



Seaweed Cultivation

Sector outline and present status in Europe

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SEAWEED
ENERGY
SOLUTIONS AS



Uses of Seaweed



Fertilizer, hydrocolloids /chemical, cosmetics

New (high-value) uses → significant R&D required: nutraceuticals, functional ingredients/additive, plant care, medical applications, bio-materials



SEAWEED for FOOD
B2B customers
"Sea vegetable"
companies across Europe (25 recent in Norway)

Food processors:
Bakery, Pasta, Soups, Ready-meals, Seafood products, Meat products, Snacks...

R&D and clarification required regarding regulations (I/As/Cd..)



Seaweed food products in Europe
European from niche to mainstream!

Asia vs. Europe: different worlds.

EUROPE: <0.1 % of global production

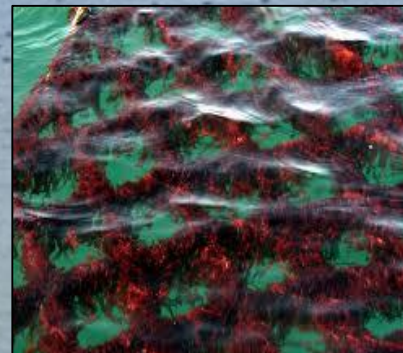
- Wild harvest 80 000 tons vs. Cultivation **200-300 tons**
- Cultivation is **very recent**; approx. 10y (but now 25 companies only in NO)
- **Land-based** (Ulva, Porphyra) vs. **offshore** cultivation (Kelps):
 - very different processes and challenges depending on species
 - non-linear learning effects in starting phase



Saccharina japonica
(5.2 million ton)



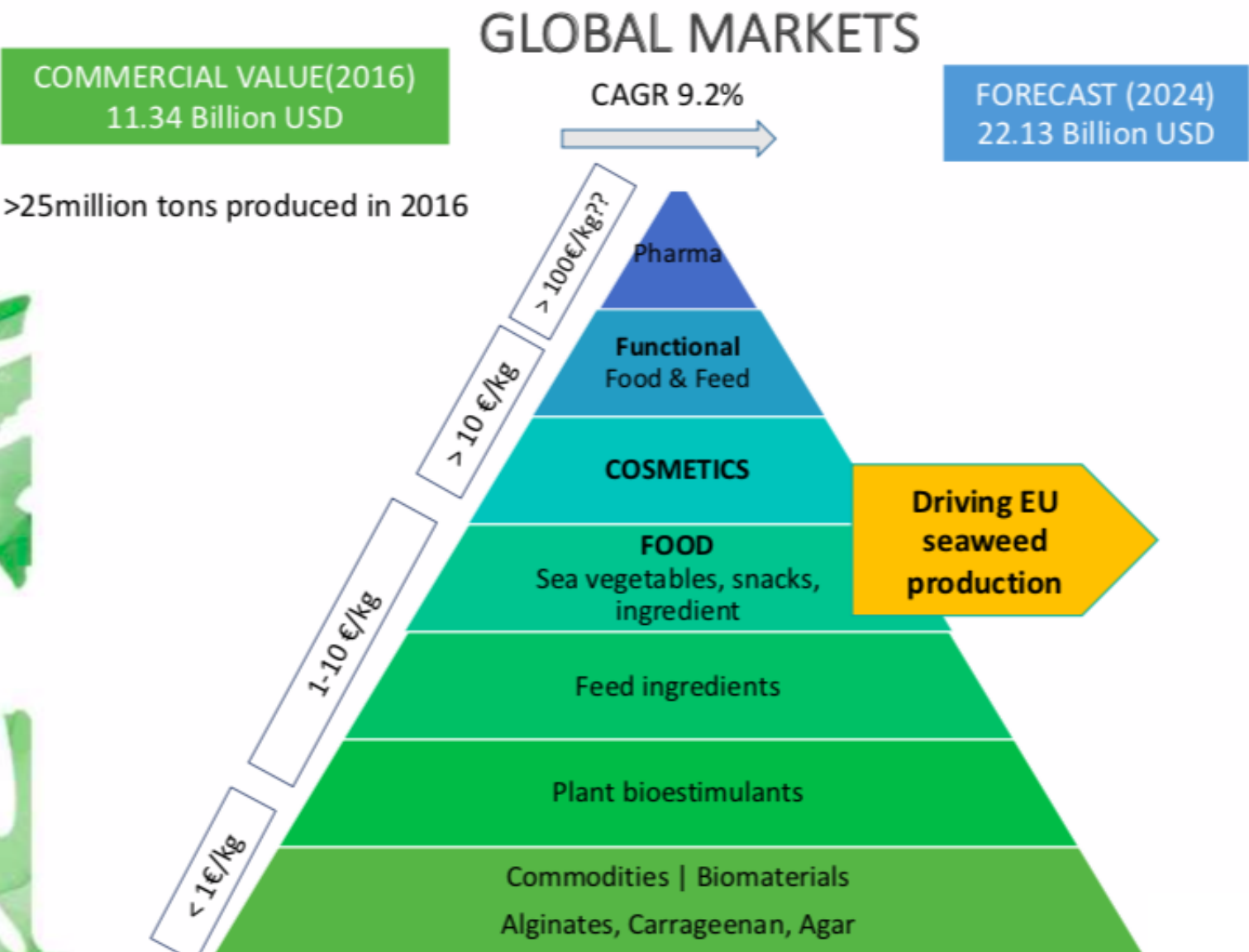
Undaria pinnatifida
(1.7 million ton)



