FOODS OF NORWAY

The BIOFEED project

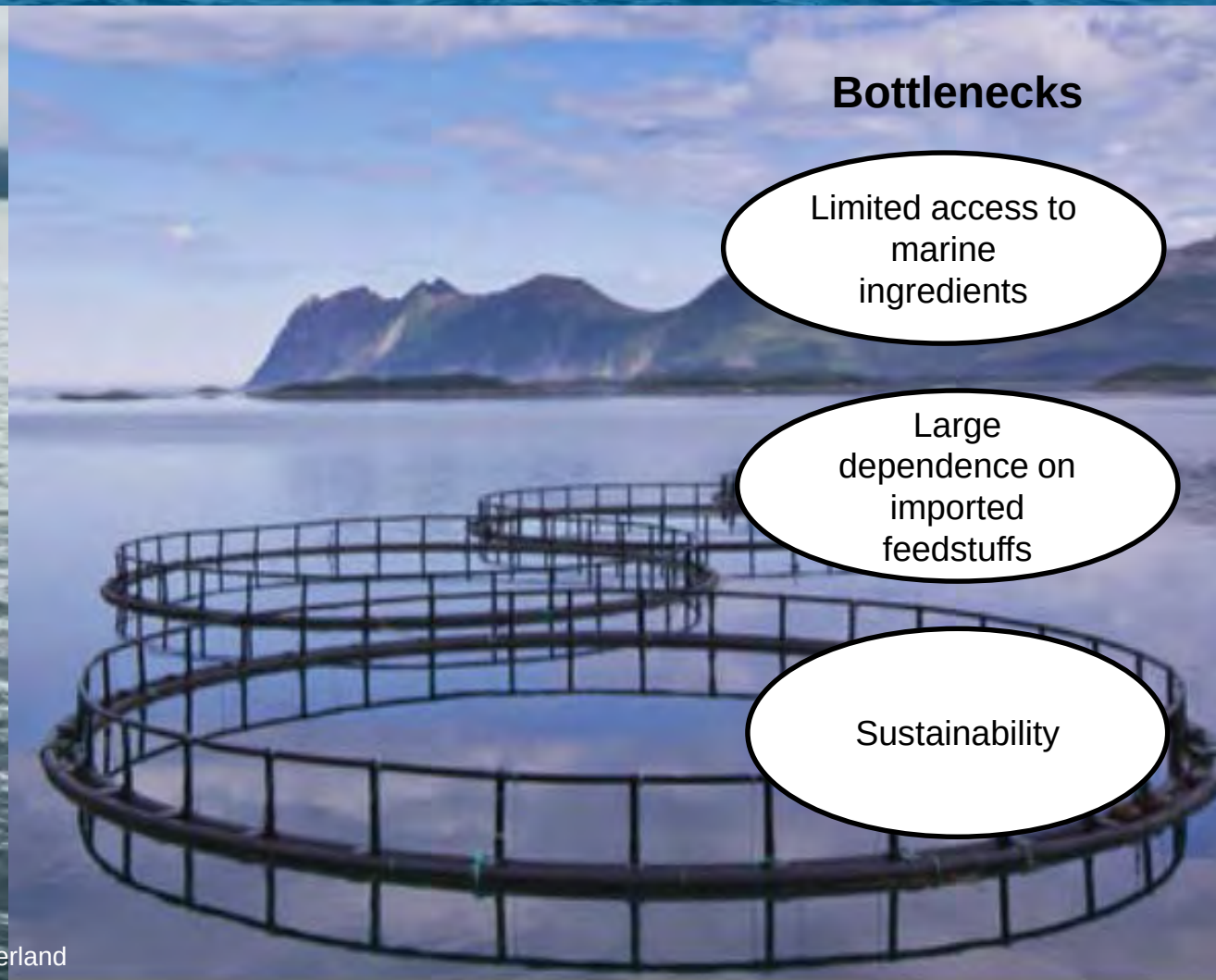
Sustainable feed resources from land and ocean

