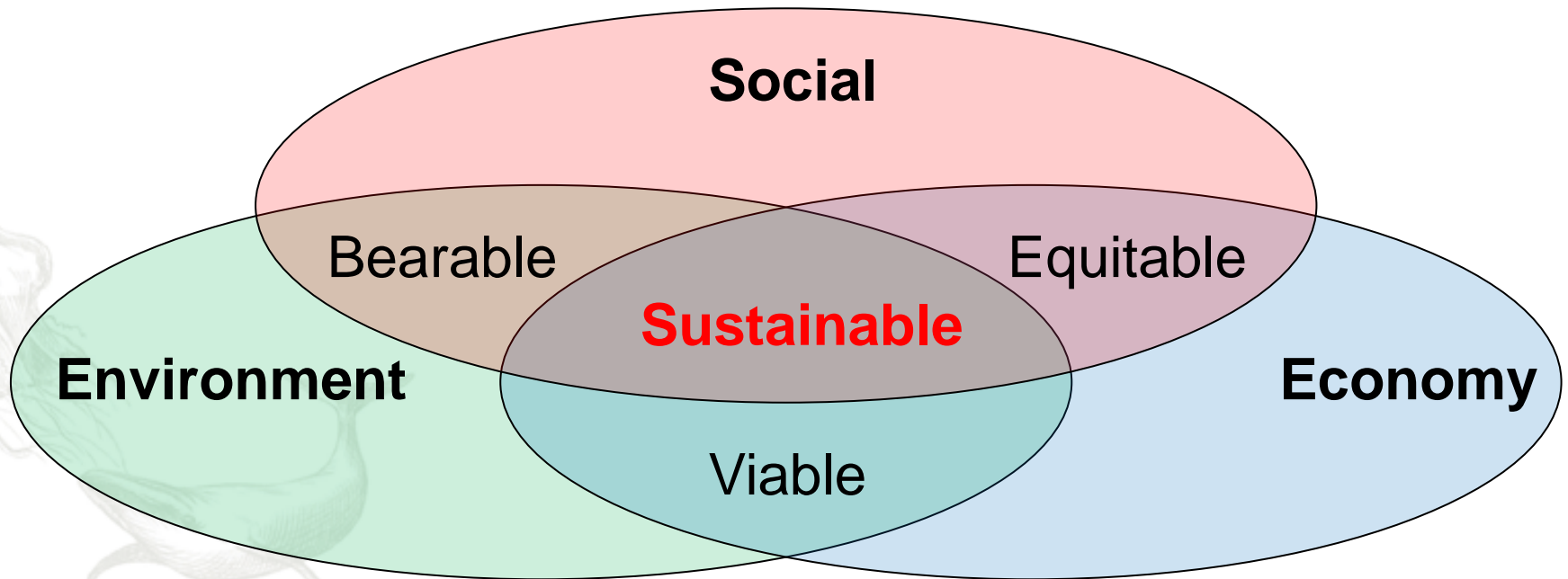
FAO defines food security to exist “. . . *when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life*”.



Sustainability

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs".

Our Common Future, 1987



Meat has an environmental cost!

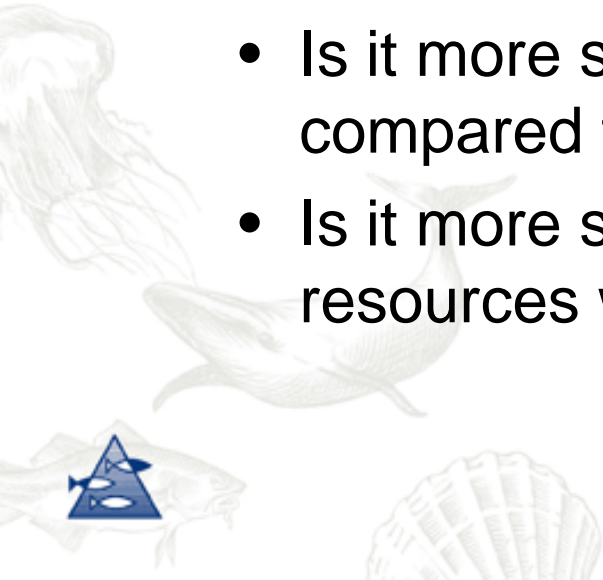
- Feed provision is the single most important contributor to resource use and emissions associated with the farm-gate production of salmon cultured (Pelletier et al., 2009), as it is for terrestrial farmed animals.
- Cattle and other ruminant livestock, such as sheep and goats, graze one half of the planet's land area.
- Ruminants, along with pigs and poultry, also eat feed and fodder raised on one-fourth of the cropland (Durning and Brough, 1991).
- The global livestock sector is estimated to contribute to 18% of anthropogenic greenhouse emission and 63% of reactive nitrogen mobilization and consume 58% of human-appropriated biomass (Pelletier and Tyedmers, 2010).



