# Fishmeal and Fish Oil as Essential Components in Aquafeed


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- IFFO, The Marine Ingredients Organisation

- AquaFarm, Pordenone
- 13th February 2019

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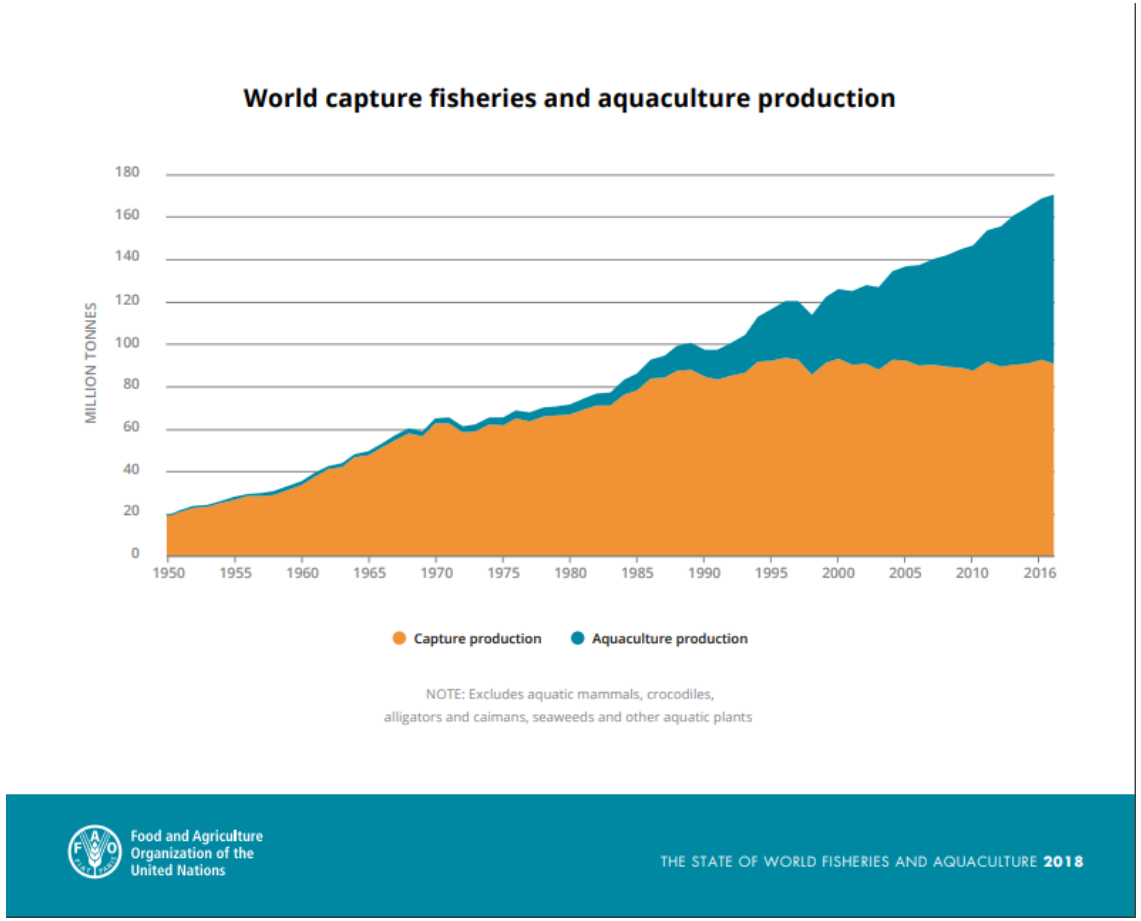
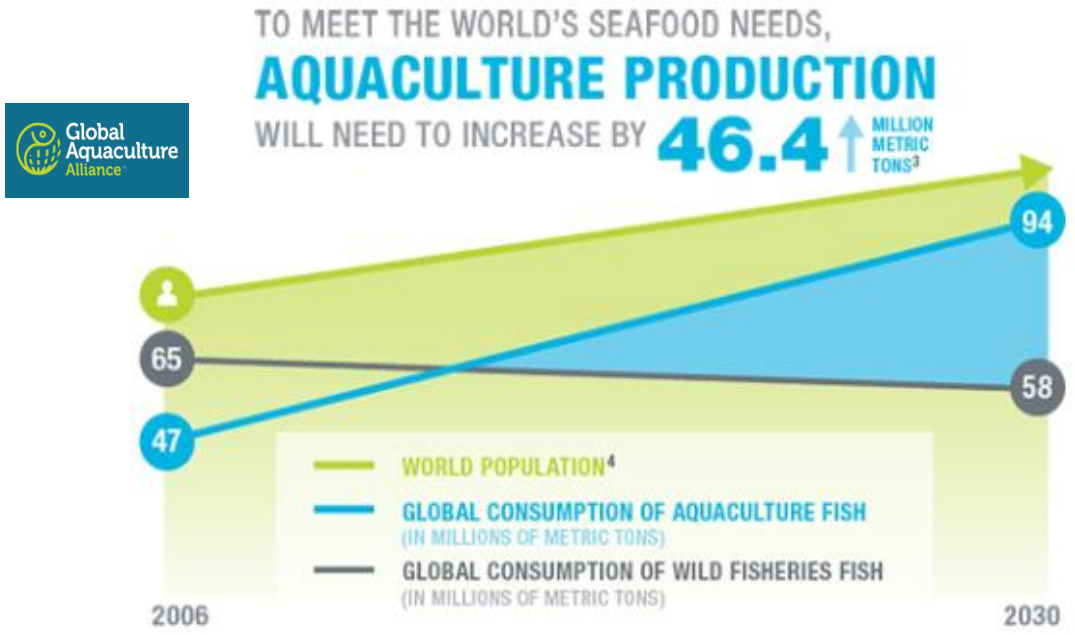
# The importance of farming fish

