Fôrmidler til laks

Ressursregnskap og SWOT analyse

Torbjørn Åsgård

Mål

1. Utvikle og evaluere metoder for å beregne utnyttelse av fôrressurser til laks

2. Lage et ressursbudsjett som sammenlignes med andre viktige produksjonssystemer (gris, fjørfe)

3. Foreta en SWOT analyse av ingredienser i laksefôr (dagens og morgendagens fôr)

4. Bidra til å skape en kunnskapsplattform for evaluering av fôrmidler og identifisere FoU behov

Bakgrunn

- Økt fokus på bærekraft og matvare sikkerhet blant forbrukere
- Det oppfattes negativt å bruke fiskemel og olje til laksefôr
- Behov for å dokumentere ressursutnyttelse i dagens lakseoppdrett sammenlignet med andre relevante husdyr- produksjoner
- Mange av referansedata som brukes i dag er opptil 20 år gamle

Dyr	Laks	Kylling	Gris
Spiselig del (%)	65	50	50
Protein (g/kg)	190	200	165
Fôrfaktor*	1.0	2.5	3.0
Protein avleiret i spiselig del (%)	31	21	20

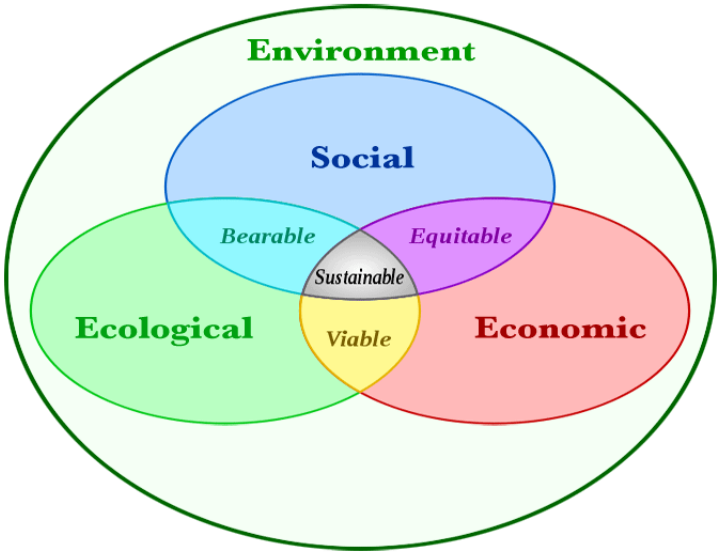
Kilde: Åsgård, Berge, Mørkøre, Refstie, Norsk fiskeoppdrett nr 2 2008

Bærekraftig utvikling i oppdrett

- World commission on Environment and Development (1987):

"En utvikling som tilfredstiller dagens generasjoners behov uten at det går på bekostning av fremtidige generasjoners muligheter til å tilfredsstille sine behov"

- For fiskeoppdrett betyr dette:
  - Forsvarlig bruk av ressursene
  - Å ivareta et godt vannmiljø – på kort og lang sikt
  - Sikre tilgang på sunn sjømat langs kyst og vassdrag
  - Samfunnsmessig aksept
  - Bærekraft sammenlignet med andre produksjoner



Ingredienser til fiskefôr

- Plant ingredients
  - Protein:
    - Soyamel
    - Soyakonsentrat
    - Rapsmeal eller canola
    - Bygg
    - Hvete
    - Mais
    - Erter
    - Bønner
    - Lupin
  - Oljer:
    - Soyaolje
    - Linfrøolje
    - Rapsolje
    - Solsikkeolje
    - Palmeolje

- Ingredienser fra landdyr
  - Land animal Protein (LAP):
    - Blodmel
    - Kjøtt- og beinmel
    - Fjærmel (hydrolysert)
    - Fjørfe biproduktmel
- Mikrobe protein
- Marine ingredienser:
  - Fiskemel og olje
  - Biprodukt
  - Krill
  - Amphipoder
- **GMO**
  - Protein
  - Fett

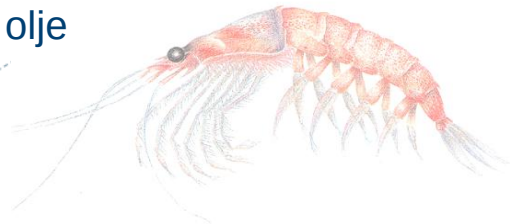


Foto: www.snl.no, www.nrk.no, www.folk.ntnu.no

EPA/DHA-rike råvarer er en knapphetsfaktor

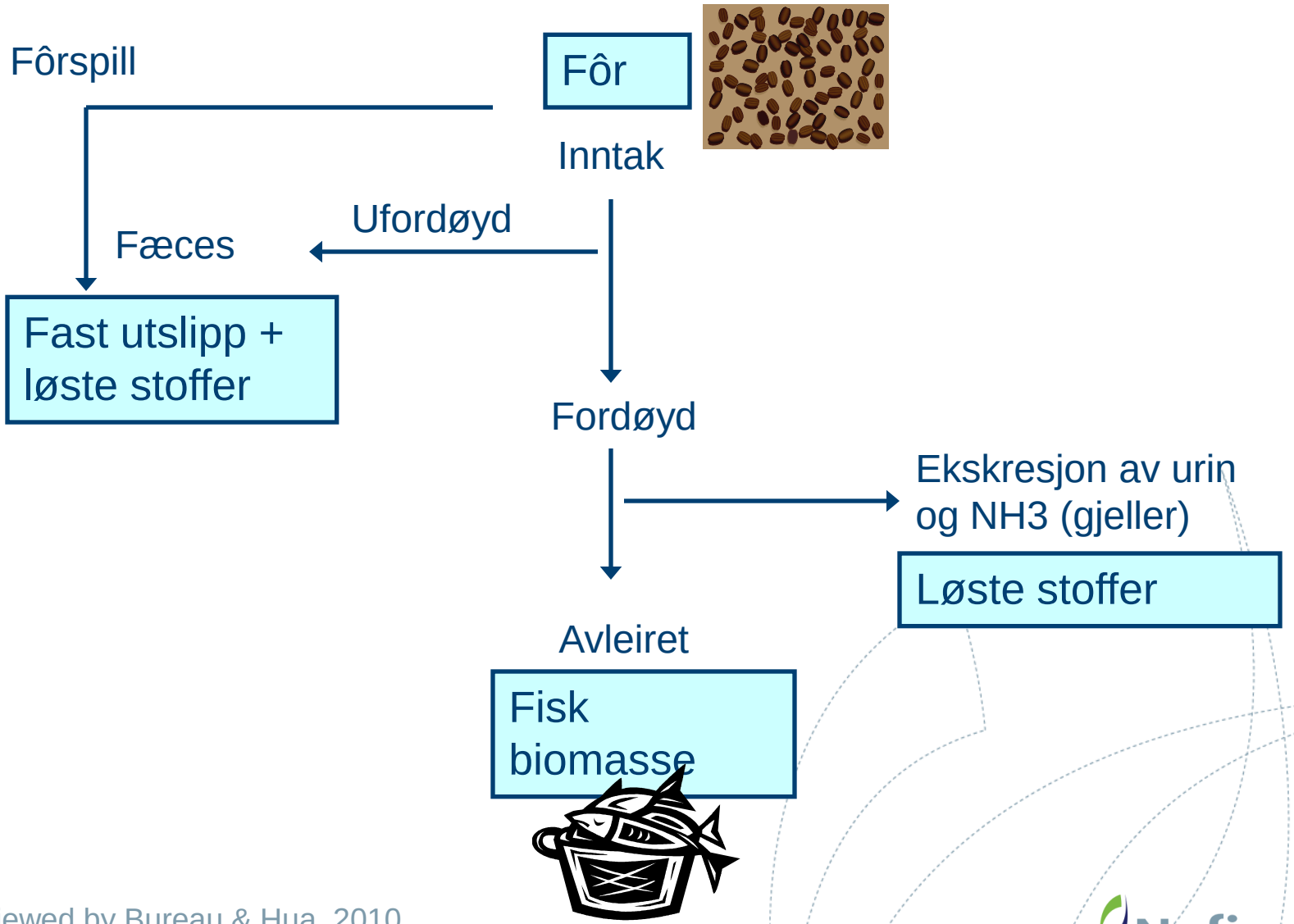
- De marine oljene i fôret, betydning for:
  - Laksens vekst og velferd,
  - Reduksjon av innholdet av fettsyrene EPA og DHA i fillet
  - Dekning av daglig anbefalt inntak (hos laks og humant)