Replacement not absence

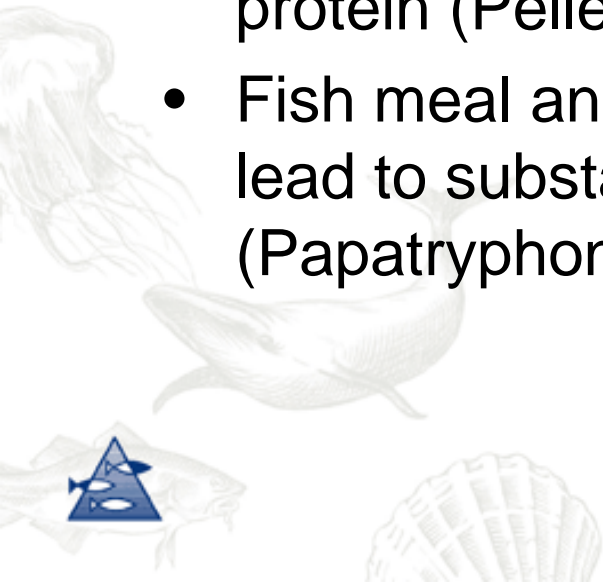
Humans (as farmed animals) needs food daily – the sustainability issue is therefore not the question of eating or not, but a question of choice:

- Is it more sustainable to substitute animal products with vegetables?
- Is it more sustainable to consume farmed fish compared to farmed terrestrial animals?
- Is it more sustainable to substitute farmed feed resources with wild harvested?



“As you cry in the woods you get answers”

- Emission from Canadian Atlantic salmon farms “increased largely due to greater use of poultry products” (Pelletier et al. 2009)
- Marked improvement could be achieved through replacing “mixed whitefish trimmings” with plant protein (Pelletier et al. 2009)
- Fish meal and oil substitution with plant products will lead to substantial improved sustainability (Papatriphon et al 2004)



Obstacles:

“Separate snot and moustache”

- “Takes the food out of the mouth of the poor”
- “Fish meal (oil) is unsustainable”,
“improved sustainability by use of agricultural products”
- Abuse of sustainability indicators
- Definition of terms



”Takes the food out of the mouth of the poor”

- Salmon, poultry, pigs as well as humans can utilize the same protein, fat and carbohydrate sources. Common feed ingredients like wheat, corn and soy are excellent human food.
- Feeding animals will inevitably reduce the availability of food for human consumption
- Salmon give 2-3 times as much meat per unit of feed fed compared to terrestrial farmed animals.
- Poverty rather than availability is the challenge in food security at present.

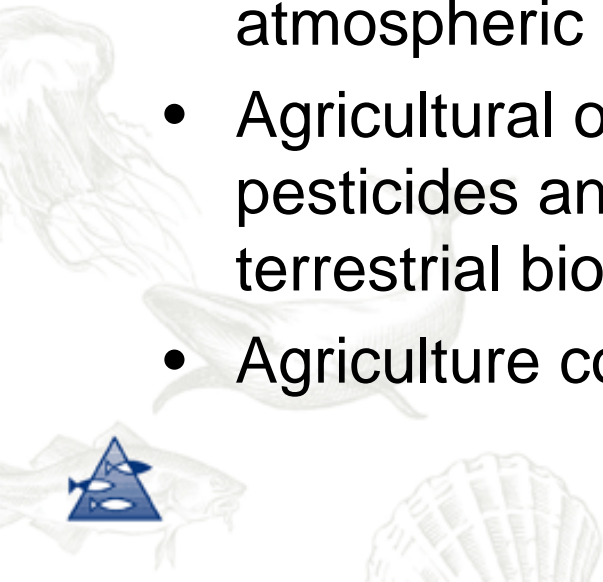


Is agriculture without ecological impacts?



”Improved sustainability by use of agricultural products”?

- Growing grains causes long-term changes to the landscape.
- Create soil erosion.
- Growing grains requires inputs of non-renewable resources, such as fertilizers, and causes atmospheric emission.
- Agricultural operations require use of herbicides and pesticides and also have a severe impact on terrestrial biodiversity.
- Agriculture consume huge amounts of freshwater.



