

**ORGANIC
PLUS**

Pathways to phase- out contentious inputs from organic agriculture in Europe

International course in contentious inputs in organic agriculture
2nd-30th June 2022

Marine-derived fertilisers; a new fertiliser product

Anne-Kristin Løes, Norwegian Centre for Organic Agriculture (NORSØK)



PATT_2022
Organic-PLUS has received funding from
the European Union's Horizon 2020
research and innovation programme
under grant agreement No 774340





Møre og Romsdal
county municipality

RESTOR

Marine-derived fertilisers; a new fertiliser product

International course

June 9, 2022 (recorded 4.4.22)

Anne-Kristin Løes, NORSØK

Norway has a long coastline

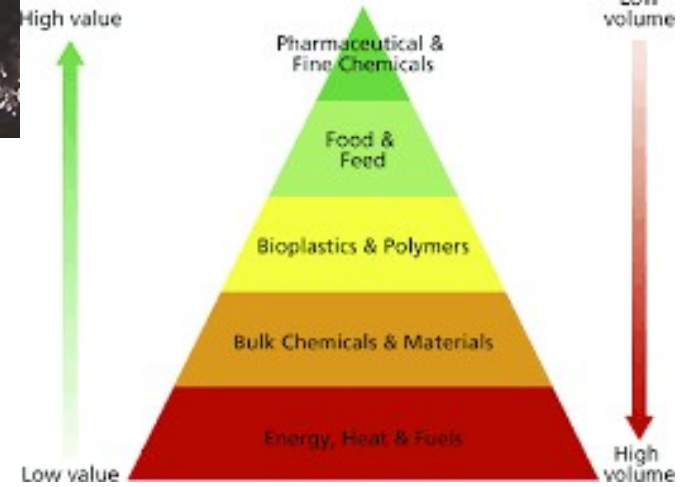


Fish capture: 2.5 mill tons live weight/year (white fish, herring ++)
Aquaculture: 1.5 mill tons/year (mainly salmon)





Significant volumes of organic material are poorly utilised

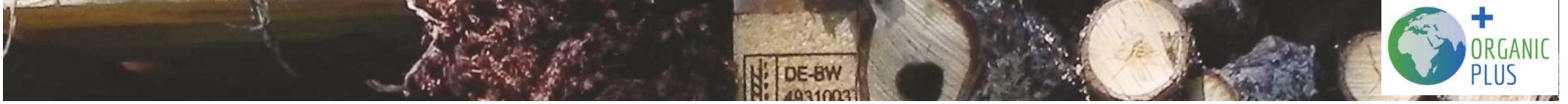


.... product development aims at pharmacy, food and pet food... fertilisers are cheap

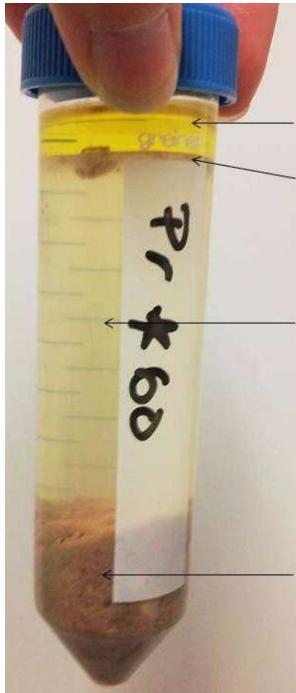
Residual materials from processing of food etc; or processing of left-over fresh materials

- NORSØK har worked with FISHBONES (fish residues with large proportion of bone), and ALGAE FIBRE (after extraction of wild seaweed to produce fertiliser)
- These materials are currently not applied for commercial products and are commonly wasted
- Norway used to have «guano»-factories around 1900





Sediments from grinded fish residues conserved by formic acid ($\text{pH} < 4$) (or drying)