SIG Seaweed workshop IV April 4, 2017

Senter for forskningsdrevet innovasjon

Norges forskningsråd

Aquaculture is expanding to meet world's fish demand



Bottlenecks

- Limited access to marine ingredients
- Large dependence on imported feedstuffs
- Sustainability

hotos: Directory of fisheries, Shutterstock, M. Øverland

Food security

- Challenges:
  - Climatic changes,
  - Limited agricultural land,
  - Over reliance of imported feed resources

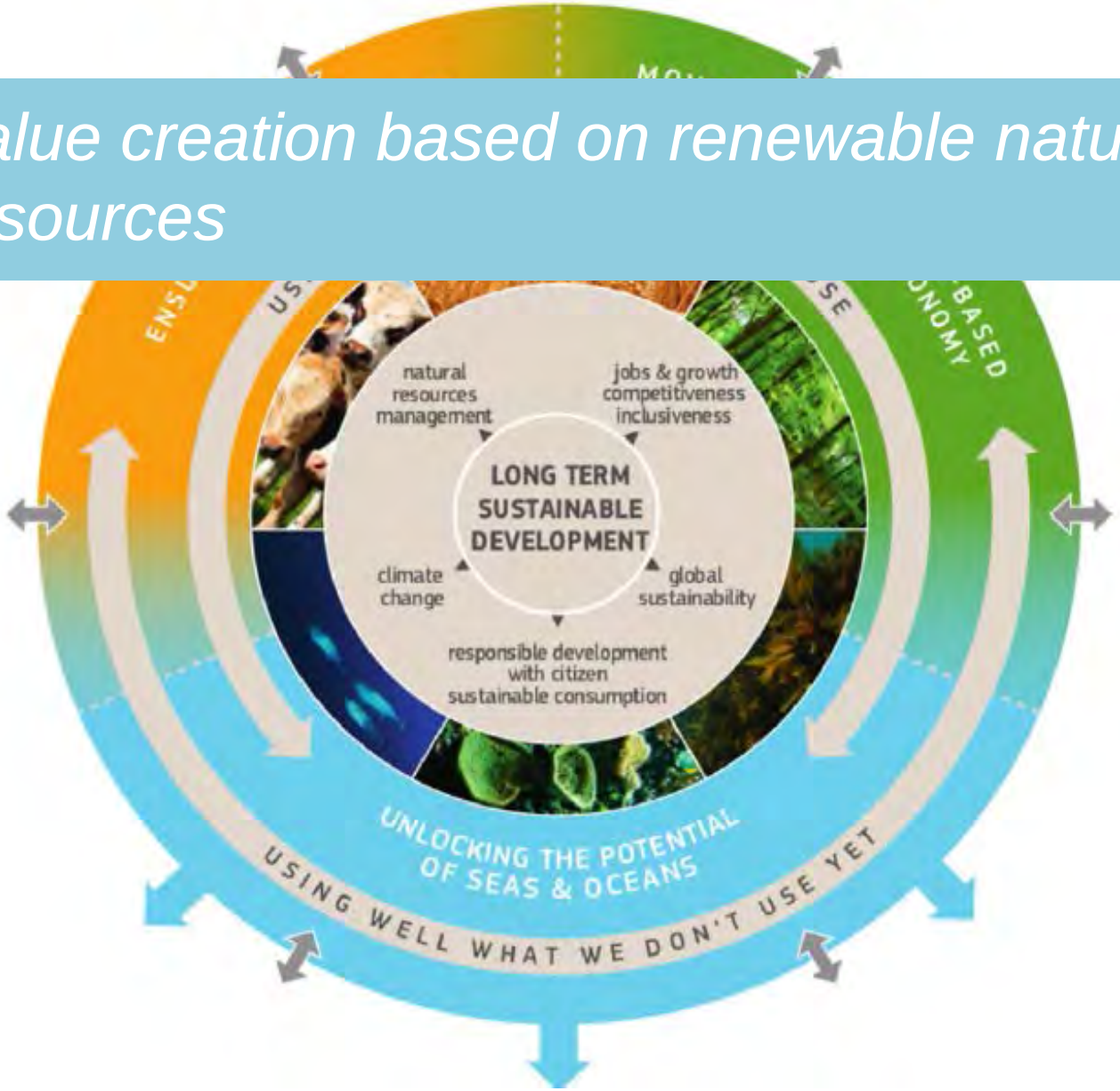


Foto: NMBU; Spire, Shutterstock

Feed from ocean and land

The Bioeconomy

Value creation based on renewable natural resources



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Senter for forskningsdrevet innovasjon
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Foods of Norway aims to feed fish and farm animals using amazing new ingredients