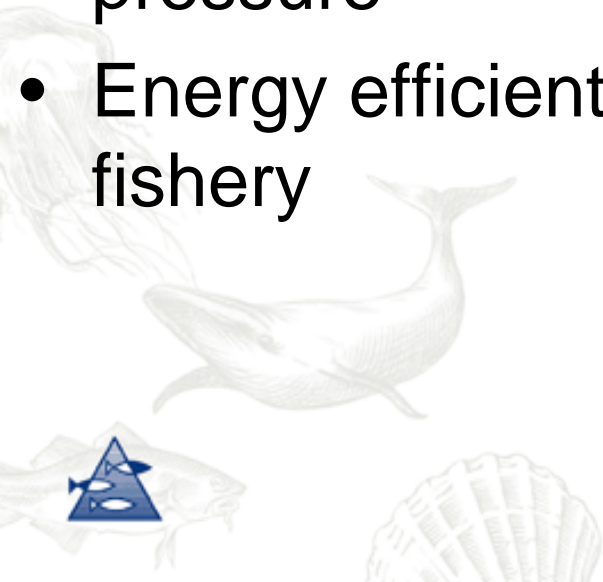
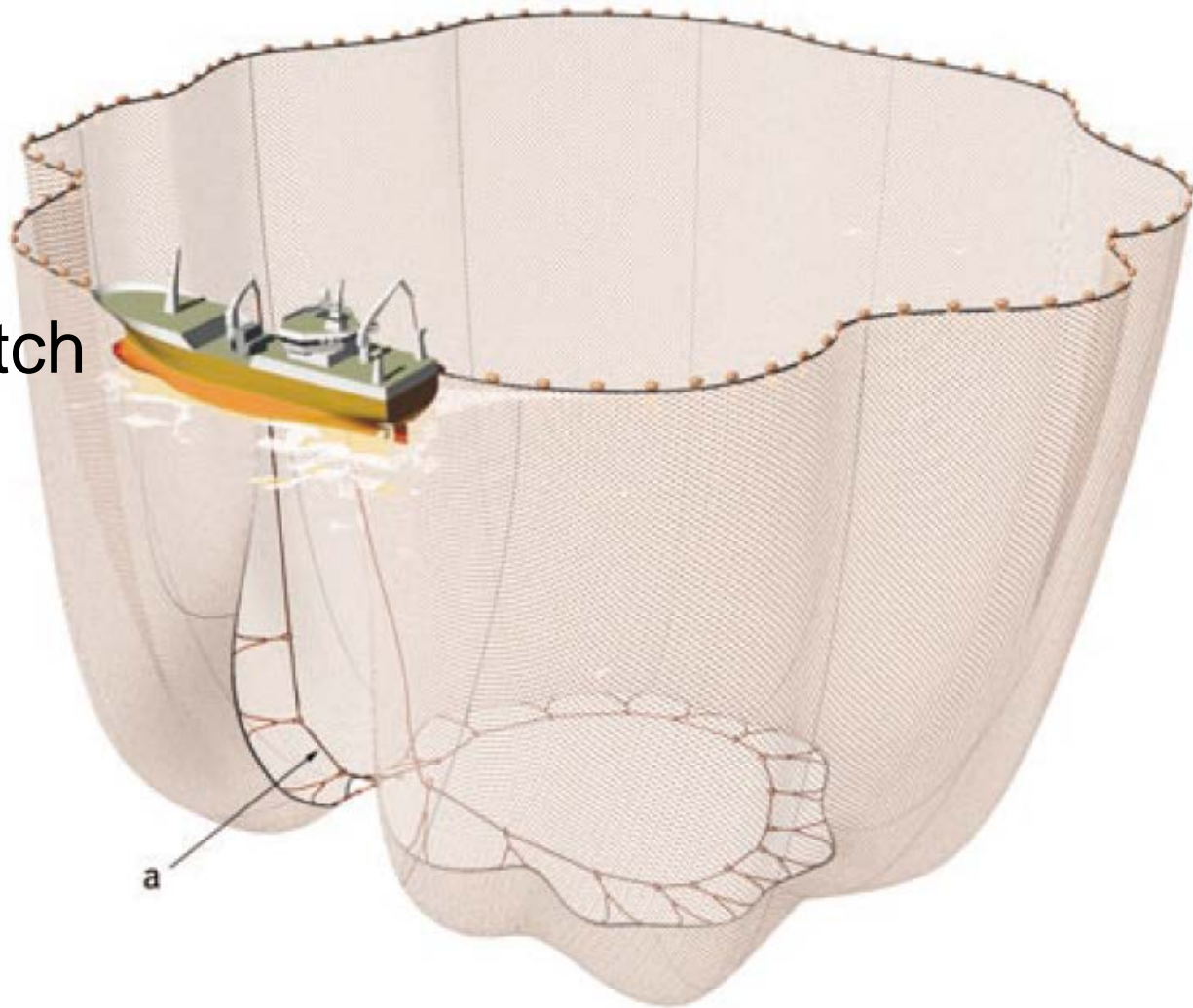
Also a cost connected to fisheries

- Fisheries require a relatively high energy input in locating, harvesting, transporting, and processing of the fishes for feed.
- Fisheries are utilizing a limited natural resource with a risk for overexploitation.



Pelagic fishery – purse seine

- No benthic impact
- Relative low by-catch
- Low evolutionary pressure
- Energy efficient fishery



Feeding all farmed salmon exclusive plant products would require:

	ha
Carbohydrates:	75 000
Proteins:	675 000
Fat:	320 000
Total (≈)	1 100 000

1.1 mill. hectar is equal to the agricultural land area of Norway or 50 % of Denmark's agricultural area.