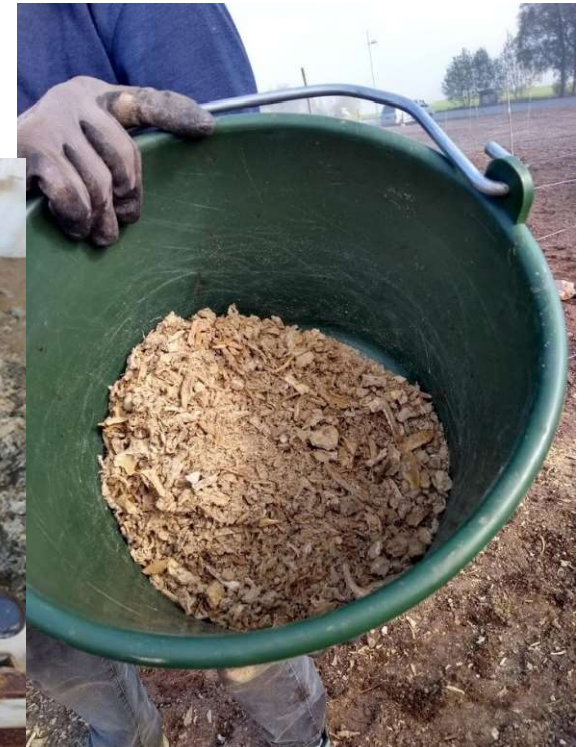
Lab scale



Industry scale tank for hydrolysis



Sediments in container (1m^3), ca. 50% DM



Air-dried and sieved sediments for field application

A rich source of P, Ca, N – but little K, Mg, S



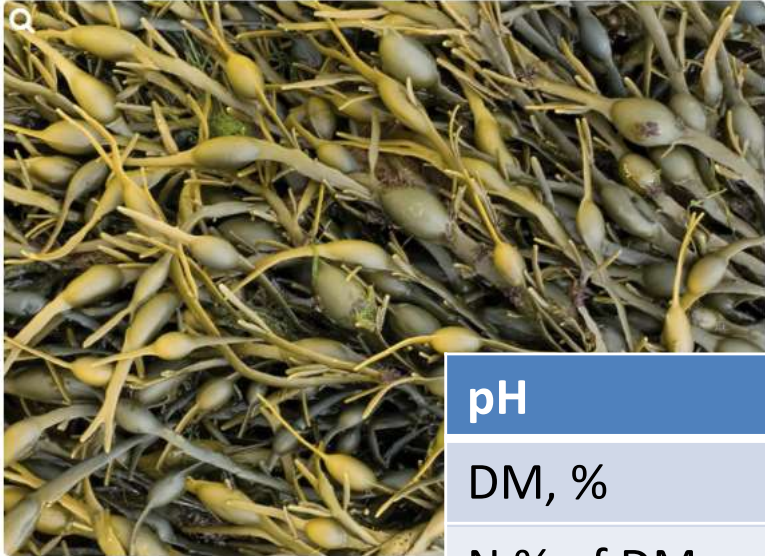
pH	4.9
DM, %	80
N % of DM	4.1
P % of DM	9.3
Ca % of DM	16
K % of DM	0.1
Mg % of DM	0.08
S % of DM	0.2