- **Energy: FCR; Efficient protein production;**
- **(Comparatively low) Environmental impact;**
- **Space: availability of area for increased protein supply;**
- **Nutrition: compares favourably with the best terrestrial proteins; some unique factors;**

# Aquaculture growing (& needs to continue to grow)

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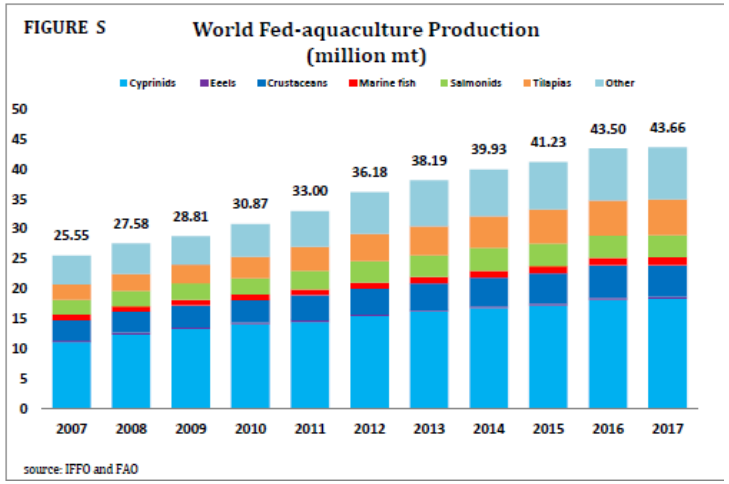
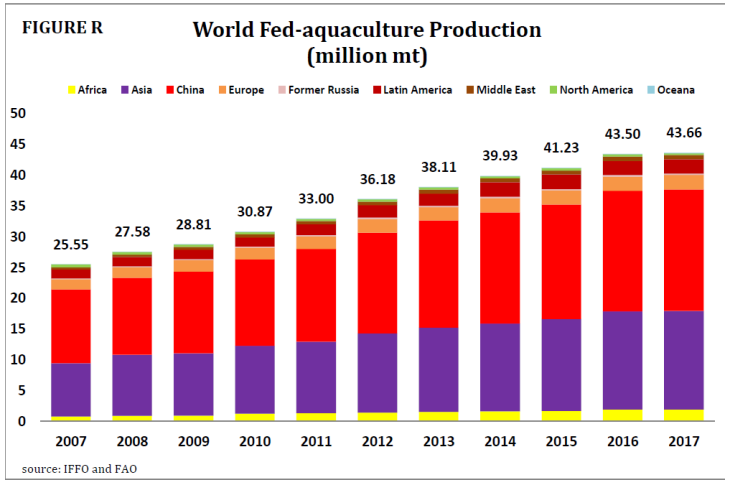



**The growth of farming of fed aquatic animal species has outpaced the farming of unfed species in world aquaculture.**

The share of unfed species in total aquatic animal production decreased gradually from 2000 to 2016, shrinking by 10 percentage points to 30.5 percent.




# “Fed” Aquaculture also growing & increasing in importance

FAO: SOFIA, 2018:

# Feed volume growing: All species & Aquafeed

**2019 Alltech Global Feed Survey estimates world feed production increased by 3 percent to 1.103 billion metric tons**

January 29, 2019


General: All species

undercurrentnews
seafood business news from beneath the surface

HOME PRICES SPECIES COMPANIES DOWNSTREAM UPSTREAM BLOGS JOBS

ucn 2017 REPORT Top 40 Latin American Seafood Companies Out now! View sample here