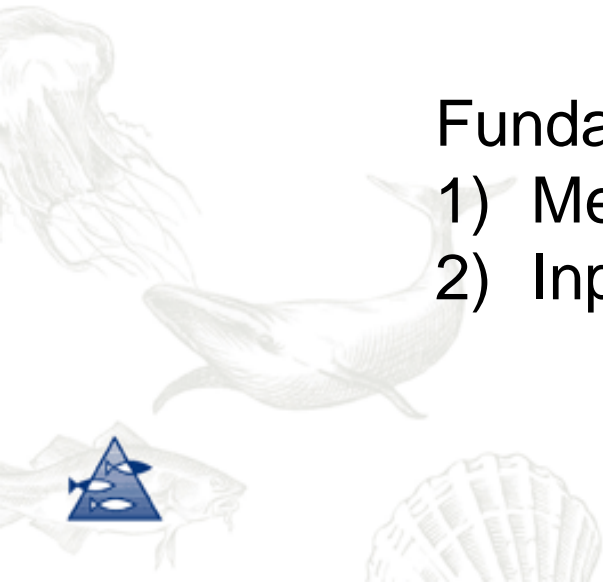
Sustainability indicators

“statistical measure that give an indication of the sustainability of social, environmental and economic development”

OECD, 2005

Fundamental requirement:

- 1) Measure “sustainability”
- 2) Input equals output



Abuse of indicators



FIFO – fish in fish out

- 25 % of fish input is byproducts.
- Extra fish is needed for providing fat. The extra fish meal is not accounted for.
- Byproducts of salmon is utilized as feed for other animals.
- Retention of nutrient is not considered. Salmon contain 3x the amount of fat compared to forage fish.

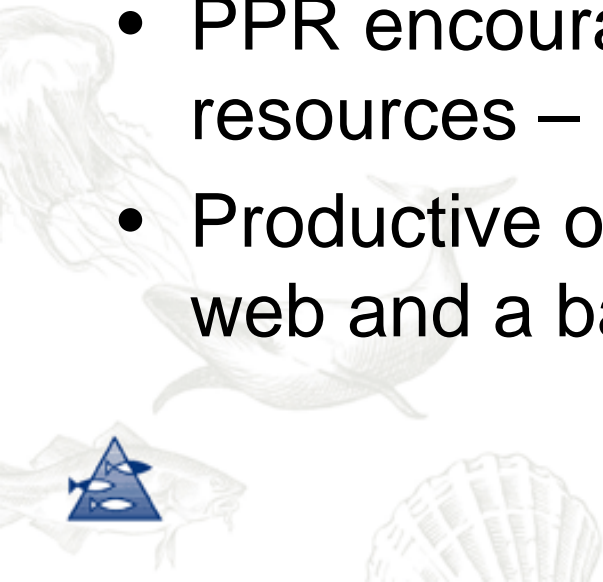
FIFO is overestimating the input and seriously underestimating the output. FIFO does not say anything about sustainability of harvest or relative efficiency of use.



PPR = Primary Production Required

PPR is intended as an indicator for depletion of biological resources.

- It seems to function well for controlled production systems, but not for harvest of natural resources.
- PPR encourage use of low trophic level feed resources – “fishing down the food web”.
- Productive oceans require a functional food web and a balanced harvest.