100 kg would contain

- 3.3 kg N
- 7.4 kg P
- 12.8 kg Ca
- 0.08 kg K



Rockweed contains significant K, S, Mg



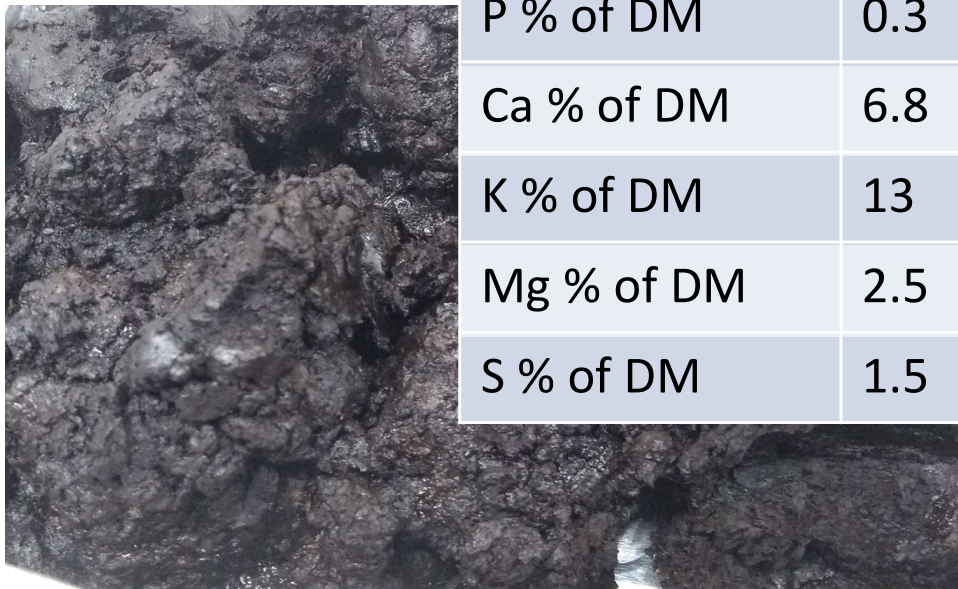
pH	9.6
DM, %	30
N % of DM	1.5
P % of DM	0.3
Ca % of DM	6.8
K % of DM	13
Mg % of DM	2.5
S % of DM	1.5



Product for sale:
AlgaFert Base, pH 5



From the plant:
About 15 tons/week
of algae fibre,
currently
incinerated



Liquid fertilisers are permitted but
not fibre residues due to extraction
with HNO_3



Field experiment with ryegrass 2020 (4 cuts)

Fresh, ground fishbones (F)



Cultivator used to incorporate fertilisers in soil



Dried fishbones (FB) conserved by formic acid



Clumps of algae fibre (AF) made smaller



Control: Enriched poultry manure, well balanced fertiliser («Green Organic», GO)