ANALYSIS COMPANIES R&D

**Alltech: Global aquafeed production hit 40m tons for the first time in 2018**

By Dan Gibson Jan. 31, 2019 17:51 GMT

Aquaculture

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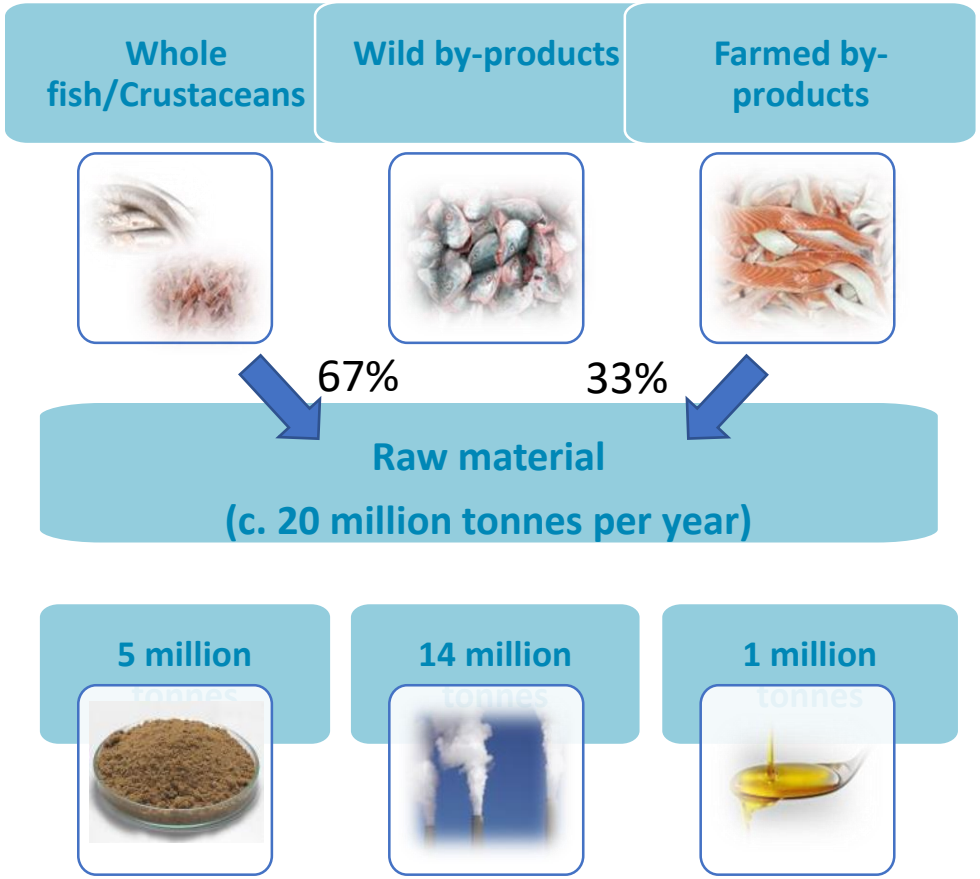
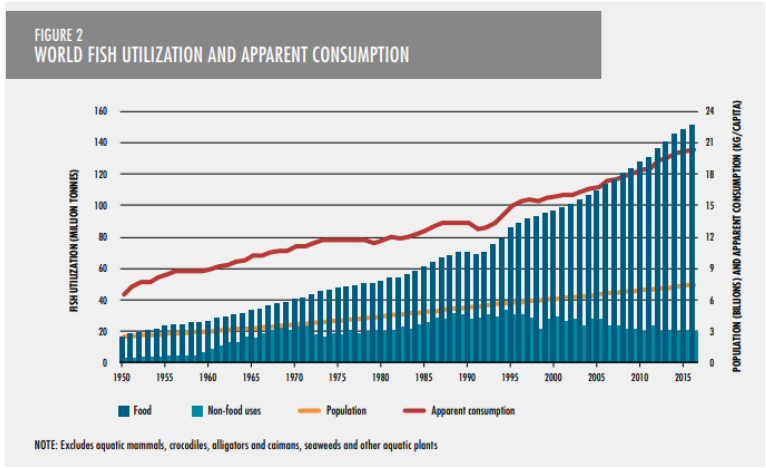
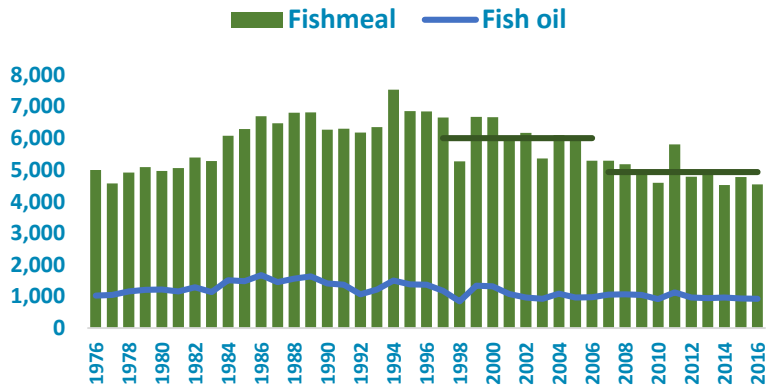
# Fishmeal and Fish Oil supply – static/slight decline in volume




**World's fishmeal and fish oil supply (1,000 mt)**

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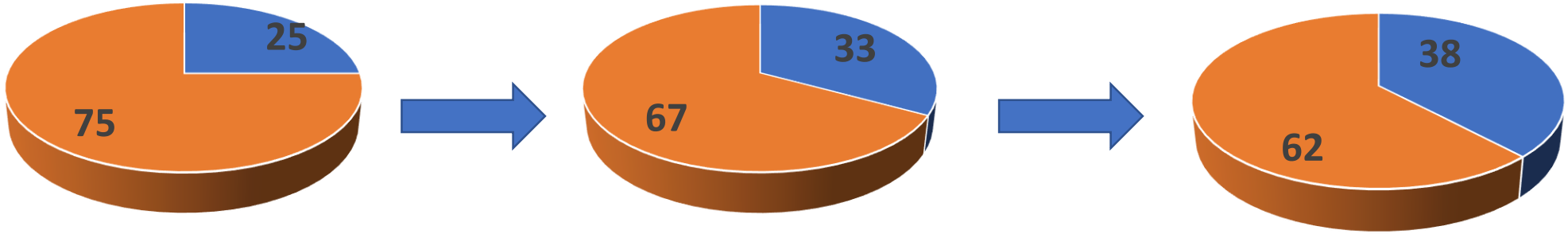
# Raw material: Trend for increasing Byproduct (trimmings) use




Estimated by Shepherd, 2012

Calculated by Jackson & Newton, 2016

Predicted by FAO for 2025 (2016)

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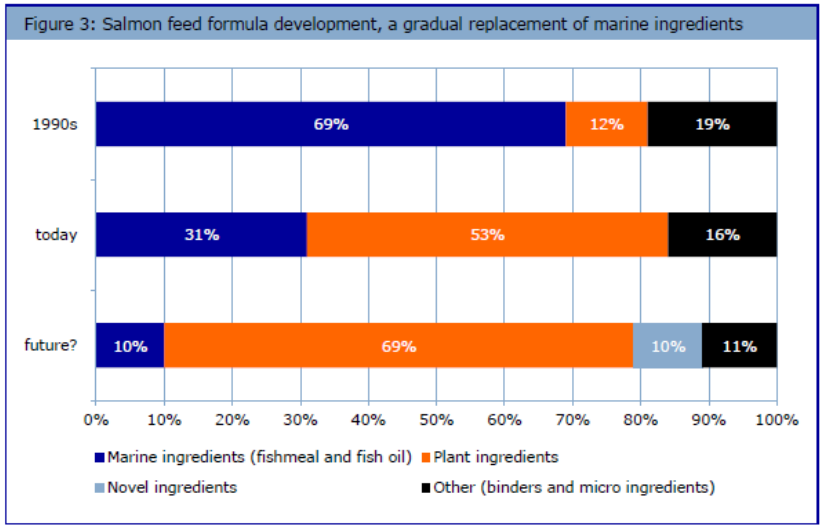
# What this means in reality