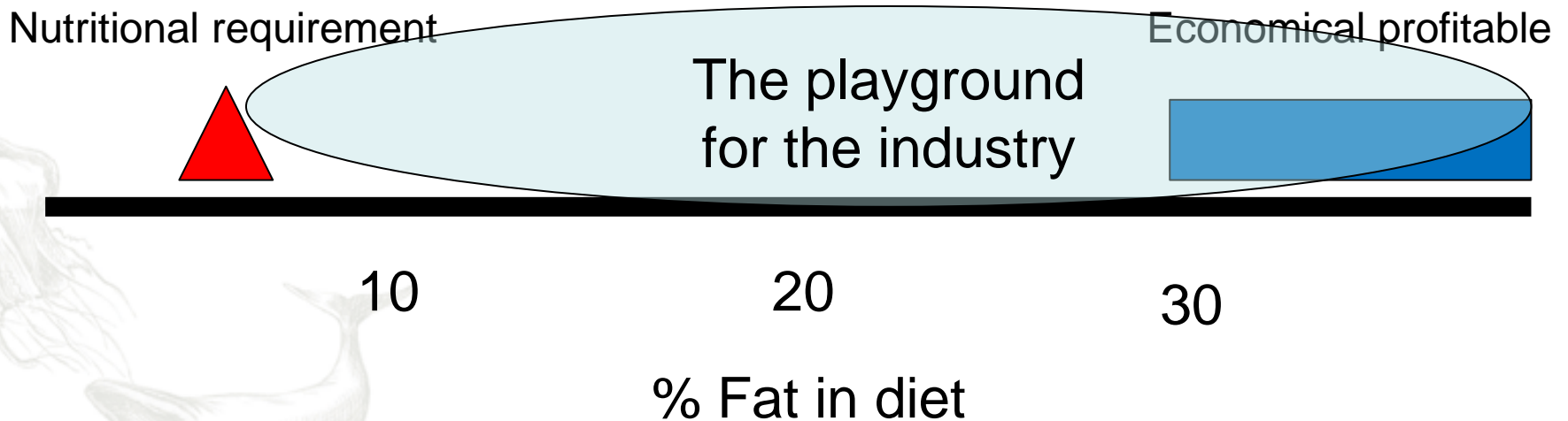


Well managed harvest of marine resources has low impact on the ecosystem.



Definition of terms

“Requirement” – what do we mean? Economical profitable or nutritionally essential?



It's easy to make brave decisions when it doesn't have consequences for you

All Norwegians want to protect the tigers in Asia, wheat farmers in the midwest of USA and soy bean farmers in Brazil probably all agree on saving the oceans from fisheries and aquaculture. Even wolves and bears in Sweden are worth protection — as long as they don't cross the border to Norway!

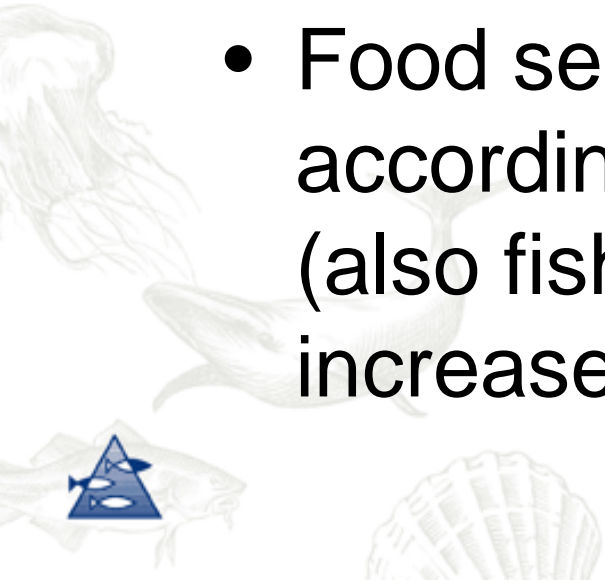


It is important to recognise the right of indigenous people to preserve and develop their cultures and to control their lands (and waters) and traditional resources as a key to perpetuate all forms of diversity on the Earth ([ISE, 2006](#)).



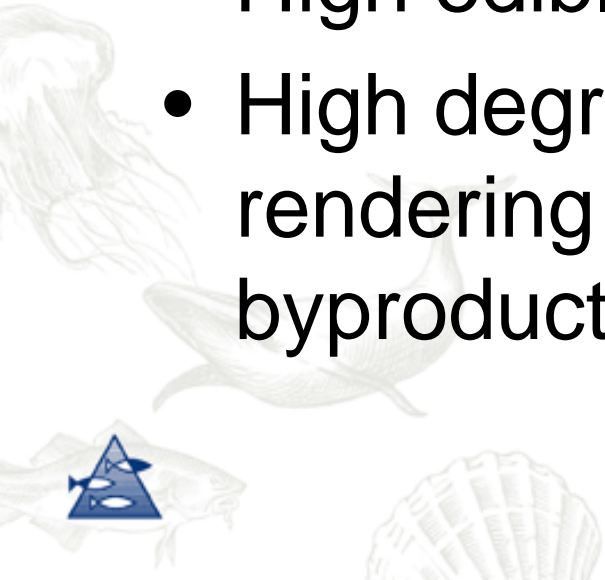
Feeding the people

- World's food production needs to be doubled by 2050:
 - World's population is expected to increase to approximately 9 billion
 - Increased wealth
- Food security also includes food according to preferences – meat (also fish meat) consumption will increase



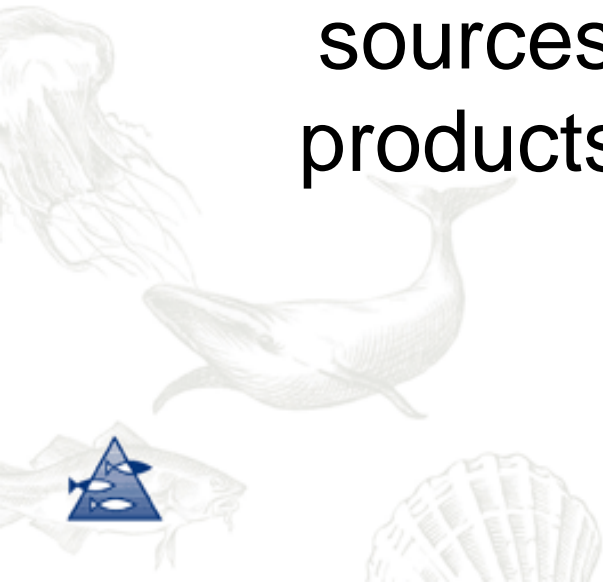
Farmed salmon compare excellent to domestic farm animals