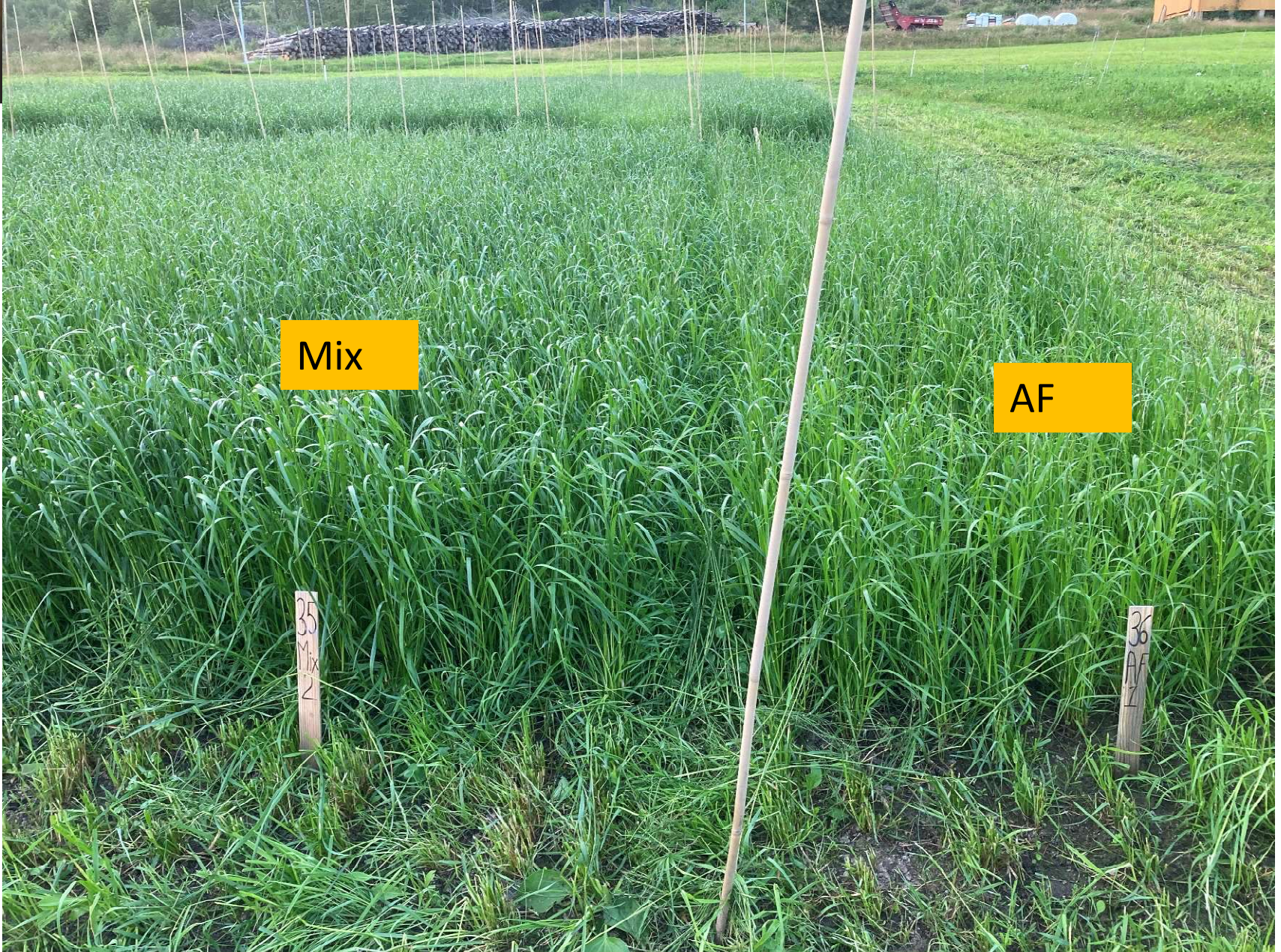


Mix 2	Mix	F	K0	GO 2	FB	GO	FB 2	AF
Mix	F	Mix 2	FB	GO 2	FB 2	GO	AF	K0
AF	FB 2	Mix	FB	GO 2	F	Mix 2	K0	GO
GO	K0	F	GO 2	FB	FB 2	Mix	Mix 2	AF