Decreasing inclusion rates

Decreasing Fish In: Fish Out (FIFO) ratios

# Decreasing Inclusion Rates

(Documented in salmon)




Source: EWOS, 2015

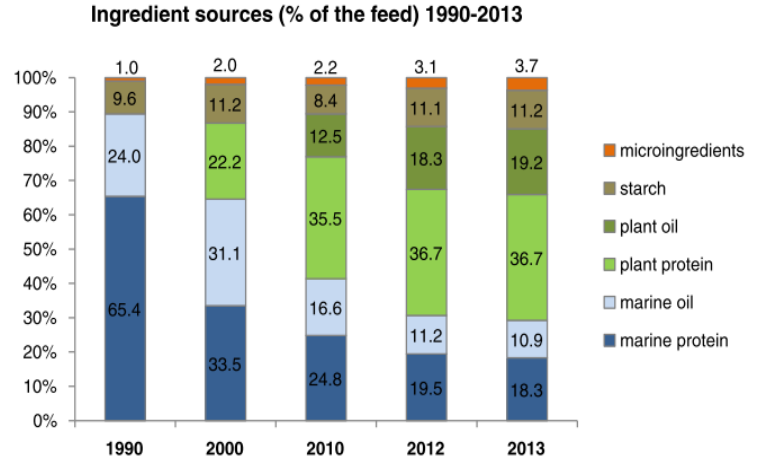



**Fig. 1.** Nutrient sources in Norwegian salmon farming from 1990 to 2013. Each ingredient type is shown as its percentage of the total diet.

**Ytrestoyl, et al. (2015) Aquaculture 448 365–374**
**http://dx.doi.org/10.1016/j.aquaculture.2015.06.023**

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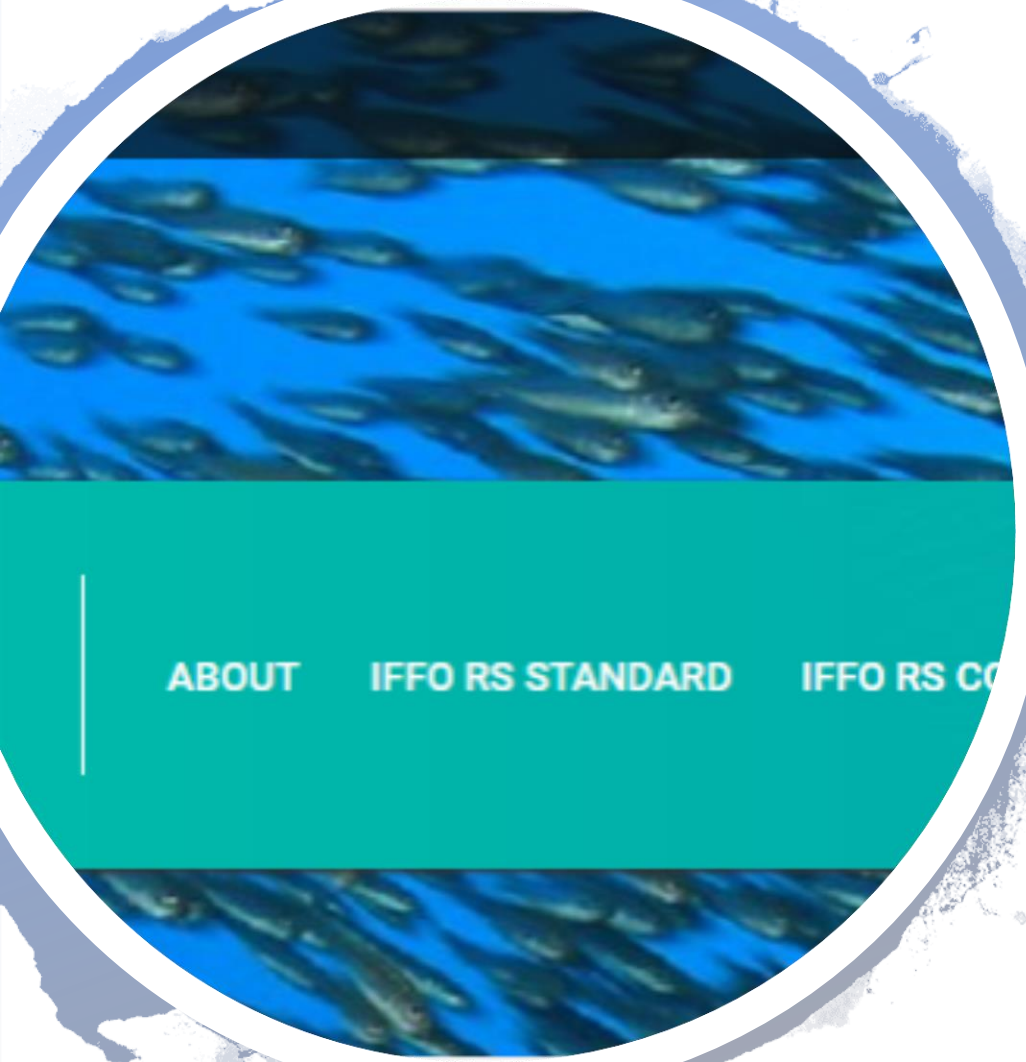
# Decreasing Fish In: Fish Out (FIFO) ratios (Global, all species)

| | 2000 | 2010 | 2015 |
|---|---|---|---|
| **Crustaceans** | 0.91 | 0.45 | 0.46 |
| **Marine Fish** | 1.48 | 0.88 | 0.53 |
| **Salmon & Trout** | 2.57 | 1.38 | 0.82 |
| **Eels** | 2.98 | 1.81 | 1.75 |
| **Cyprinids** | 0.07 | 0.03 | 0.02 |
| **Tilapias** | 0.27 | 0.18 | 0.15 |
| **Other Freshwater** | 0.60 | 0.15 | 0.13 |
| **Aquaculture total** | 0.63 | 0.33 | 0.22 |