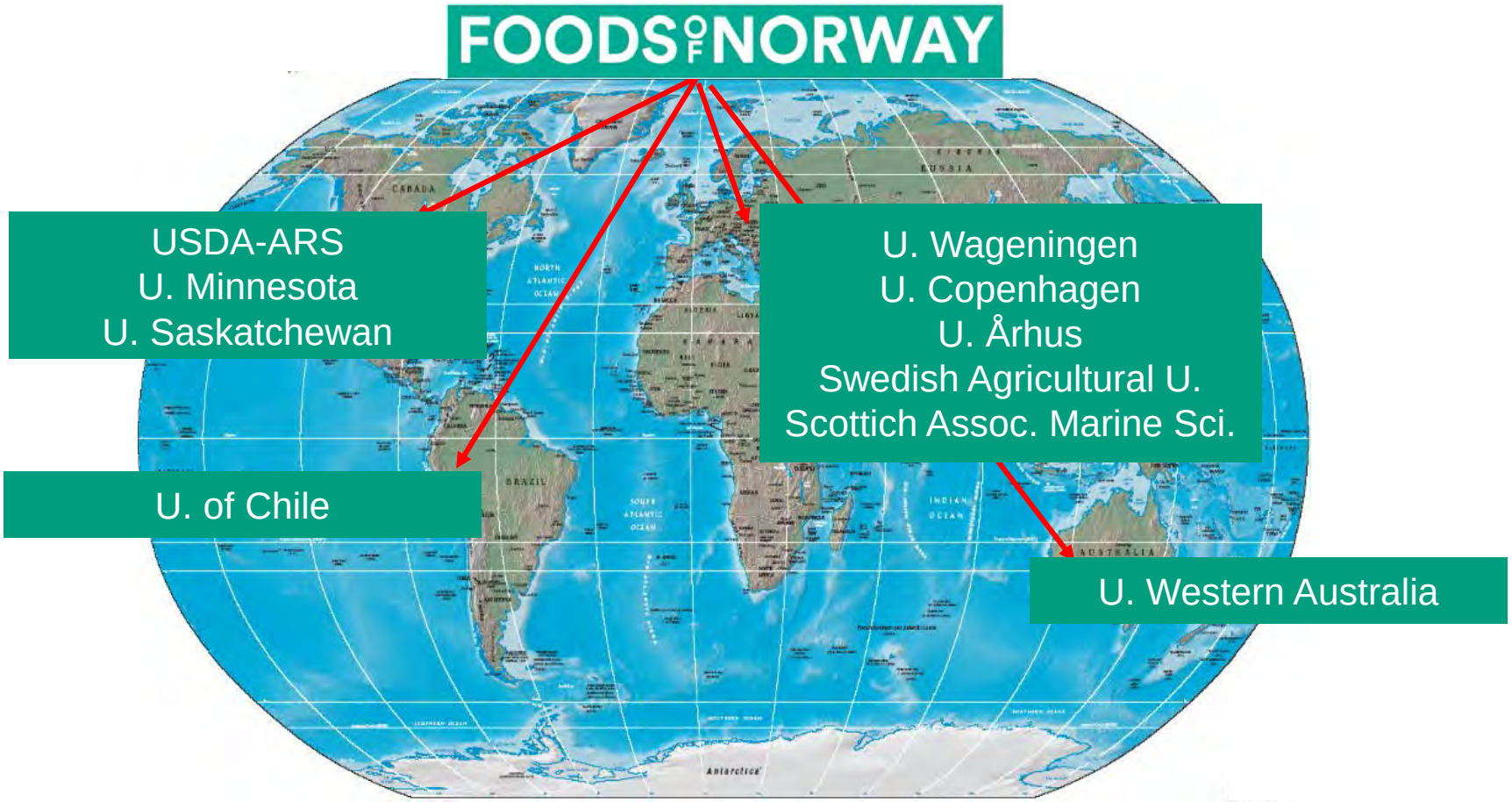
Three faculties at NMBU:

- **Biosciences**
  - **Dept. of Animal and Aquacultural Sciences**
- **Chemistry, Biotechnology and Food Science**
- **Veterinary Medicine**

The industrial and innovation partners

International collaboration

Ongoing activities with universities and research institutes



Trees – as a feed resource

Norwegian forest is our largest bioresource

- ✓ ~ 43% of Norwegian land area
- ✓ Standing biomass: ~ 912 mill. m^3

Photo: Skog 22

Process: Feed from tree biomass

Tree biomass

Seaweed **Animal co-products**

1. Tree biomass
2. Mechanical pre-treatment
3. Enzymatic hydrolysis
4. Sugar
5. Fermentation with yeast

30 L fermentor at NMBU

Yeast from trees: A high-quality feed resource

Review

SCI

Received: 21 June 2016 Revised: 19 August 2016 Accepted article published: 25 August 2016 Published online in Wiley Online Library:

(wileyonlinelibrary.com) DOI 10.1002/jsfa.8007

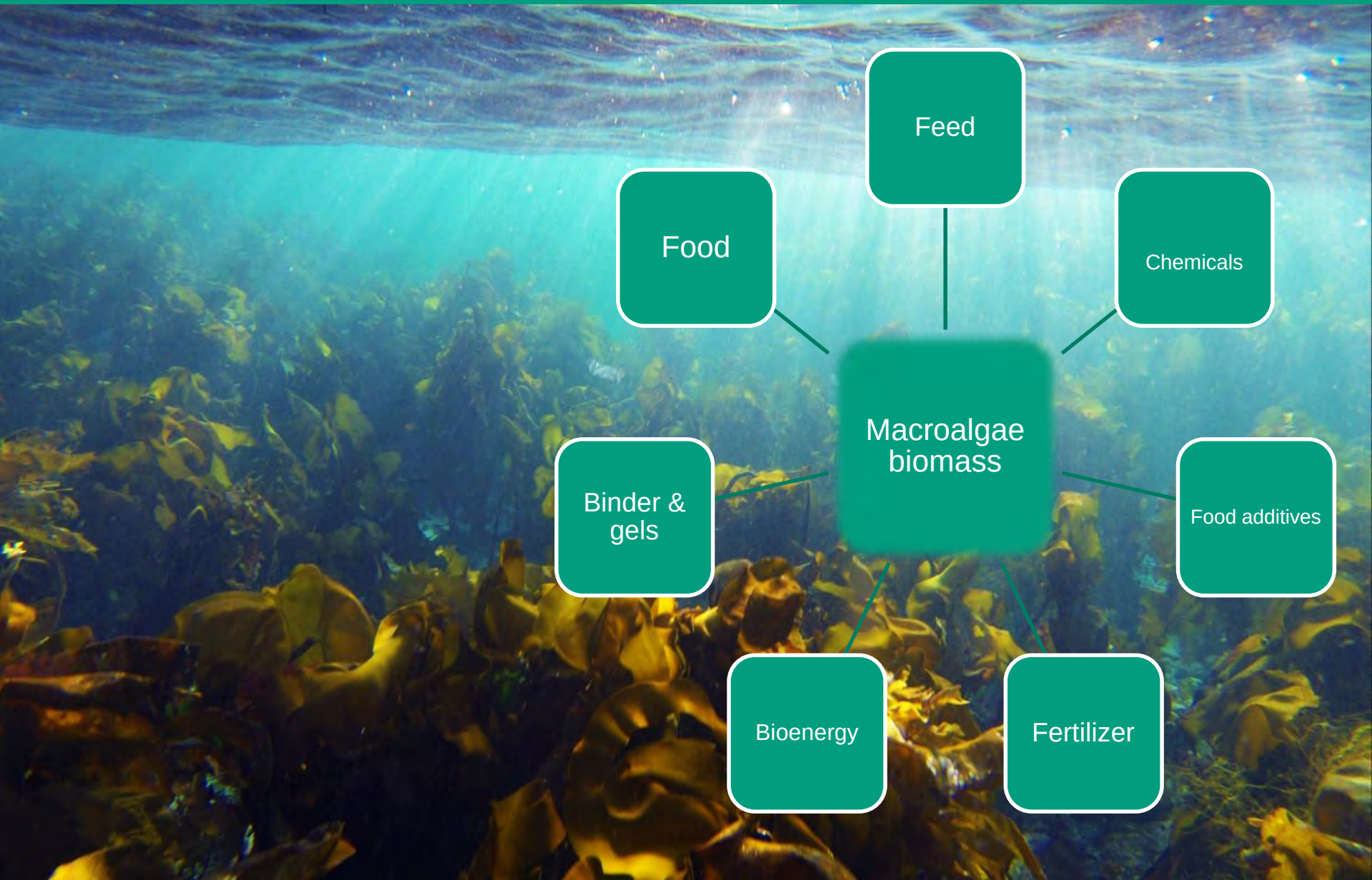
Yeast derived from lignocellulosic biomass as a sustainable feed resource for use in aquaculture