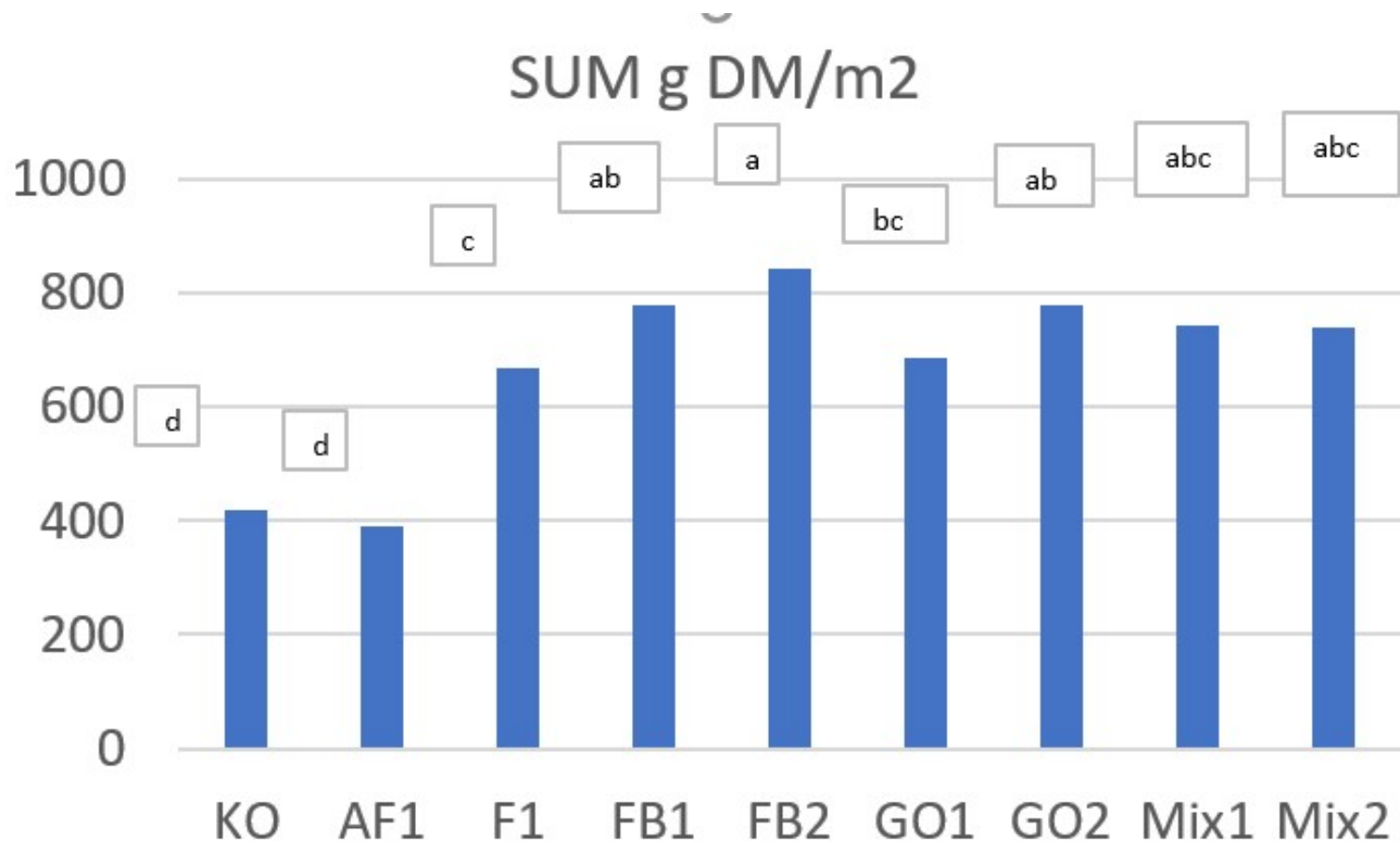


- 9 treatments, 4 replicates
- Control, 5 types of fertiliser, 2 N levels
- 300 or 600 kg N/ha in acid-conserved fish bones (FB), Mix (algae fibre + FB), poultry manure Green Organic (GO)
- Algae fibre (AF) and fresh ground fishbones (F) only 300 kg N/ha