# But FMFO plays an essential role

- Low volume, high impact (c. 5 million tonnes FM in c.40 million tonnes aquafeed)
- Some key nutritional contributions (different factors important for different species)
- Manage volume of supply into key species, or key life stages – strategic use
- To achieve increasing feed volume, need to supplement available FMFO with other ingredients

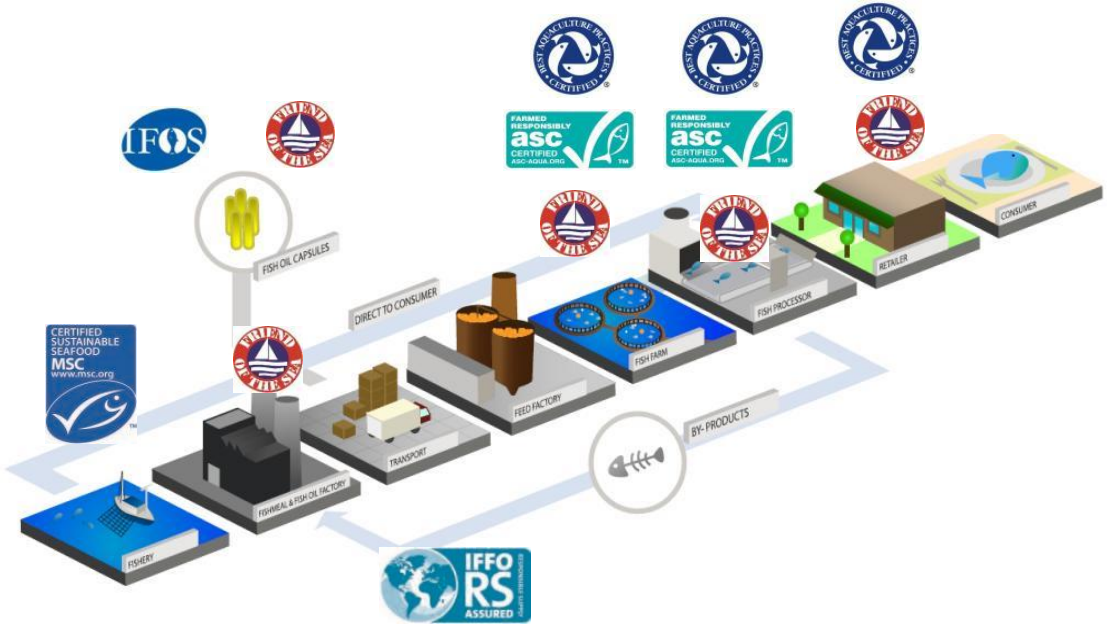


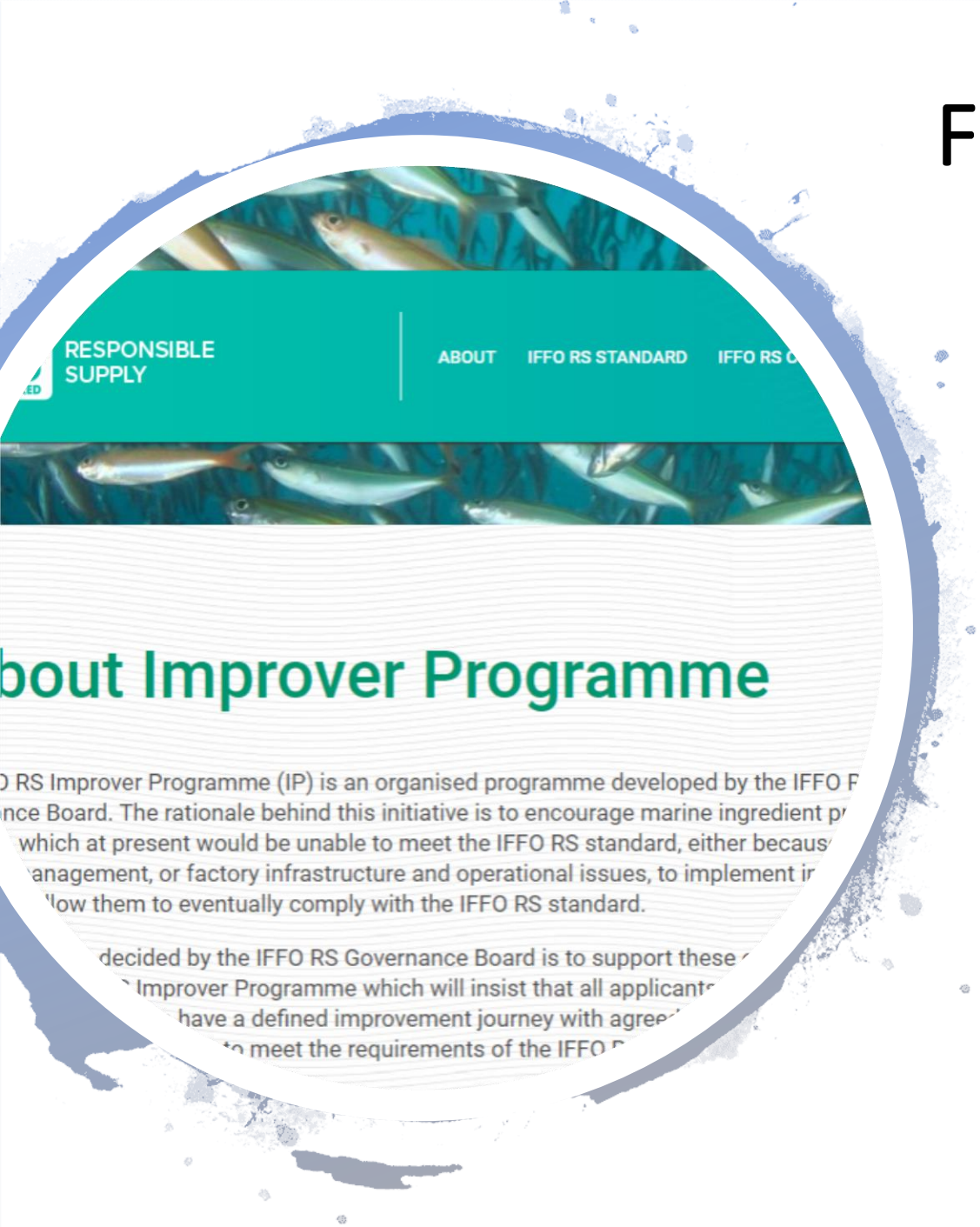

# Certification

- Growth over time
- Supply chain driver
- (Continual) growth in available certified product
- FMFO upstream products: Important source for certified aquaculture product
- Driving certified supply volume
- IFFO Responsible Supply significant player in FMFO (c.50% production certified)

# Benefits of certification

- **Management of social and environmental impacts on sustainability**
- **Traceability**
- **Helps to secure value of product in the market**