- Nye kilder:
    - Bioteknologisk fra planter og mikroorganismer
    - Nye marine kilder som krill og raudåte

Mineraler og vitaminer

- Fosfor

Hva med næringsutslipp fra lakseoppdrett?



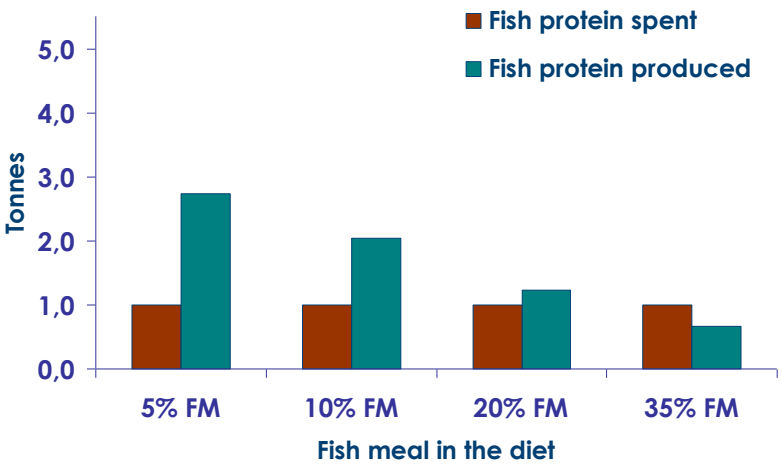
Source; reviewed by Bureau & Hua, 2010

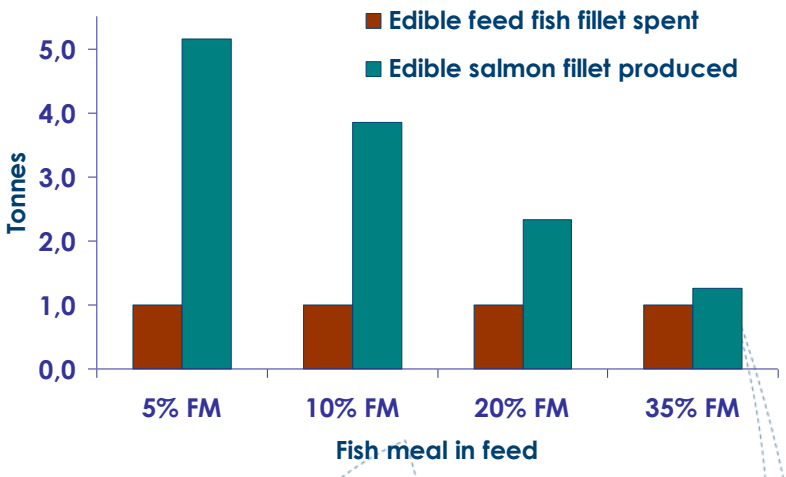
Metoder

- Øko-effektivitetsmodeller
- Ressursbruk for dekning av dagsbehov
- Retensjons effektivitet
  - FIFO
  - Protein, nitrogen, aminosyrer (total og marint)
  - Fett, fettsyrer, EPA, DHA (total og marint)
  - Energi
  - Mineraler

  Se på utviklingen i norsk lakseproduksjon over tid og i relasjon til andre kjøttproduksjoner (i Norge og internasjonalt)

Forbruk kontra produksjon: Laksen vil i framtiden være netto produsent av marint protein.





Kilde: Åsgård, Berge, Mørkøre, Refstie, Norsk fiskeoppdrett nr 2 2008

Kilde: T. Åsgård, Nofima

Eksempel på bruk av en øko-effektivitetsmodell (BASF)

Future Challenges in Salmon Feed Composition: Sustainable Solutions defined by Eco-Efficiency-Analysis

Presentert på Aquavision 2004 av

Ståle Refstie[a], Peter Saling[b], Martin Rimbach[c],

Mette Sørensen[a], Stig Myran[b], Christoph Günther[b]

[a]AKVAFORSK,[b]BASF, [c]Nutreco ARC

About the analysis

According to P. Saling, A. Kicherer et al, Int. J. LCA **7** (4),203-218, (2002)

The ecological calculations belong to the ISO-rules 14040 ff. The methodology is approved by the German TUV. It is used by the Eco-Institute in Freiburg Germany, TNO in the Netherlands. The Wuppertal Institute accepts the method. It was developed by BASF and Roland Berger Consulting, Munich.