Porphyra
(1.7 million ton)³

Sangou Bay, China

Up-scaling Challenges: 1 – THE MARKET



- SeaVegetables 25-60€/kg (dw) in the food market
- Production costs offshore in range of 25€/kg (dw) – without drying costs (double if freeze-drying)
- Food regulations can be obstacle (allowed species list, Iodine limitation, inorganic/organic Arsenic issue)
- Raw material prices still low due to wild harvest, imports and undefined short-term demand

Up-scaling Challenges: 1 – PRODUCTION TECHNIQUES

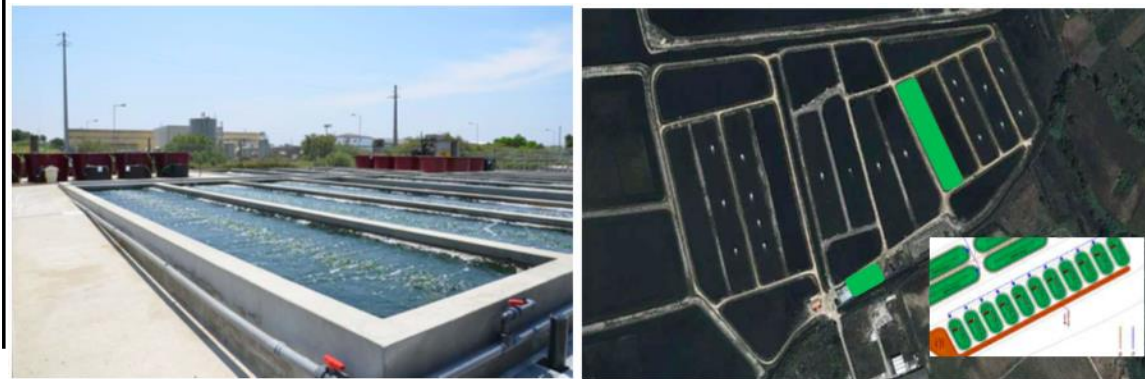
Farming the sea – the industrial way

- Infra-structure /ops costs even for small volumes
- **Mechanised deployment, harvest and transport** of material from farm to factory required (“harvest window”)
 - investment risks (break-even 500tons/y +)
- State of the art food **processing technologies**
- **Licensing issues and spatial conflicts**; preferred sites scarce → **exposed offshore** brings new challenges



Land-based Farming

- Species with demand in high market values – need to satisfy market
- Land-based production system – energy and land use
- High investment costs into pond/raceway systems and harvesting
- Large-scale proof of system planned within GENIALG EU project
- Limited availability of sites



Addressing Food Industry's Issues

Global health issues

Natural salt replacer

Salty taste with 70 % less sodium
The industry is looking for solutions!

Natural iodine source

50 % of newborns in Europe are deficient
85 % of vegans are deficient

1 g/day seaweed salt replacer per pers. in Europe = 2.5 million ton seaweed OR 11 billion EUR



Food safety/ security

Certified and traceable (local European «safe and clean»)

Tasty & food grade
Frozen and freeze dried (nutrients preserved)
Concerns towards Asia imports (certification/traceability, polluted waters, processing standards, etc.)