# Fisheries Improvement Projects

- A (growing) important component
- FIP process improves fisheries stock management
- Based on multi-stakeholder approach
- FIPs also carry benefits to marine ecosystem
- Provides additional volume of material for feed standards and aquaculture certification supply chain

# Fishmeal – why is it important (nutritionally)?

**HIGH PROTEIN**

**HIGH DIGESTIBILITY**

**EXCELLENT AMINO ACID PROFILE, OF WHICH SOME ARE "ESSENTIAL" AMINO ACIDS**

**RICH SOURCE OF SOME VITAMINS (E.G. B12) AND MINERALS (E.G. Cu, Zn, Ca, Se)**

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# Fish oil – why is it important

**Dietary source of energy**

**Rich source of essential fatty acids**

**Currently, only commercially significant volume n-3s**

**Some additional nutritional factors**

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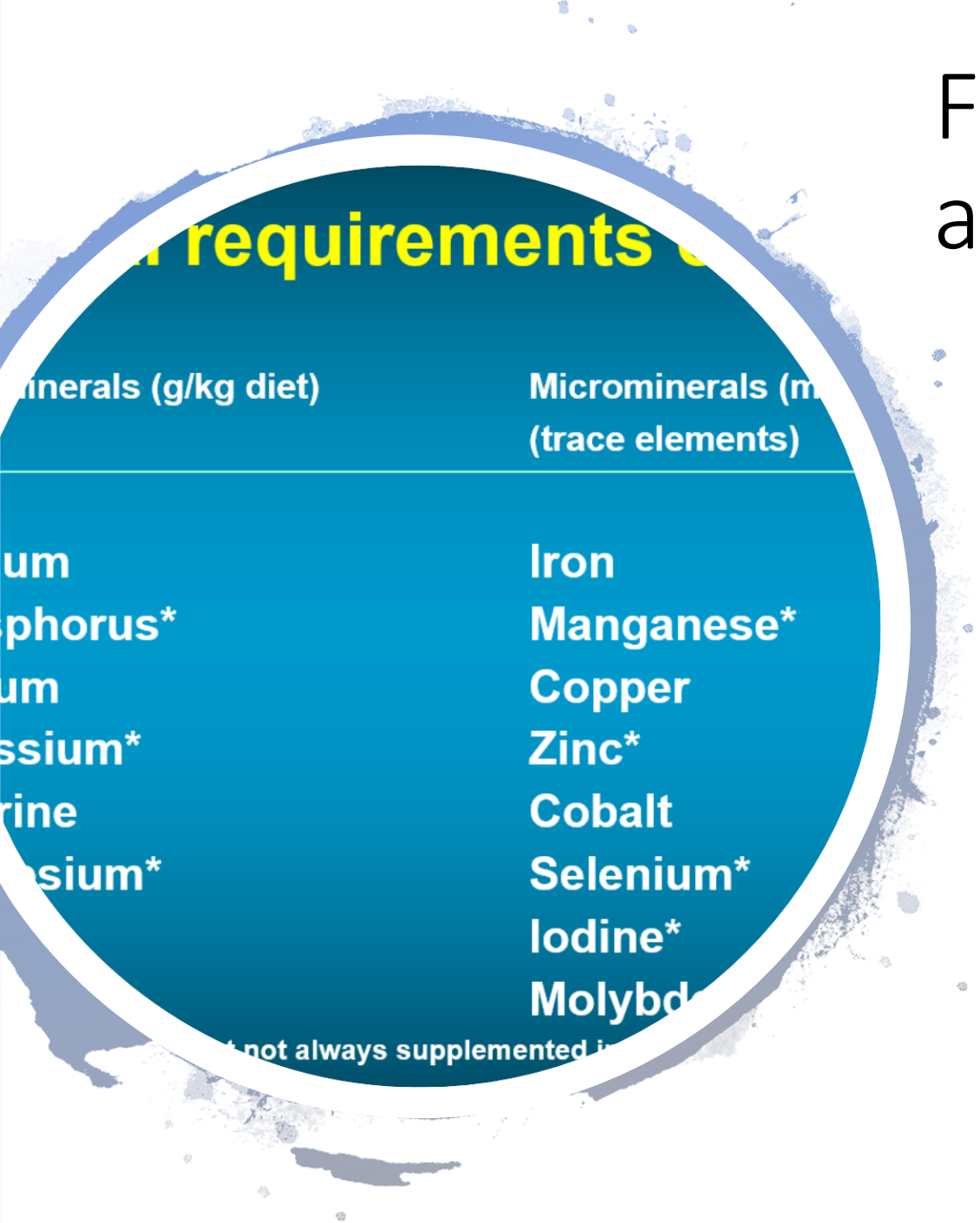