Target of Eco-Efficiency Analysis

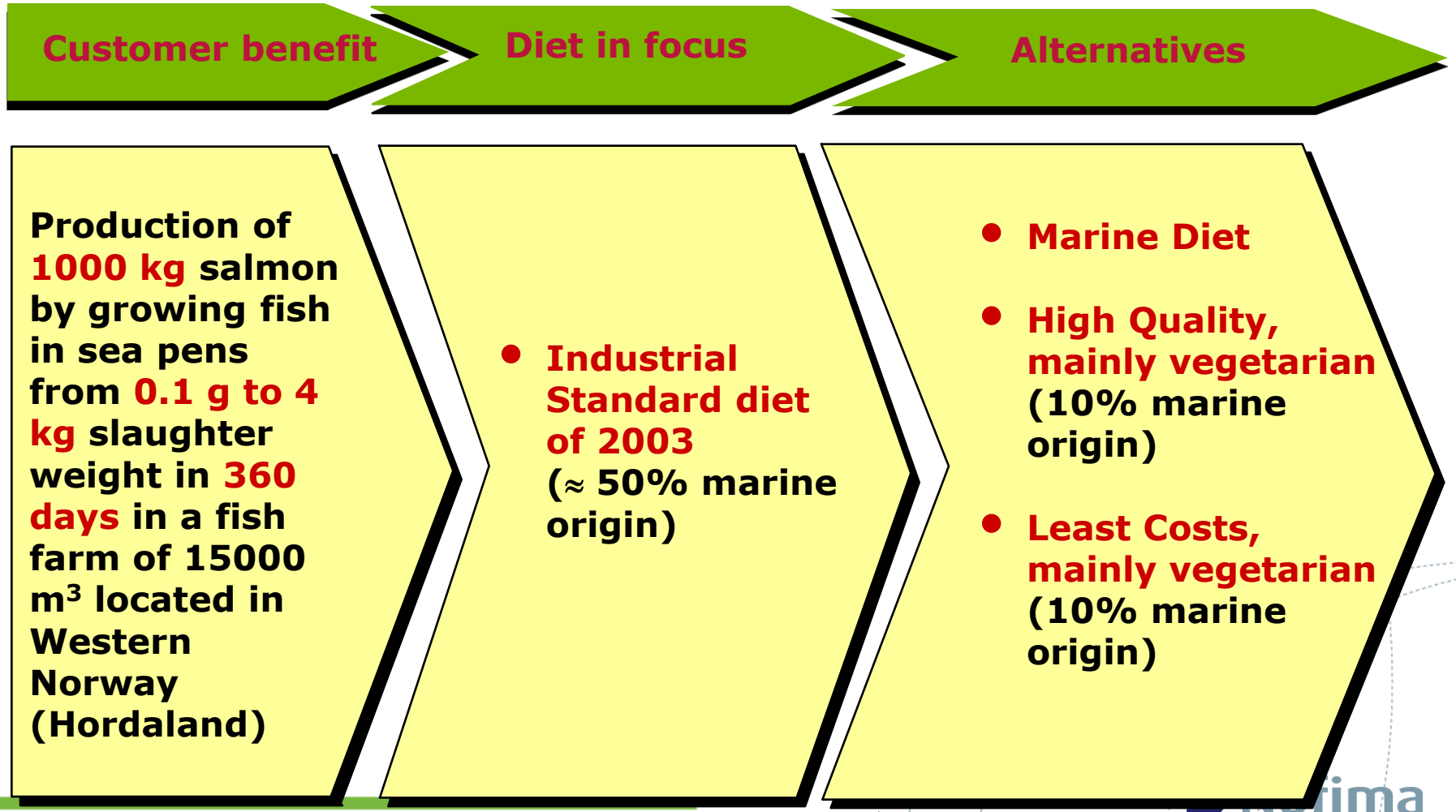
- Comparison of comparable products and systems
- Integral analyses of alternative solutions with
  - total cost determination
  - calculation of ecological burden for the whole life cycle
  - a fundament for strategic decisions and evaluation of product portfolios
  - ideas for improvement of product quality in respect to sustainability
  - arguments for the food chain

Nofima

Target of Eco-Efficiency Analysis

- Results can give
  - a fundament for strategic decisions and evaluation of product portfolios
  - ideas for improvement of product quality in respect to sustainability
  - arguments for the food chain

Analysed system



Feed ingredients considered

- LT fish meal (Northern and Southern hemispher)
- Fish oil (Northern and Southern hemispher)
- Soybean meal, extracted 48
- Soy concentrate
- Soy semi-concentrate (Hamlet HP340)
- Corn gluten
- Wheat gluten
- Dehulled lupins
- Wheat
- Heat treated maize
- Rapeseed oil
- Monocalciumphosphate
- Vitamin / Mineral premix
- L-Lysine*HCl
- DL-Methionine
- Inositol
- Astaxanthin 10%

Prices based on Q4 2003

Restictions on feed formulation

3 diets per dietary regime

I.	100 – 750 g BW:	40% dig. prot. and 30% lipid
II.	750 – 2000 g BW:	35% dig. prot. and 35% lipid
III.	2000 – 4000 g BW:	31% dig. prot. and 35% lipid

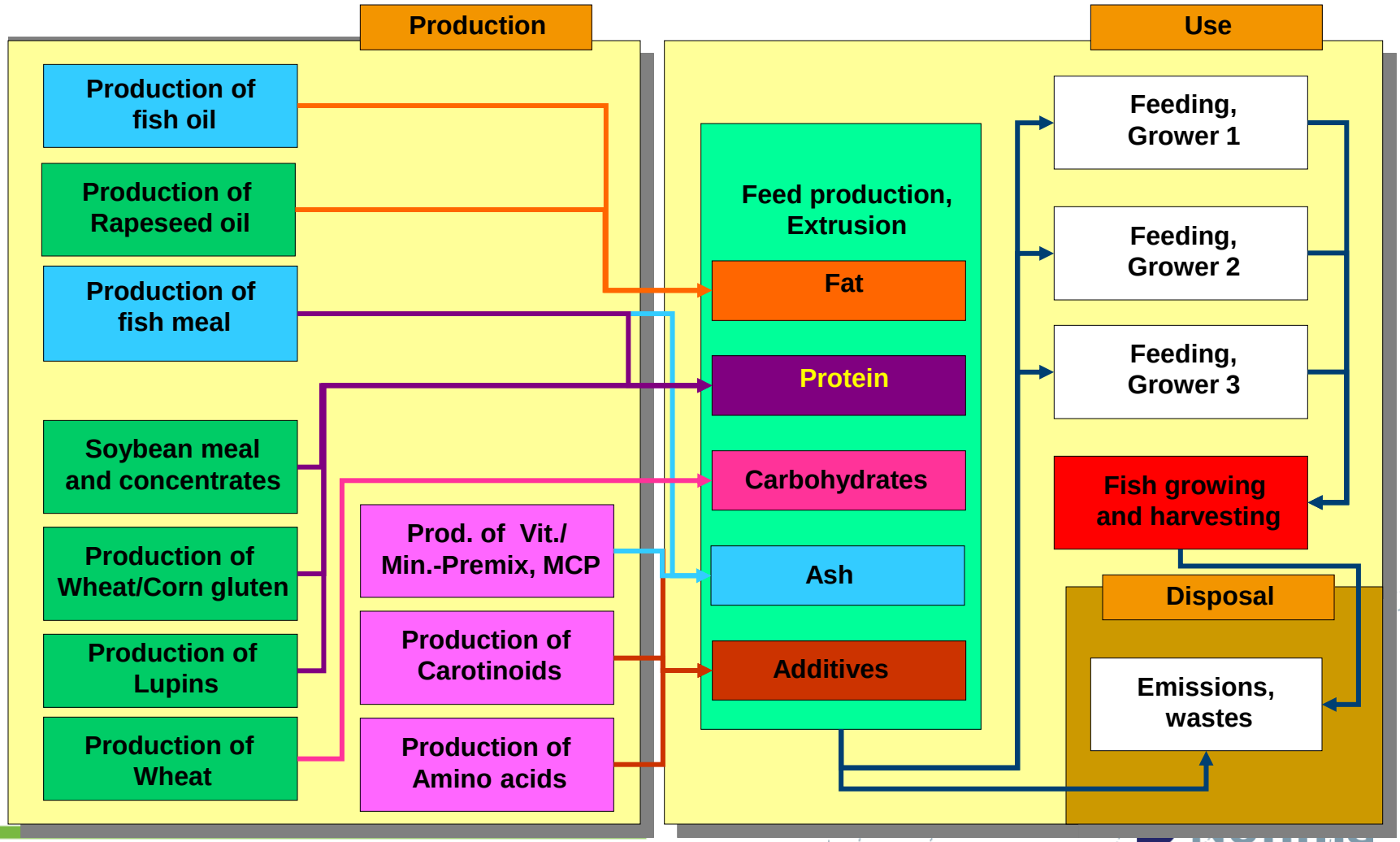
In comparable diets among regime

- EPA+DHA > 1% of the diet
- Available AA and P adjusted by supplements
- Constant vit+min and ax supplement
- Inositol supplement only in vegetarian diets