- Efficient utilization of the feed
- High edible yield
- High degree of rendering of byproducts

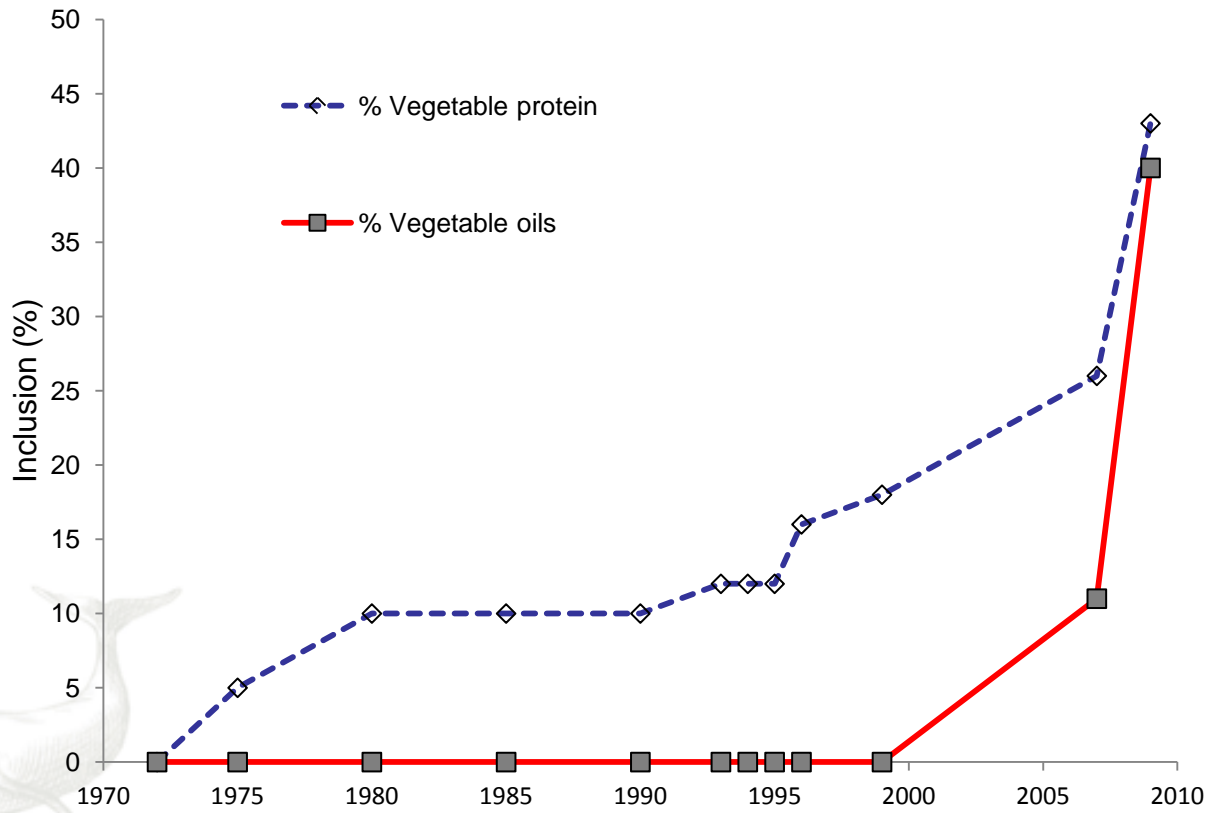


When will Ole come to the issue he was going to talk about?

Protein need vs fish meal- where can and will this come from. Alternative, viable, sources to marine ingredients, by-products, LAPs, algae products etc



Increased demand for fish meal and over exploitation of fish was predicted



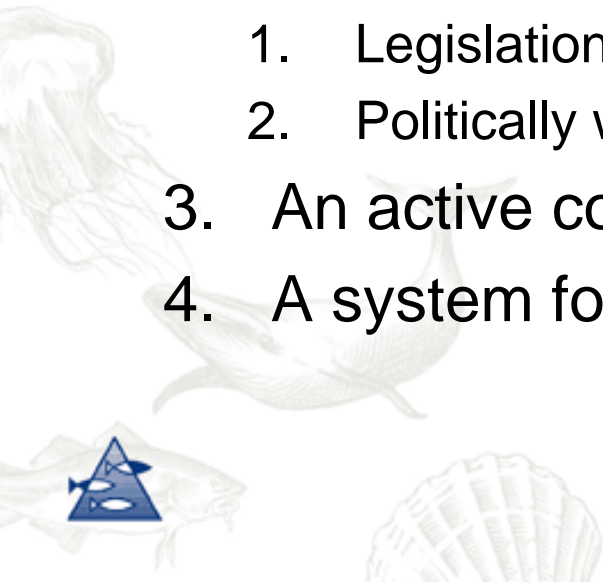
Fish meal production has decreased

- Increased demand has not increased production
- Fishermen are commercial actors. They deliver where they get the best price – as corn farmers, fish feed producers and fish farmers.