Major food trend

Umami taste natural flavour enhancer

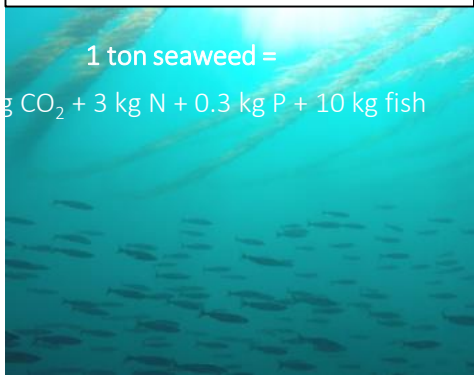
Naturally rich in umami
«MSG free» labelling



Sustainability

No feed, fertilizer, freshwater or land area

Takes up CO2 and nutrients; Creates more fish in the ocean



1 ton seaweed =
g CO₂ + 3 kg N + 0.3 kg P + 10 kg fish

More than just “Sustainable” !

“The most powerful act to improve the health of this planet is to plant the sea..”



Mitigate climate change *More fish in the ocean*

1 ton seaweed = 120 kg CO₂ + 2 kg N + 0.2 kg P + 10 kg fish

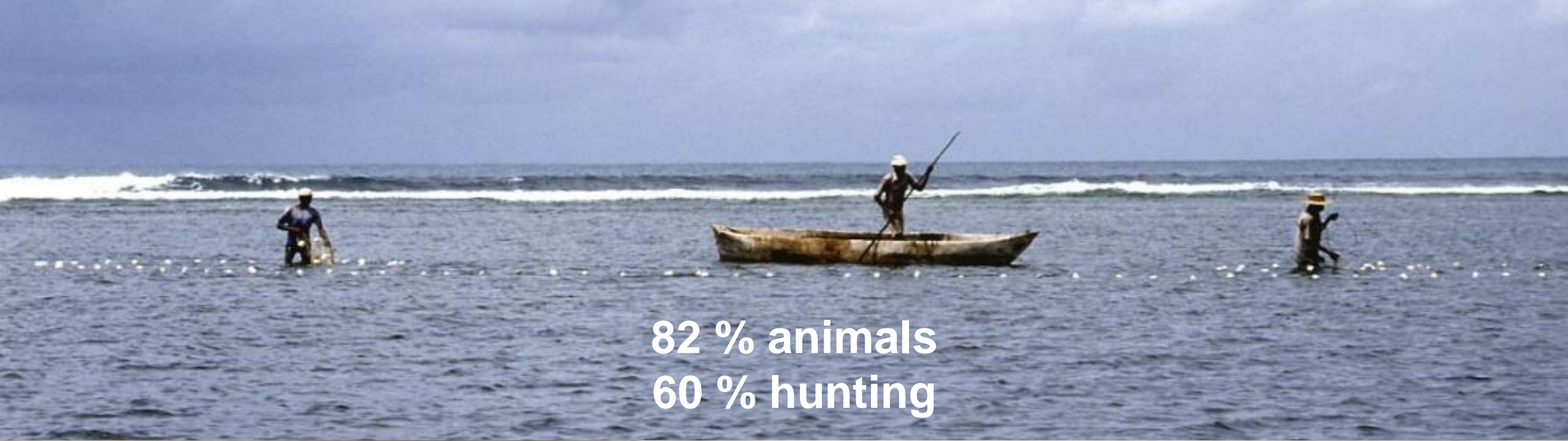
Improve water quality

www.seaforester.org



CONCLUSIONS

- Seaweed is the «material of the hour» - EU food market from niche to mainstream
- Europe is far behind with respect to production, processing and consumption culture
- Significant R&D needs in:
 - detection of functional compounds (medicine, cosmetics, etc)
 - efficient and gentle extraction methods (incl. Biorefinery)
- Significant development needs:
 - sea work optimisation (vessels and handling equipment; transport units,...)
 - pond equipment and up-scaling challenges (including quality control)
 - bio-refinery and cost-efficient processing methods
- Not only sustainable but likely to be very beneficial to environment / Ocean Health



**82 % animals
60 % hunting**



**97 % plants
>99 % farmed**

Thank you.