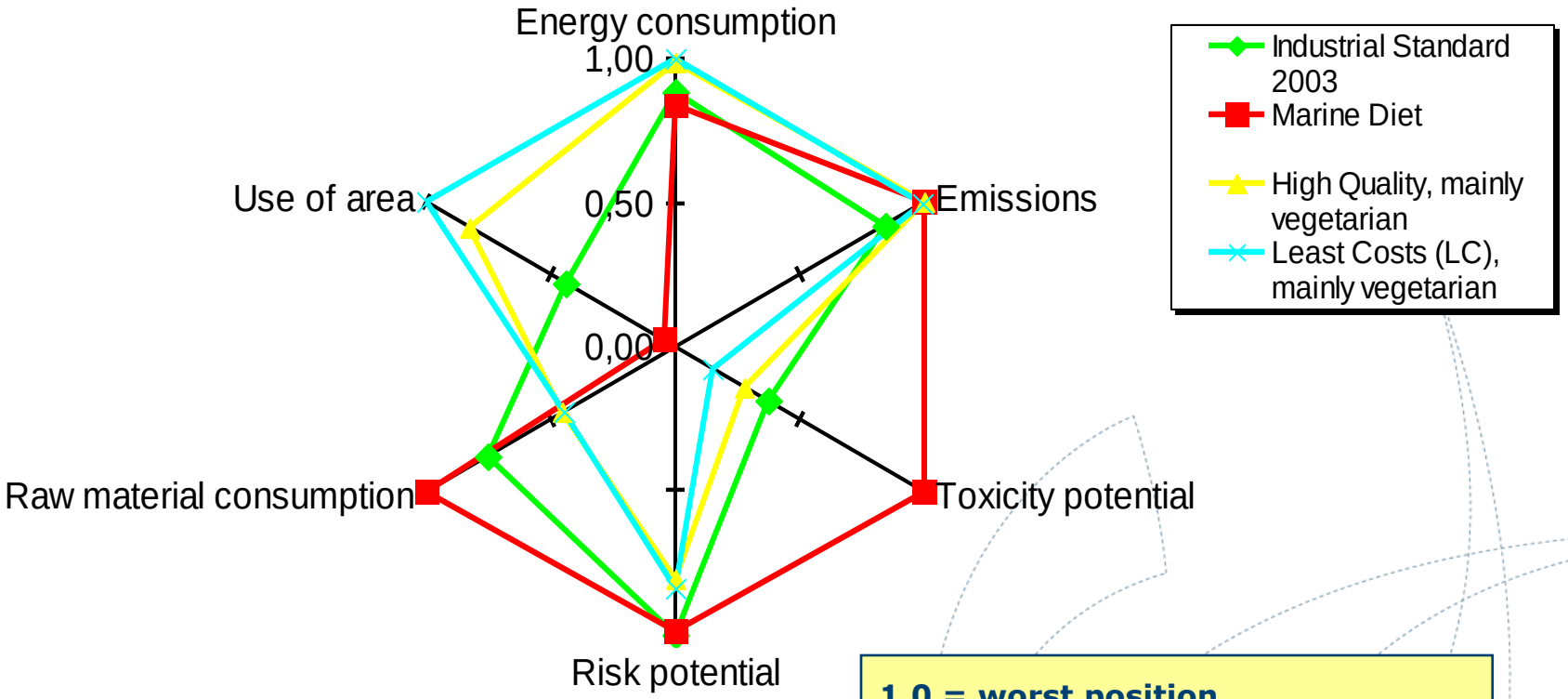
Fish facts

- Fish rearing
  - Sea pen volume: 15,000 m^3
  - Final biomass: 25 kg/m^3
- Growth data
  - Gain: 0.1 – 4.0 kg
  - Time: 360 days
  - Temperature: 9.4 ° C
  - Growth rate: 3.32 (TGC x 1,000)
- Fish composition
  - According to Shearer et al. (1994)
- Nutrient digestibility
  - According to scientific experience
- Nutrient depostition and excretion
  - Modelled according to Einen et al. (1995)

System boundaries

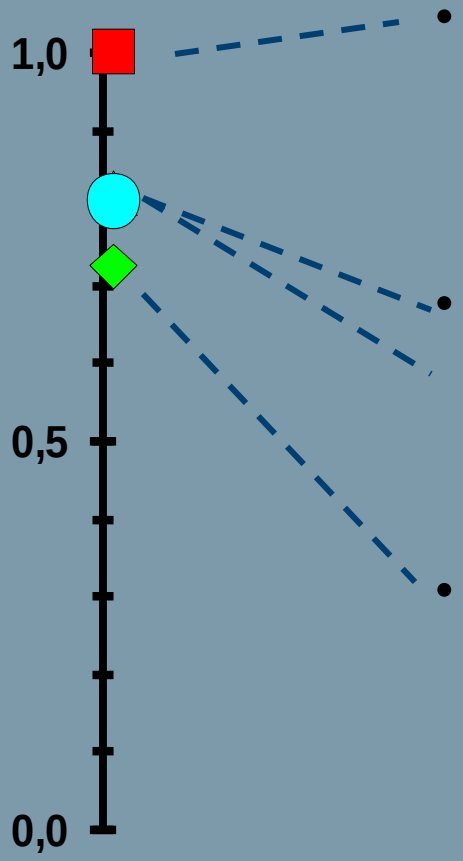


Ecology fingerprint for base case: Current situation



1,0 = worst position
Better results ordered relatively <1

Comments to the Results of the Water Emissions



- The most important impact on water emissions for **“Marine Diet”** are the contributions from the discharges. Most important are here the much more higher discharges from Phosphates, followed by the Nitrogen discharges. Additionally relatively high emissions are belonging to the fish oil and fish meal production.