Ryegrass
experiment
3rd cut,
August 13,
2020



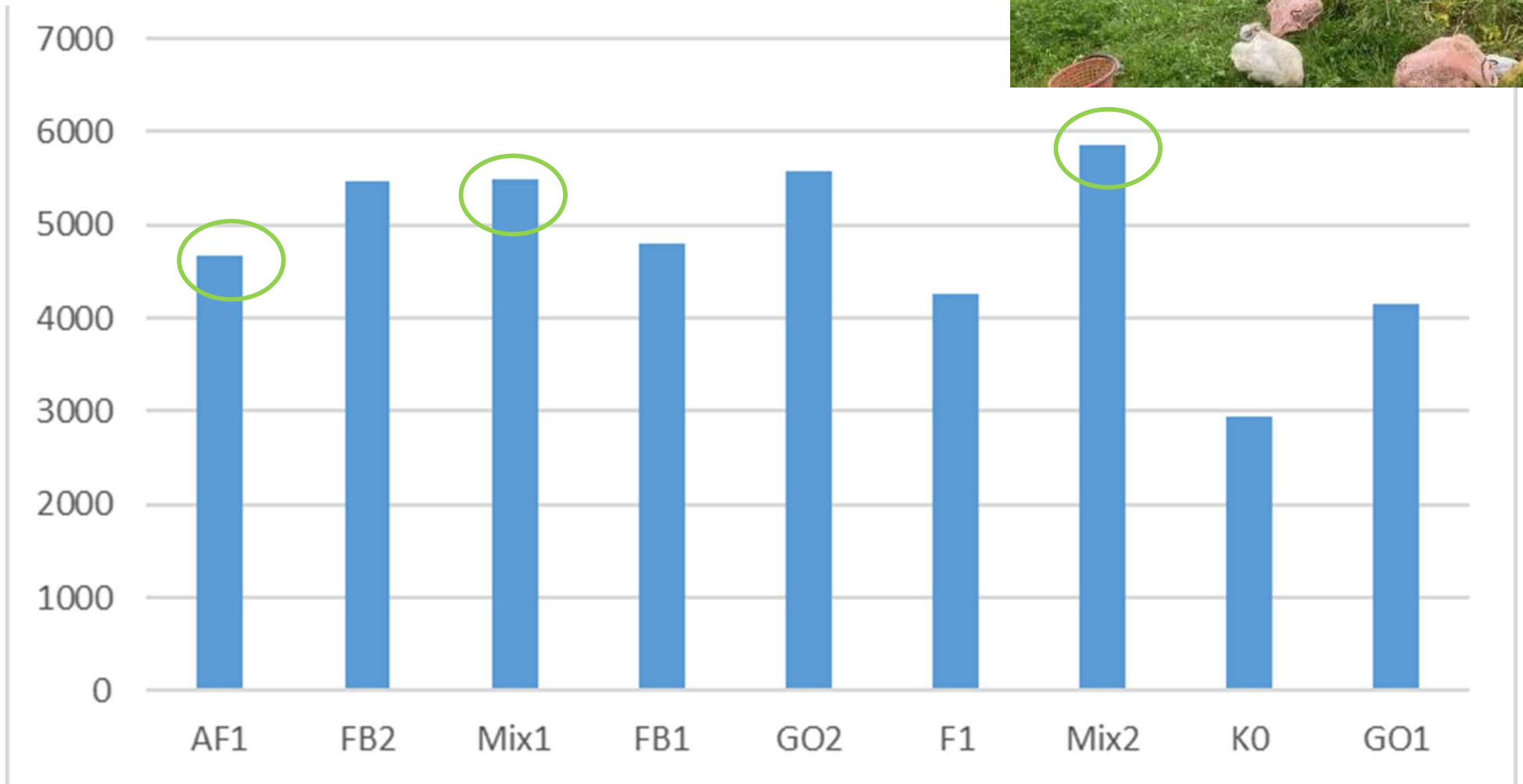
Ryegrass experiment, sum of 4 cuts 2020, about 8 t DM/ha



- K0= no fertiliser
- AF= 300 kg N/ha in algae fibre
- F1= 300 kg N/ha in fresh ground fish bones
- FB1, 2 = 300 and 600 kg N/ha in acid-conserved fish bones
- GO1, 2 = 300 and 600 kg N/ha in poultry manure
- Mix 1, 2 = 300 and 600 kg N/ha in AF+ FB where 30% N is from AF and 70% from FB



Potato tuber yields, 2021 (kg/0.1 ha)



Very rapid growth effect of fishbones, example from another field study established in 2019



Treatment	Kg N/ha (aim)	Yield, tonnes of DM/ha	Relative yield
Control (K0)	0	2.7	100
Seaweed fiber (AF)	160	2.5	91
Poultry manure (GO)	160	3.8	138
Mix AF + FB	160	4.4	160
Fishbones, acidified (FB)	160	4.8	174



Oats for green fodder, harvest July 31, 2019
Cover crop for grass-clover ley 2020-

AF	Mix	FB	GO	K0
GO	K0	AF	Mix	FB
AF	FB	K0	Mix	GO
K0	AF	FB	GO	Mix

Field plan (4 reps)