Most fisheries are regulated according to FAO Code of Conduct

1. Scientific knowledge about the resources and system for transferring this into advice for management.
2. A managing system consisting of:
 1. Legislation
 2. Politically will to govern internationally through negotiation
3. An active control of the fishery
4. A system for accounting fish catch



Precautionary approach

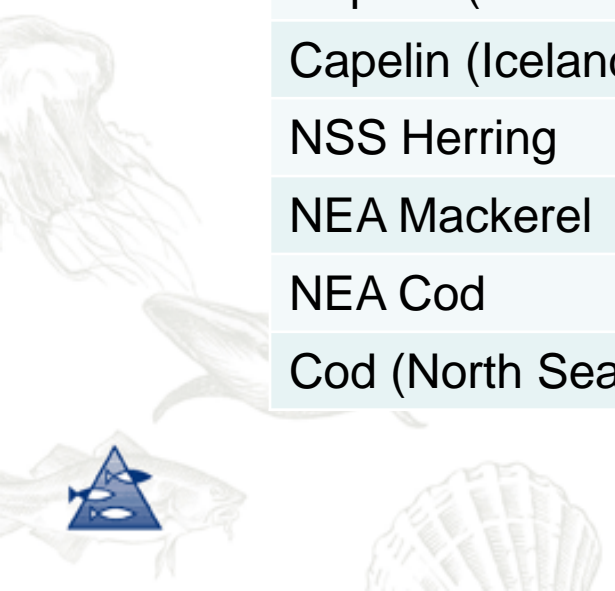
Flim	Red	Red	Red
Fpa	Red	Yellow	Yellow
	Red	Yellow	Green
	Blim	Bpa	

Fish stocks are classified according to spawning stock biomass and exploitation



Classification of fish stocks in the Northeast Atlantic

Stock	Spawning stock pa	F-pa
Blue whiting	ok	Too high
Sandeel	Not defined	Not defined
Norway pout	Not defined	Not defined
Capelin (Barents Sea)	ok	
Capelin (Iceland)	na	
NSS Herring	ok	ok
NEA Mackerel	ok	Too high
NEA Cod	ok	ok
Cod (North Sea)	Very low	Too high



The industry will solve challenges with limited feed resources:

- Refine available protein and fat sources
- Develop new sources (harvest, producing, GMO)
- Inclusion level depending on nutritional requirement and economical profitability.



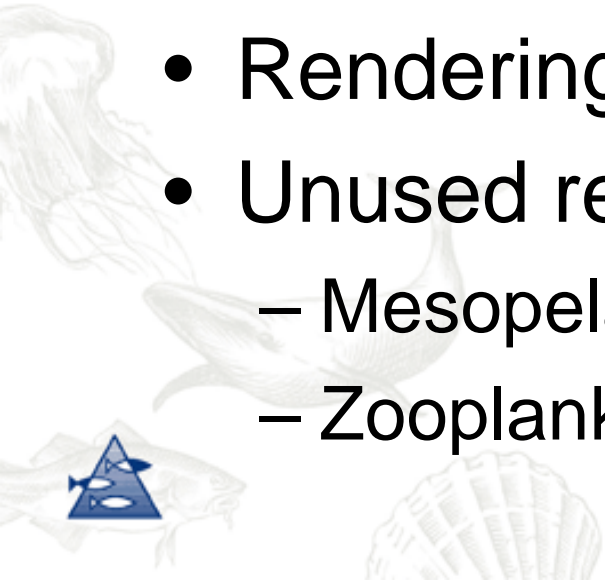
Guided by:

- Governmental regulations
- Consumer preferences and requirements
- NGO's

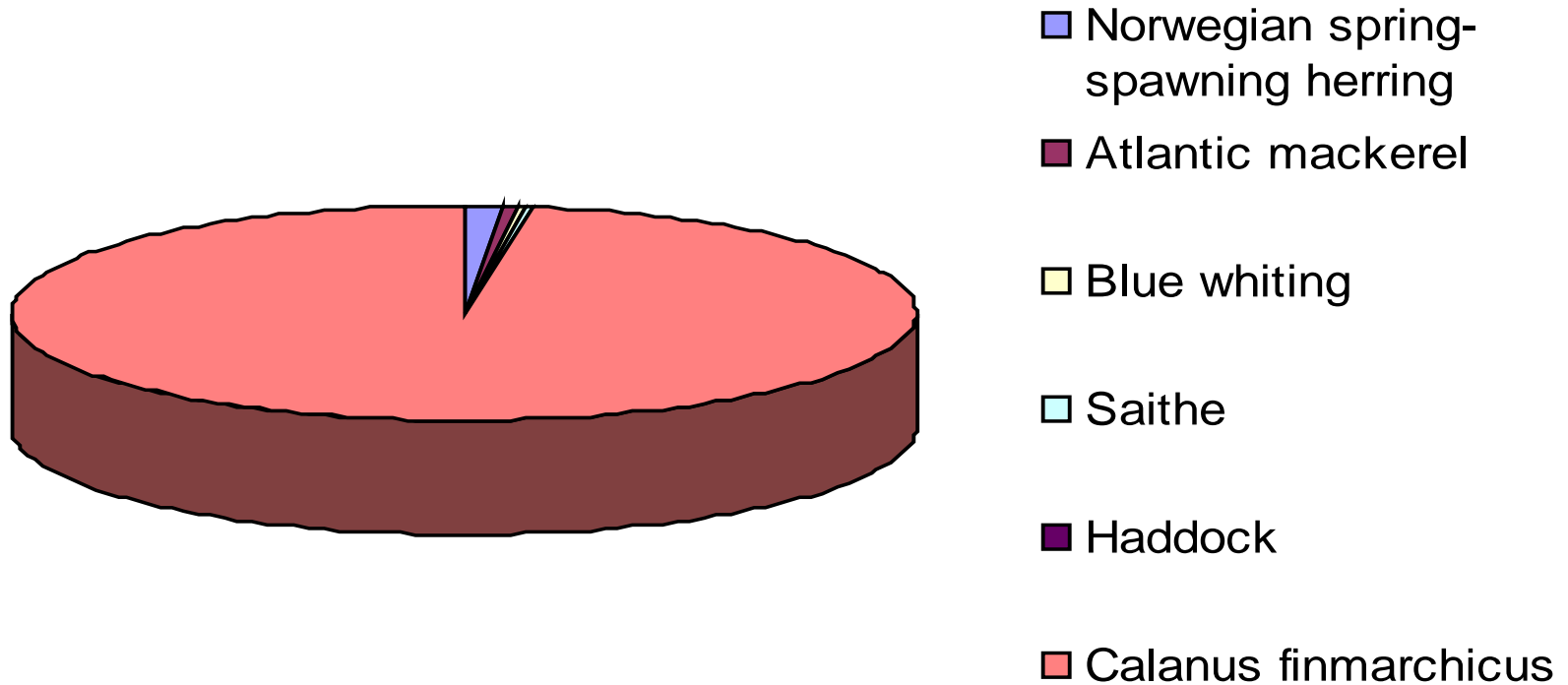


Industrial potentials for supporting industries

- Limited potential for further increased landings of small pelagic fishes for feed.
- Huge discards in fisheries – 38.5 million tons per year
- Rendering of post-harvest byproducts.
- Unused resources:
 - Mesopelagic fish
 - Zooplankton

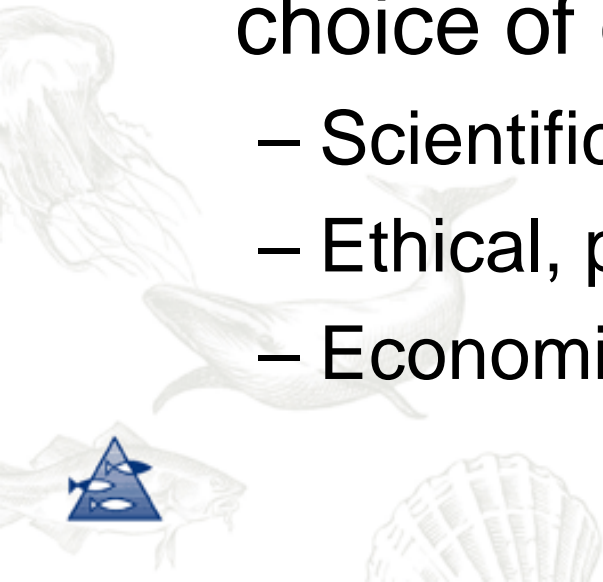


Biomass of Calanus and the major fish species in the Norwegian sea.



You are responsible:

- Not generalize and stigmatize – not all agricultural production is unsustainable.
- Be honest – If you make an economical choice you should say so.
- You should be able to justify your choice of each individual ingredient
 - Scientific criteria
 - Ethical, political, cultural, religious
 - Economical



Recommended reading:

Reviews in Fisheries Science, 19(3):257-278, 2011
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Atlantic Salmon (*Salmo salar*): The “Super-Chicken” of the Sea?

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**We will need the food from the
ocean**