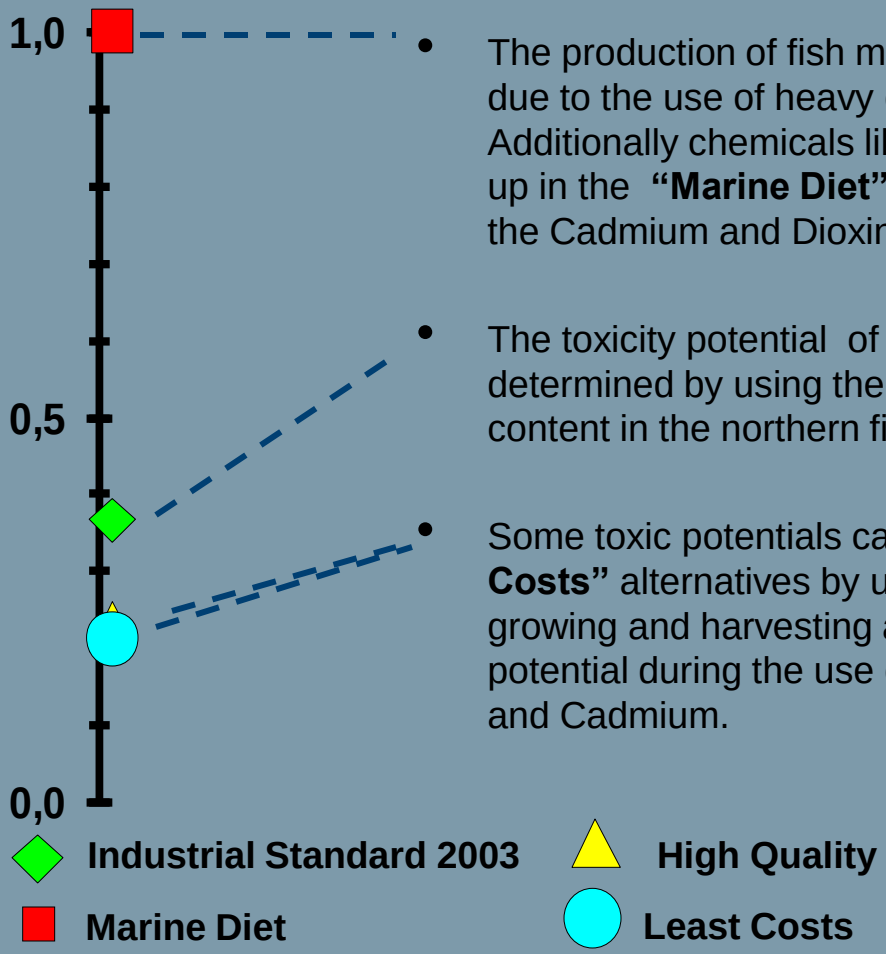
- The water emissions of the **“High Quality”** and **“Least Costs”** alternatives are in between the position of the other alternatives due to the higher emissions from the fish oil production and lower discharges caused by the vegetarian part of the diet. The discharges during the fish growing period are also high and comparable to the “Marine Diet”.

- The best position due to water emissions can be detected for the **“Industrial Standard”** Mainly the Phosphate discharges with a high impact category factor are much more lower than in the other alternatives. But Nitrogen emissions are higher. Mainly the emissions from the production of the vegetarian raw materials are much lower than those of fish oil/fish meal productions.