Margareth Øverland* **and Anders Skrede**

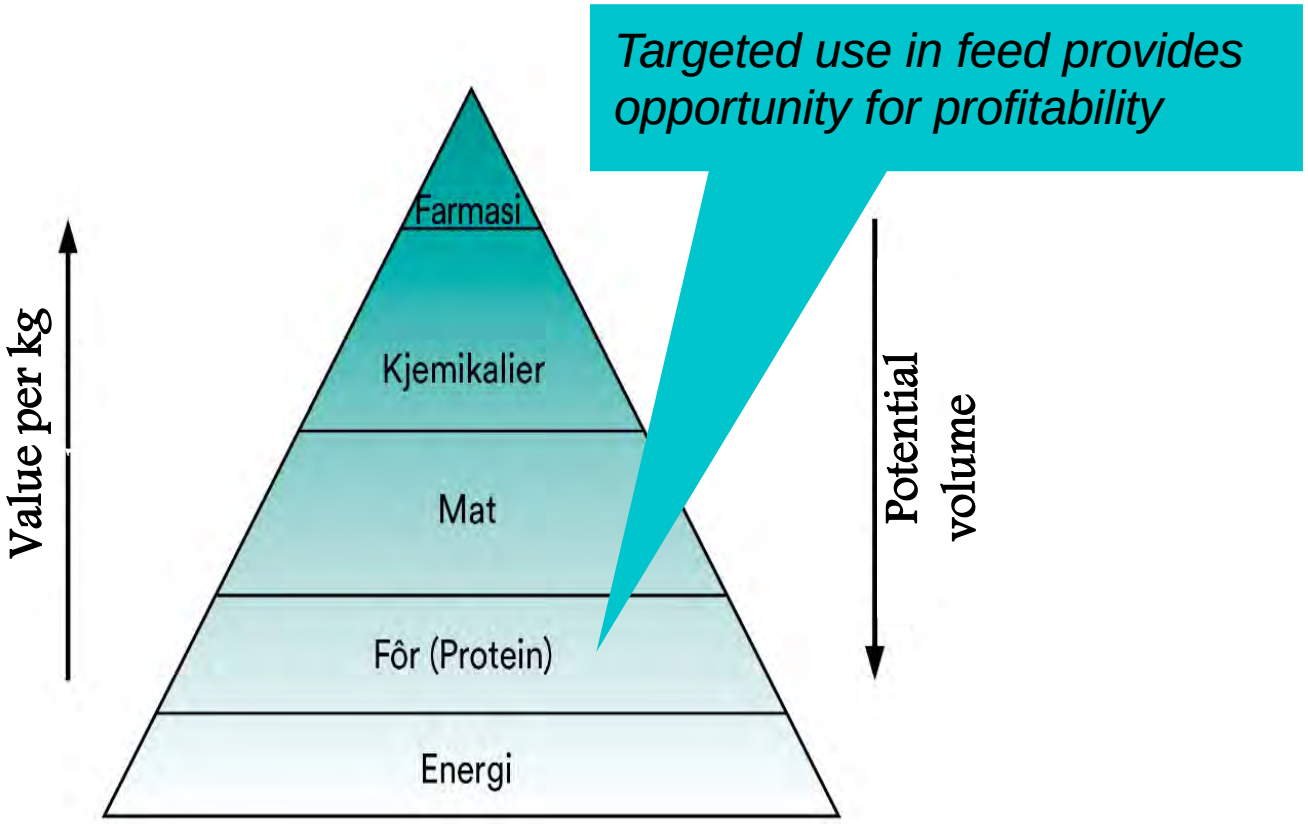
Marine macroalgae as a feed resource

- Seaweed as a protein source:
  - Large biomass production,
  - Don’t require any agricultural land, fertilizers, or fresh water
  - Can be cultivated in sea water