# FMFO potentially has a link with health

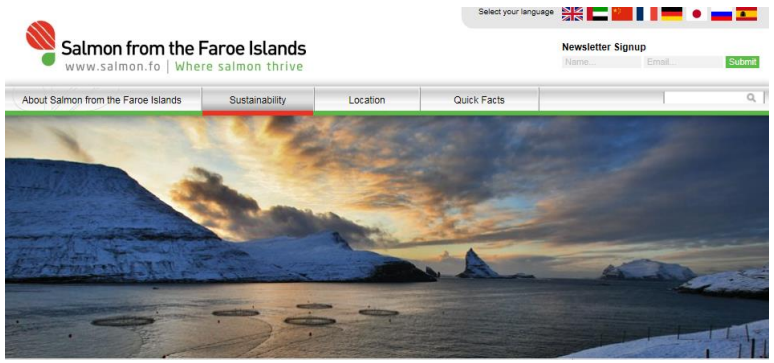
- **Some micronutrients linked to immune system function (e.g. Se)**
- **Known dietary requirement for some important micronutrients, e.g. n-3s**
- **Fish micronutrient requirements generally managed to avoid deficiency, rather than optimal health**
- **Some replacement ingredients are known to have deleterious effects (e.g. ANFs in vegetable proteins)**
- **Some impacts on gut microbiome & possible link with immunocompetence**
- **For carnivorous fish, FMFO approaches diet of wild species (evolutionary basis for the physiology)**

# Further possible links with health

- **Feed research controlled environments – relevance to the field?**
- **Laboratory studies may miss subtle cues, and/or impacts in farming conditions**
- **Feed companies formulate diets on “least-cost” formulations, so compromise is inevitable**
- **Species requirements known to change with life history stage (also other factors?)**
- **Sub-lethal effects may not be obvious but significant (e.g. impacts on immune system functionality)**
- **Fatty acids best studied: “*Role of EFA in immune system function is pivotal” and “affects the balance between immunosuppression and immunostimulation*” (Tocher and Glencross, 2015);**
- **Overall it’s complex - more data needed.**

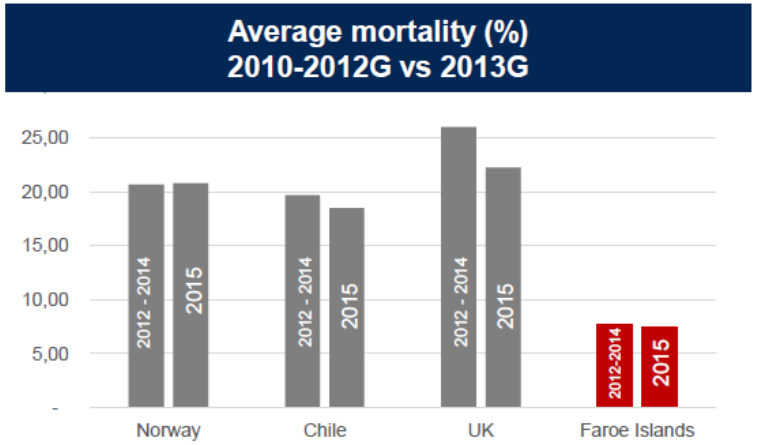
# Case study – Faroe Islands

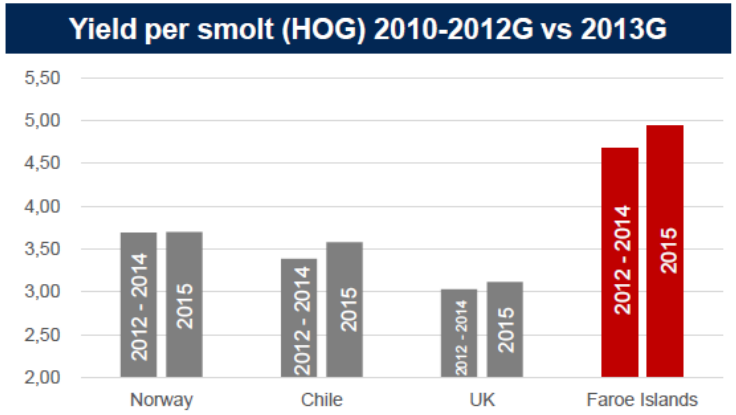
- **Comparatively high marine ingredient inclusions in salmon feed**
- **Industry reports low FCR, good survival, growth rates**
- **Anecdote – not science (and farming systems/pathogen challenge/environment differ), but suggests strong link between these factors and higher levels of FMFO**