Industrial Standard 2003 **High Quality**

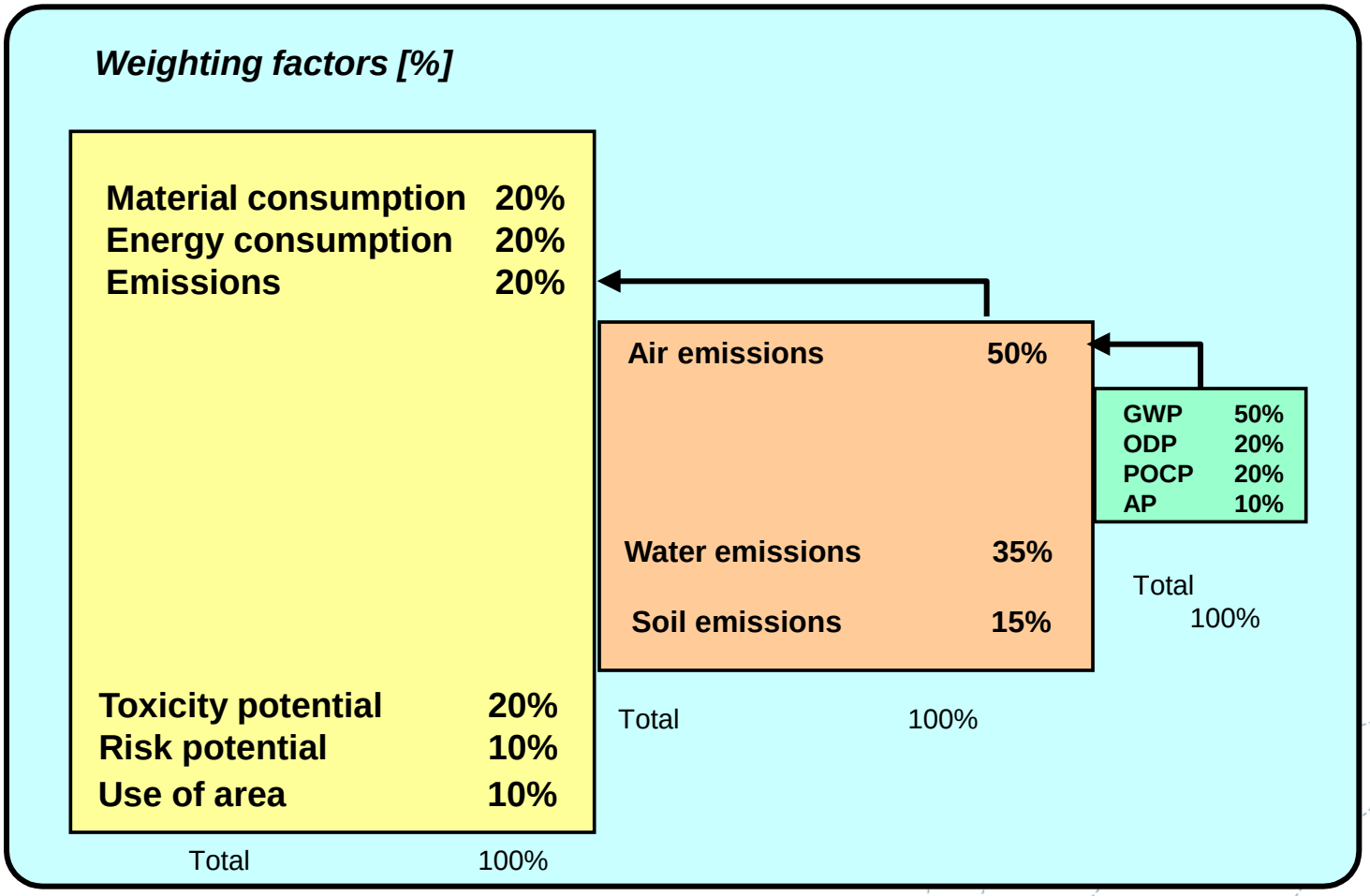
Marine Diet **Least Costs**

Comments to the Results of the Toxicity Potential

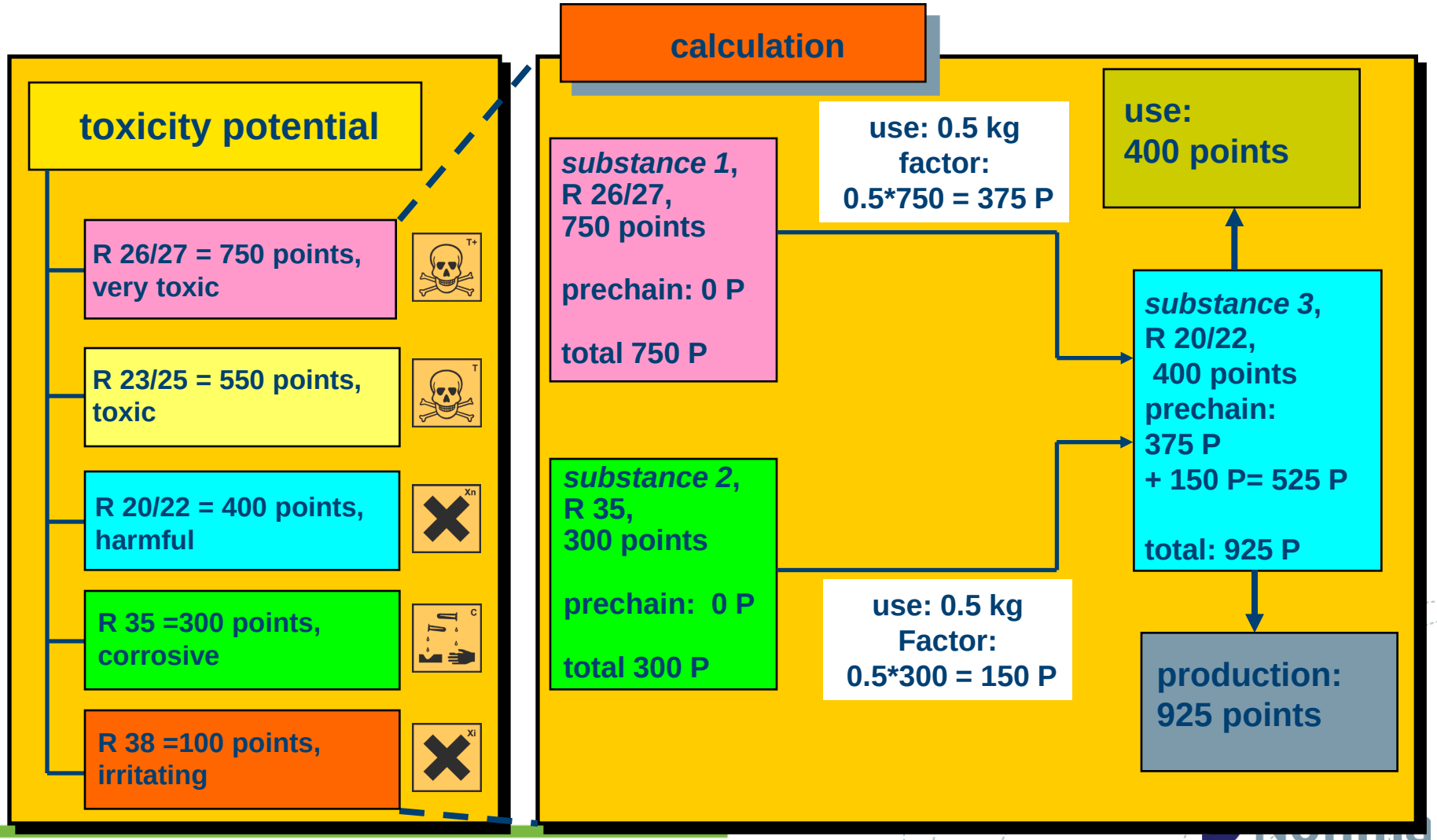


- The production of fish meal/oil has a higher impact on the toxicity potential due to the use of heavy oil and diesel oil during the catch and work up. Additionally chemicals like formalin are used in small amounts in the work up in the **"Marine Diet"** alternative. The most important impact comes from the Cadmium and Dioxin content in the northern fish oil/meal.
- The toxicity potential of **"Industrial Standard"** in the production is determined by using the fish oil and meal. Also the Cadmium and Dioxin content in the northern fish oil/meal have the most important impact.
- Some toxic potentials can be detected in the **"High Quality"** and **"Least Costs"** alternatives by using corn and corn gluten due to pesticides during growing and harvesting and using diesel. Most important is the low toxicity potential during the use of the feed because of the low contents of Dioxin and Cadmium.

Scaling scheme for the ecological fingerprint (societal factor)



Determination of the Toxicity Potential: Example

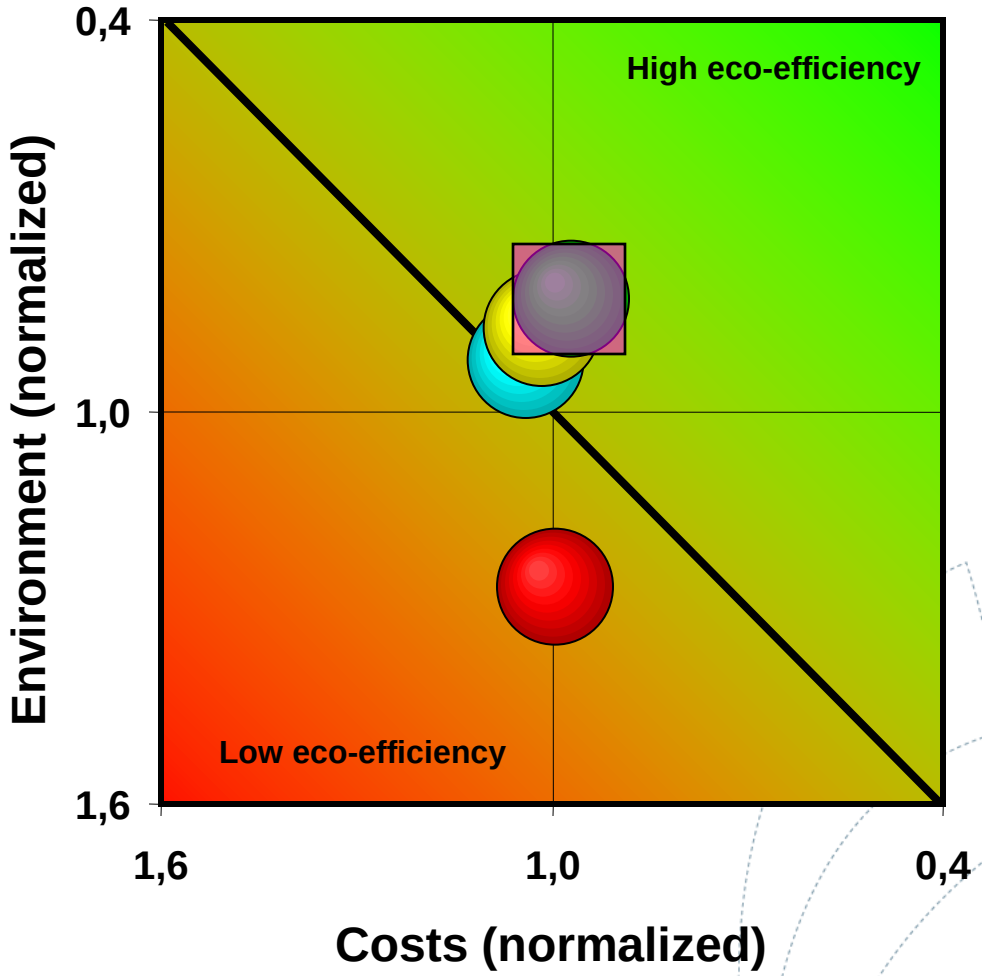


Portfolio of the base case:
Current situation

Sector of significant differences (90 % Level)