Seaweeds – as a feed resource



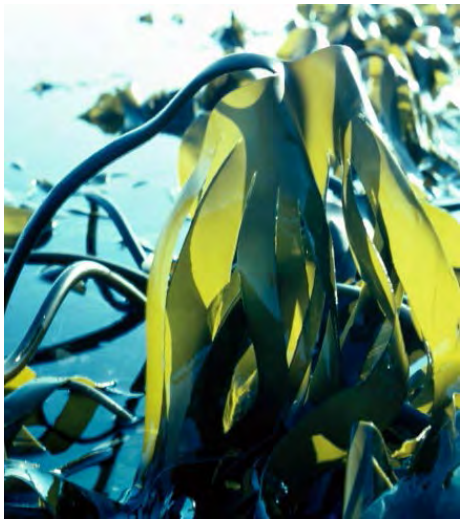
Value creation and volume potential of different macroalgae applications



Source: Norge i den nye bioøkonomien,, Øverland, Mydland og Skrede, 2014;

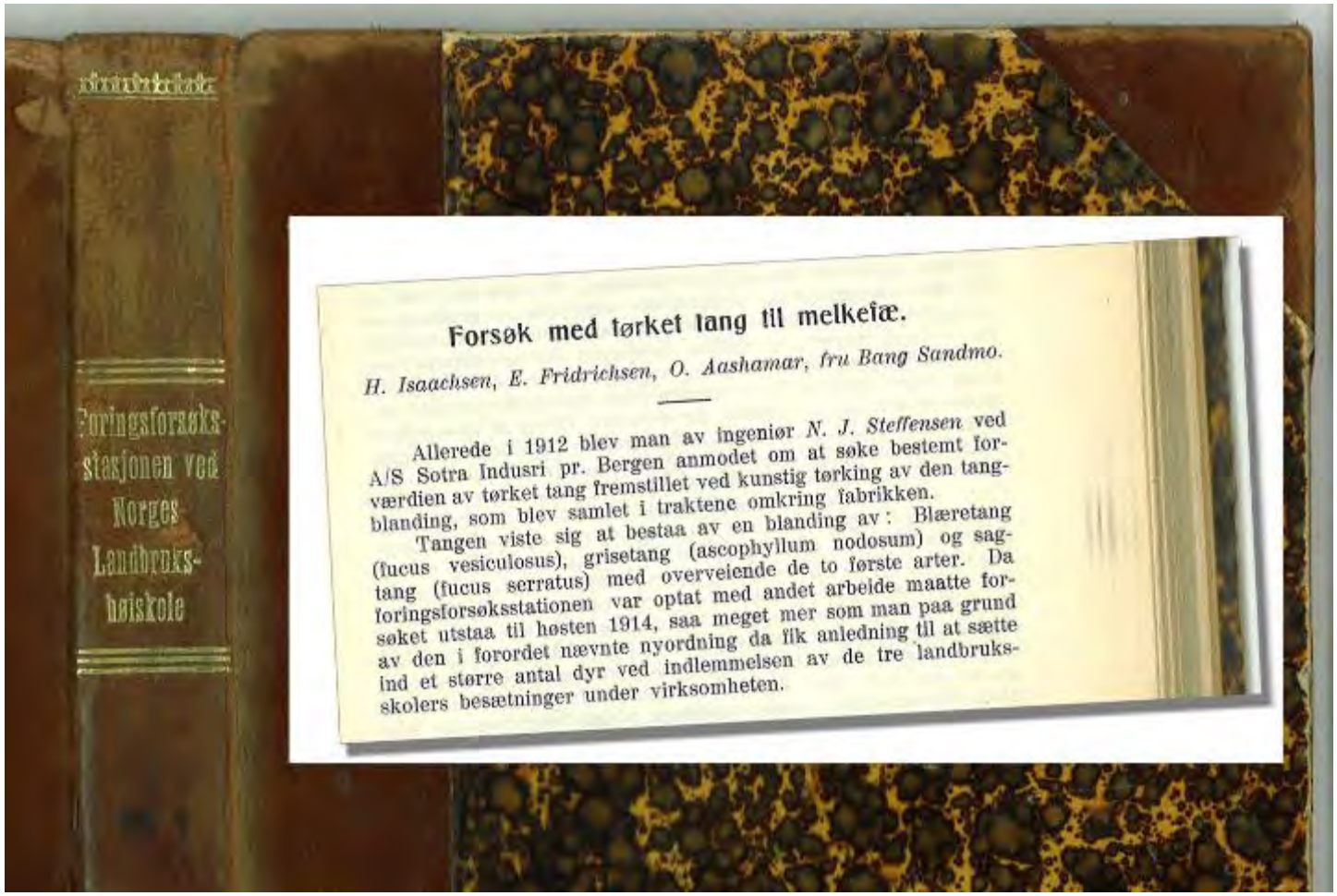
Historical perspective - Seaweed as a feed resource