Positive control, GO:
Dried poultry manure with vinasse and MBM



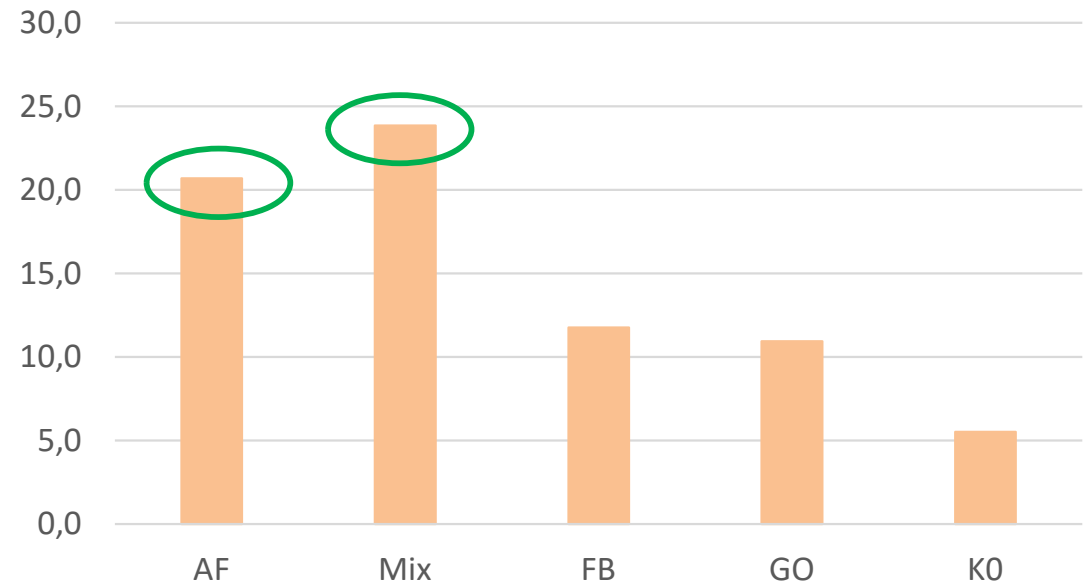
Very high residual effect of seaweed fibre in 2nd year ley 2021



AF	Mix	FB	GO	K0
GO	K0	AF	Mix	FB
AF	FB	K0	Mix	GO
K0	AF	FB	GO	Mix

Field plan

Sum yield, tonnes of DM/ha, 2021



Application of seaweed fibre in field, 16 May 2019

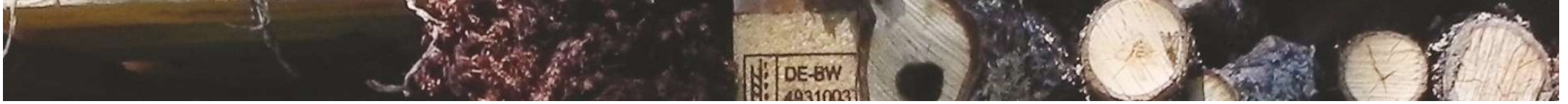
Dry matter yields of 2. year ley in 2021
Fertilisers applied in 2019 (160 kg N/ha)

Challenges – chemical composition:

Potentially toxic elements

Potentially toxic element, mg/kg TS	Algae fibre	Acid-conserved fish bones	Grinded fresh fish bones	Limit in EU regulation Annex 1	Poultry manure «Green Organic»
As	33	1.3	6.9	No limit in Ann. 1 General EUreg 40?	0.15
Cd	0.9	<0.10	0.02	0.7	<0.1
Cr	3.8	<0.3	0.68	70	4
Cu	9.4	7.3	1.8	70	23
Hg	0.08	0.09	<0.7	0.4	0.01
Ni	<1.5	<1.5	2.1	25	1.6
Pb	<0.3	<0.3	0.34	45	0.71
Zn	94	100	67	200	170