Customer benefit:

Production of 1000 kg of Salmon in the saltwater phase in Western Norway by growing from 100 g to 4000 g of harvesting weight in cage of 15000 cbm



- Industrial Standard 2003
- Marine Diet
- High Quality, mainly vegetarian
- Least Costs (LC), mainly vegetarian

Industrial Standard is the most Eco-Efficient alternative, followed by High quality and Least Costs diets

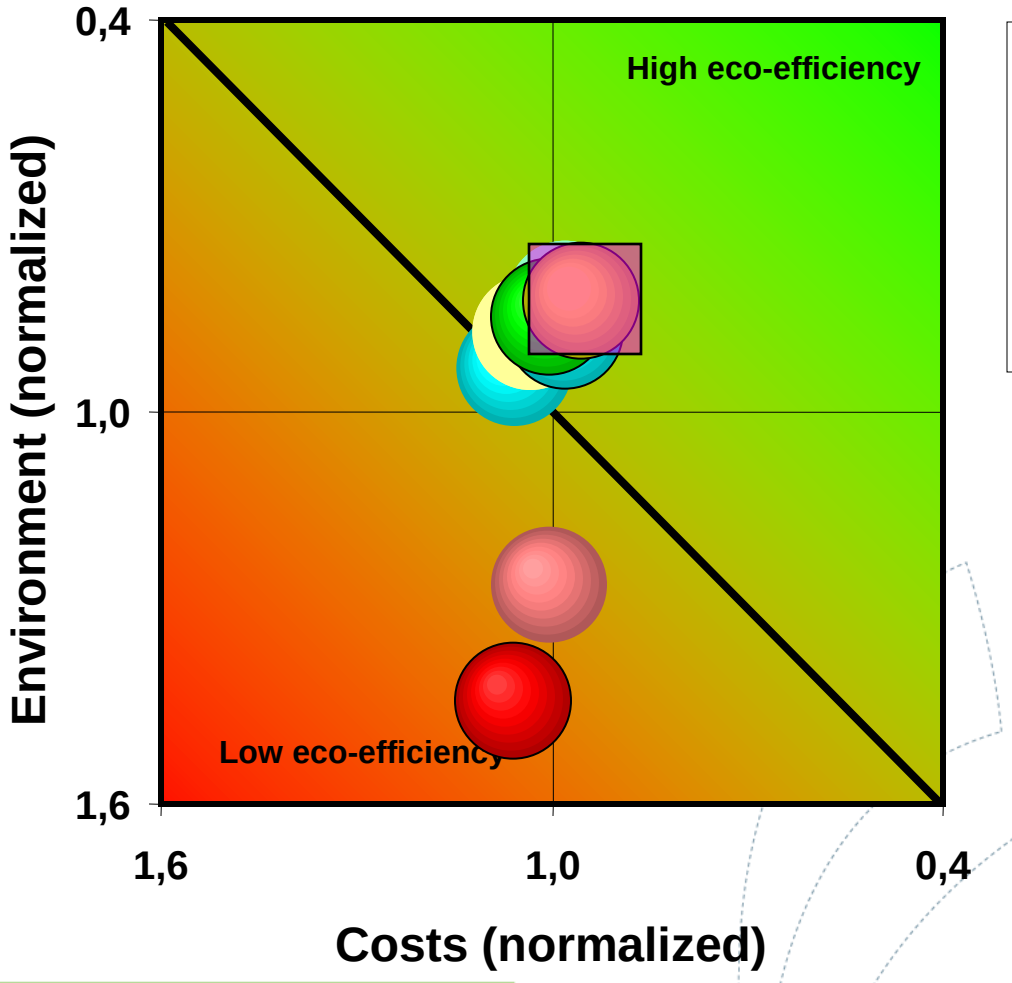
Scenarios analysed

1. A doubling of the fish meal and fish oil prices
2. As 1, when over fishing for meal and oil, with a 20-year grow-back period for the crashed fish populations
3. Removal of dioxins from the North Atlantic fish oil
4. Using only South American fish meal and oil in the marine diets

Doubling of fish meal and fish oil prices and over fishing

Customer benefit:

Production of 1000 kg of Salmon in the saltwater phase in Western Norway by growing from 100 g to 4000 g of harvesting weight in cage of 15000 cbm

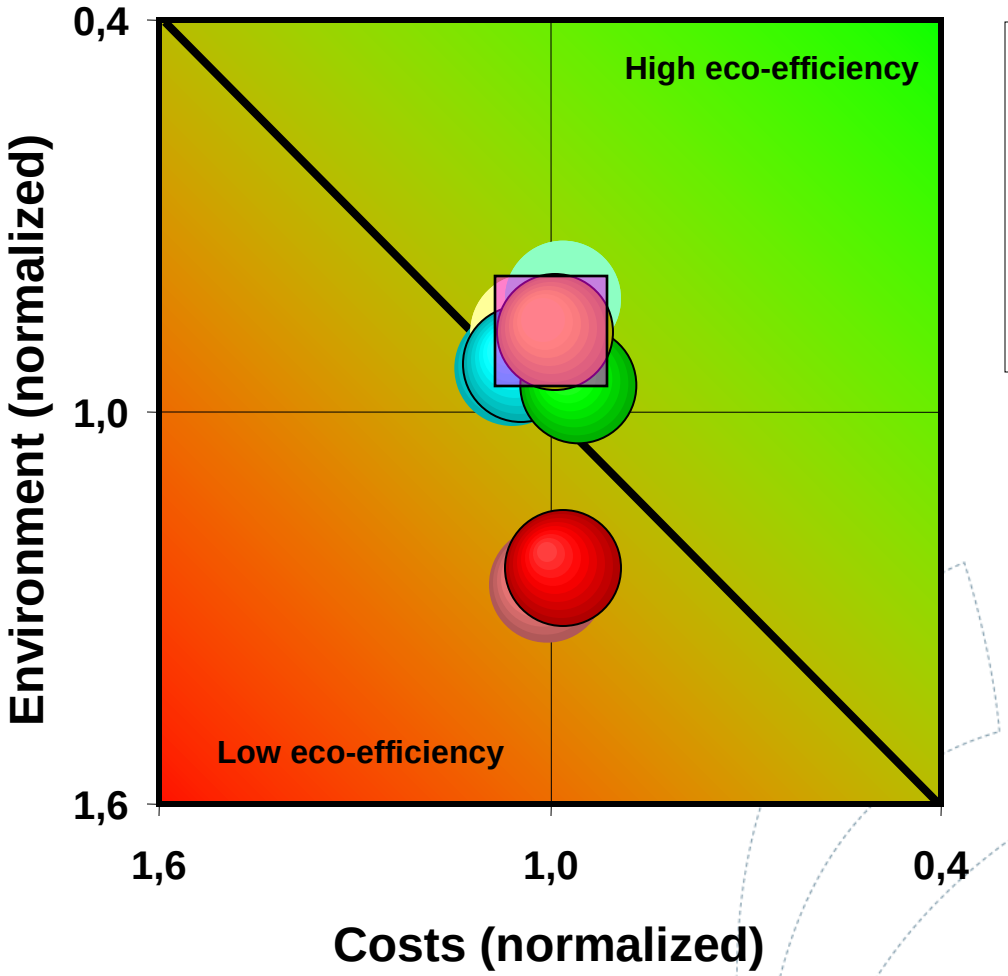


In this Scenario High Quality is the most Eco-Efficient alternative.