Ancient Greeks	Seaweeds were used as feed resource during feed scarcity
Europe/Norway	Local farmers used kelp to keep their animal alive during the winter
Proximate analyses & scientific studies	More scientific approach was used to access the nutritional value
Premix	Use of dried kelp meal as a mineral & vitamin source
Health promoting effects	Kelp meal was used as a functional feed to promote health of farmed animals
Bioactive compounds	Documented positive effect of specific bioactive compounds in feeds for different species
Feed application	Nutritional added-value products through biorefinery processing



Source: Shutterstock

Experiment with kelp for dairy cows at NMBU, 1912



Forsøk med tørket tang til melkekjæ.

H. Isaachsen, E. Fridrichsen, O. Aashamar, fru Bang Sandmo.

Allerede i 1912 blev man av ingeniør *N. J. Steffensen* ved A/S Sotra Indusri pr. Bergen anmodet om at søke bestemt forværdien av tørket tang fremstillet ved kunstig tørking av den tangblanding, som blev samlet i traktene omkring fabrikken.

Tangen viste sig at bestaa av en blanding av: Blæretang (fucus vesiculosus), grisetang (ascophyllum nodosum) og sagtang (fucus serratus) med overveiende de to første arter. Da foringsforsøksstationen var optat med andet arbeide maatte forsøket utstaa til høsten 1914, saa meget mer som man paa grund av den i forordet nævnte nyordning da fik anledning til at sætte ind et større antal dyr ved indlemmelsen av de tre landbruksskolers besætninger under virksomheten.

Research needed

- Biochemical composition
  - Nutrients, antinutrients, contaminants
- Nutritional value and applications
  - Digestibility
  - Effect on feed intake, growth, and feed efficiency
  - Functional properties
  - Effect on product quality
  - Potential risks
  - Feed technolgy

Biorefining seaweeds

Bioreffenery provides optimal utilization of the biomass
This makes use of both sugars, nitrogen and other nutrients.

Brown algae

Fish feed

BIOFEED; Havbruk / BioTek 2021, 2014-2018

Conclusion

Biomass from sea and land:

High-quality feedstuffs by biotechnology

Foundation for sustainable production of high-quality food

Photo: Norsk sjømatsråd