Challenges – chemical composition: Mineral balance- feed quality

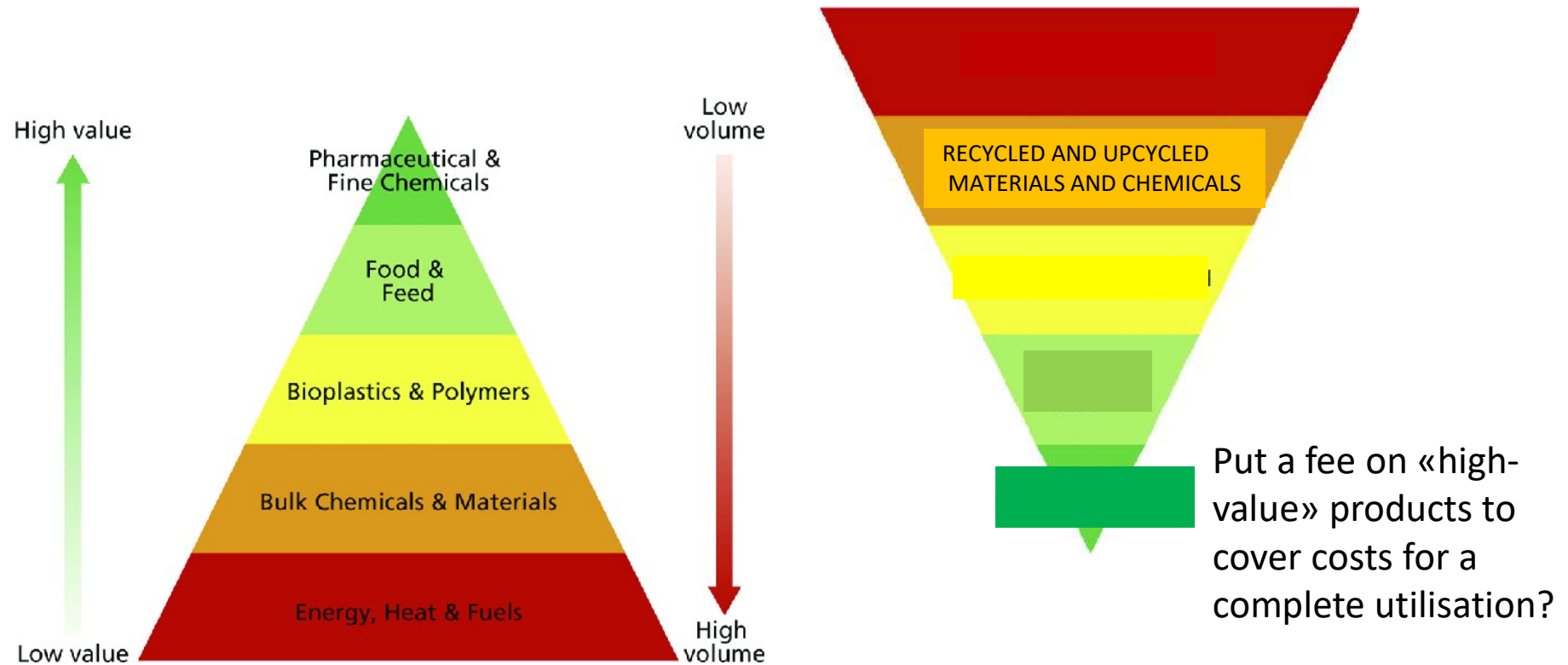


- Fish bones = N, P, Ca fertiliser; not well balanced for crop needs
- Horticulture or meadow purpose? (early spring application)
- Alga fibre not permitted for use in organic growing (Cd, As, residues of HNO_3)
- Cd could be main challenge for other seaweed products
- Seaweeds have high concentrations of K: what about feed quality?

No indication of more As in potatoes grown in soil amended with seaweed
All treatments well below safety limit of 5 mg/kg FW
= about 1.1 mg/kg DM (21.3% DM in potatoes)



Funding bodies for research and innovation should turn the value pyramid upside down!



Main conclusion: high potential for application of marine derived-fertilisers in organic growing, but the value chain needs to be developed



ORGANIC PLUS

Pathways to phase-out contentious inputs from organic agriculture in Europe

Thank you



Research Centre for Agroecology, Water and Resilience



PATT_2022

Organic-PLUS has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 774340