As 1, if removing dioxins from the Nordic fish oil

Customer benefit:

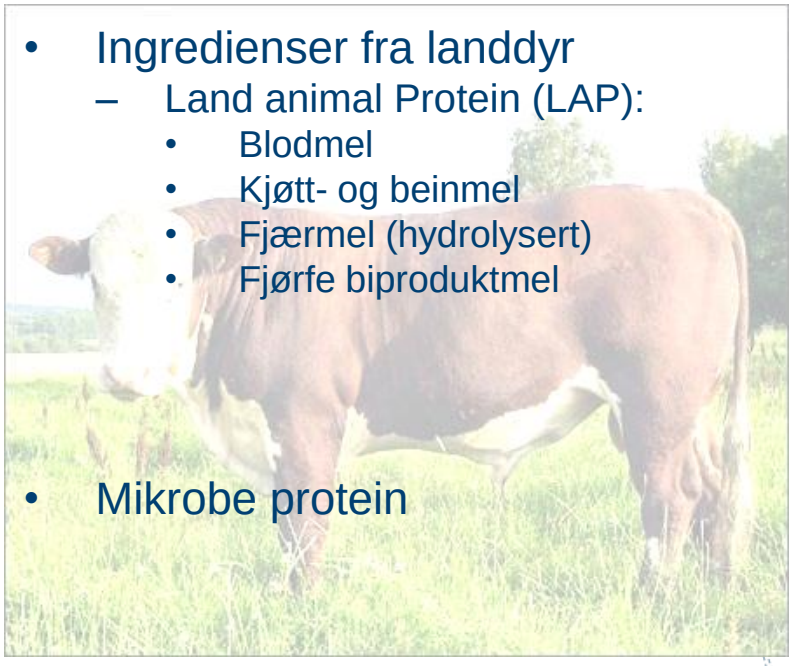
Production of 1000 kg of Salmon in the saltwater phase in Western Norway by growing from 100 g to 4000 g of harvesting weight in cage of 15000 cbm



In this Scenario High Quality is the most Eco-Efficient alternative. Marine Diet increases its position.

SWOT-analyse av ingredienser til fiskefôr

- Plant ingredients
  - Protein:
    - Soyamel
    - Soyakonsentrat
    - Rapsmeal eller canola
    - Bygg
    - Hvete
    - Mais
    - Erter
    - Bønner
    - Etc.
  - Oljer:
    - Soyaolje
    - Linfrøolje
    - Rapsolje
    - Solsikkeolje
    - Etc.



- Ingredienser fra landdyr
  - Land animal Protein (LAP):
    - Blodmel
    - Kjøtt- og beinmel
    - Fjærmel (hydrolysert)
    - Fjørfe biproduktmel
- Mikrobe protein

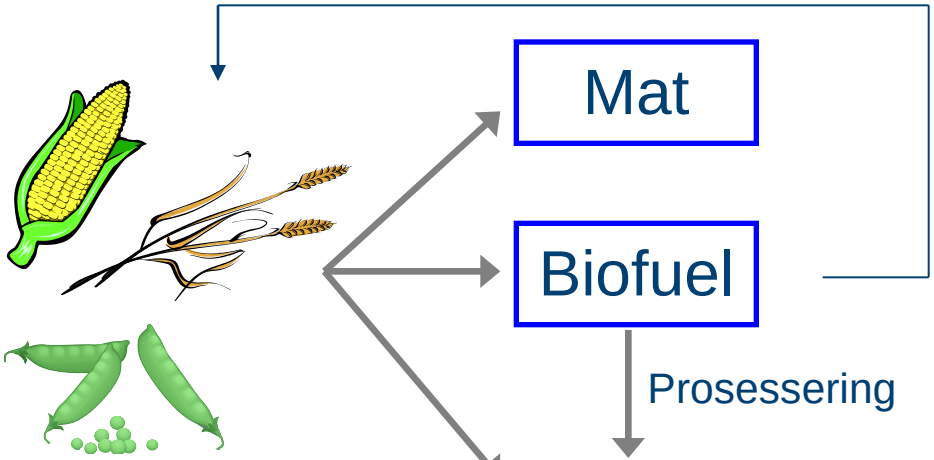
- Marine ingredienser:
  - Biprodukt
  - Krill
  - Amphipoder
- GMO
  - Protein
  - Fett

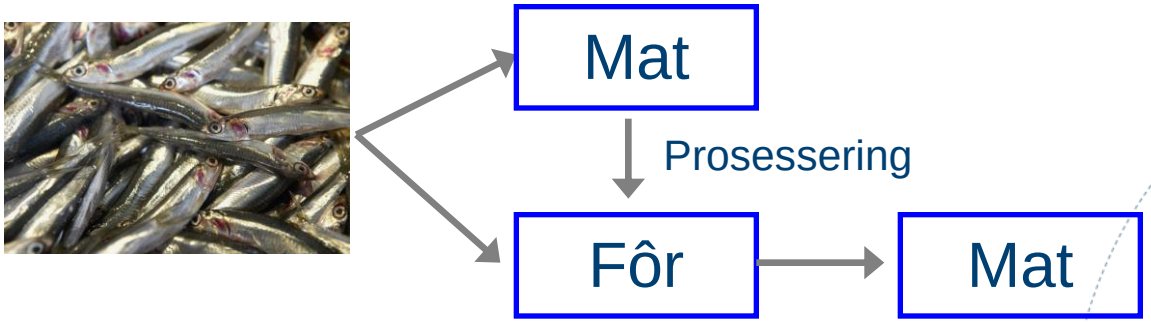
Foto: www.snl.no, www.nrk.no, www.folk.ntnu.no

Elementer i analysen av hver ingrediens

- Næringsinnhold
- Volum/tilgjengelighet
- Fiskehelse og etikk i produksjon
- Godt, sunt og trygt produkt
- Forbrukerholdninger
- Bærekraftsbetrakninger
- Muligheter
- Trusler

Bærekraftsbetrakninger
Hva skal råvarene brukes til?





Output

- Rapport
- Publikasjoner
  - Vitenskapelige
  - Populærvitenskapelige

  - TV innslag
  - Media
  - Møter
  - Konferanser