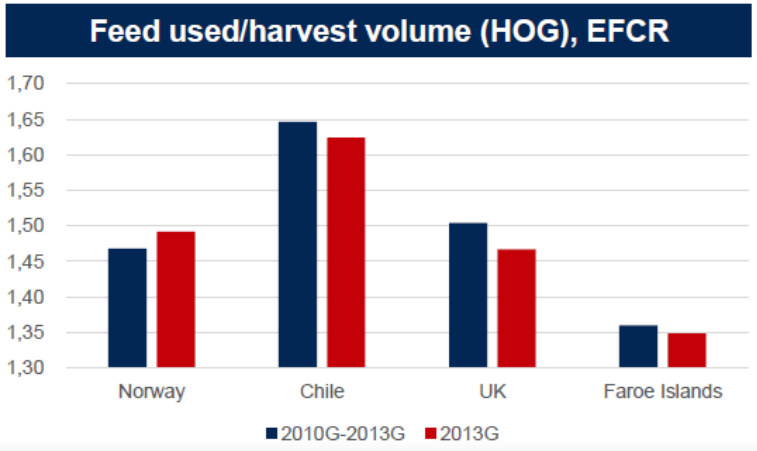


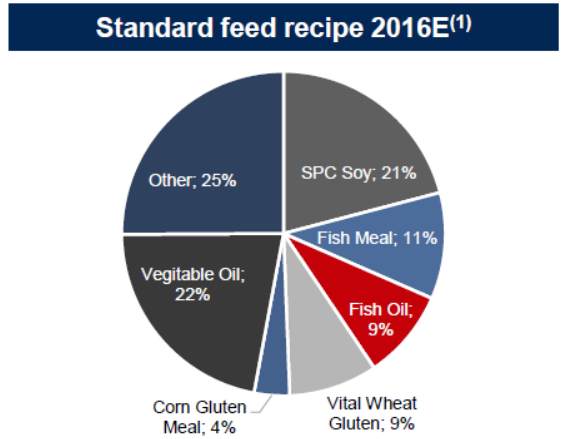

**Bakkafrost data:**

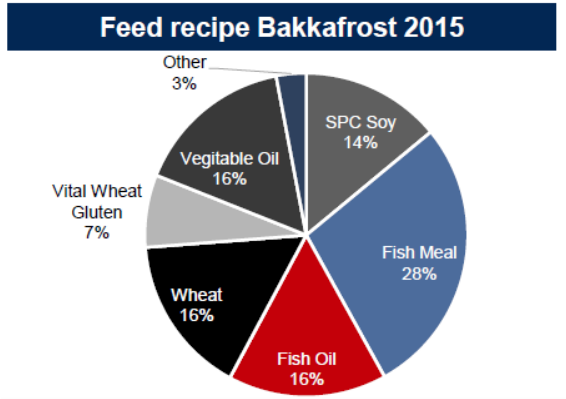
https://dsrqhvon5mja8.cloudfront.net/media/1542/bakkafrost-presentation-cmd-7-june-2016.pdf

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# Ingredients already used in Aquafeed


**Source: Glencross, B., IFFO Annual Conference Presentation, Rome 2018**

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# 2019: A rise in novel alternatives

Source: [https://www.seawestnews.com/black-soldier-fly-new-mission-salmon-farms/](https://www.seawestnews.com/black-soldier-fly-new-mission-salmon-farms/)

**Guar**

Guar bean cluster

**Scientific classification**

| | |
|---|---|
| Kingdom: | Plantae |
| *Clade*: | Angiosperms |
| *Clade*: | Eudicots |
| *Clade*: | Rosids |
| Order: | Fabales |
| Family: | Fabaceae |
| Genus: | *Cyamopsis* |
| Species: | ***C. tetragonoloba*** |

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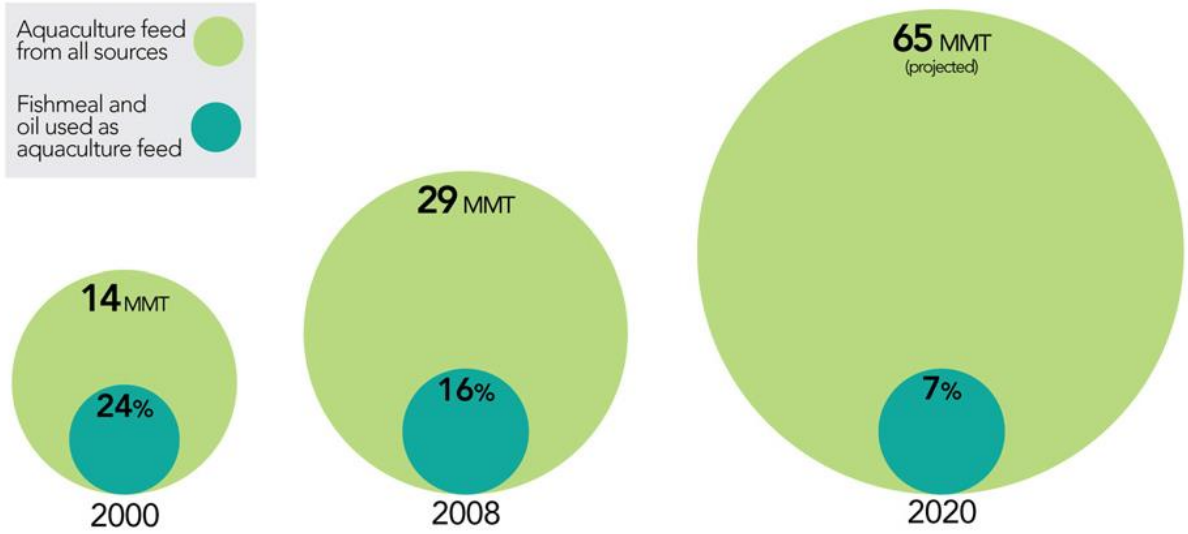
# The Future

- **Source: Fry, J.P. et al., 2016. Environmental health impacts of feeding crops to farmed fish. *Environment International*, 91, pp.201–214. Available at: http://dx.doi.org/10.1016/j.envint.2016.02.022**

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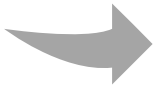
# Summary

**More volume of feed is required**



**Feed ingredient supply changing relative to total volume needs**

**Feed formulations will change relative to ingredient accessibility**

**Nutrition based on least-cost formulation approach: health?**

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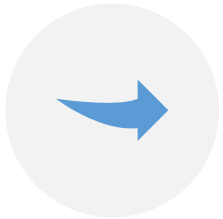

**Certification is important (for all ingredients)**

**FM & FO remain essential, as a practical means of supplying nutrition**

**Any impacts of changing ingredient profiles need to be managed (& based on science)**

**More studies needed (some information will be public; some commercial)**

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# Questions?


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