Innovation for closing nutrient loops and the local production of proteins, green renewable resources and/or energy

Online workshop CNH international at 26 Januar

Rommie van der Weide

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Application Centre for Renewable Resources
ACRRES
Initiative of Wageningen University & Research

Content

- Introduction ACRRES (what and why)
- Innovation for closing nutrient loops and the local protein and green materials production
- Example for valorizing grass (www.go-grass.eu)
- Developments concerning harvesting green materials for ‘new’ applications

ACRRES: Application Centre for Renewable RESources

Part of Wageningen Unversity were we:

- experiment with, test and demonstrate ….
- sustainably energy solutions based on sun, wind or biomass and applications of green raw materials for chemicals, building materials and others ……..
- at pilot/ semi practice scale.....
- in co-operation with companies, NGO’s and governments

EnAlgae
collaborate innovate communicate

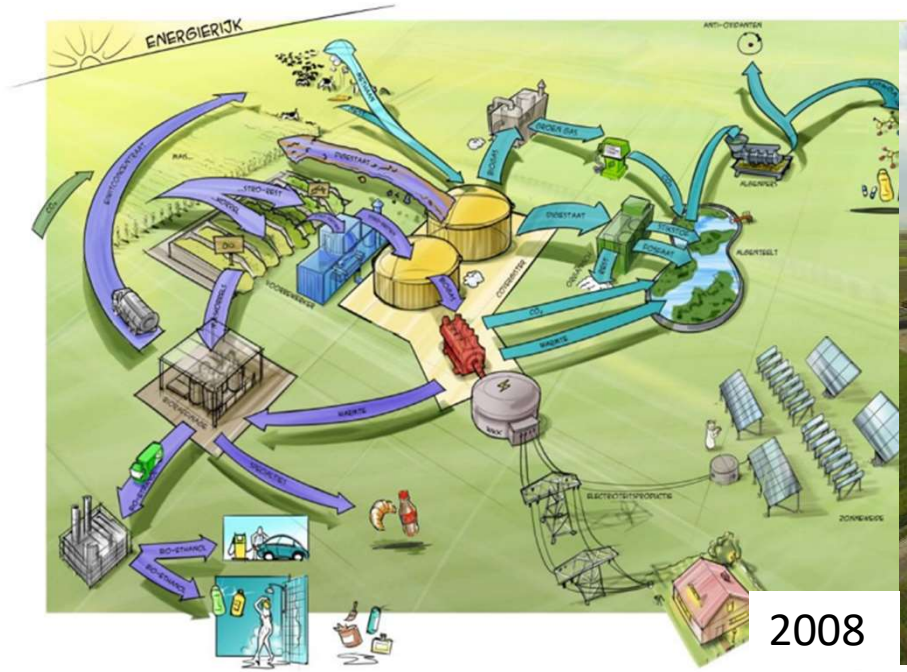
GROW 2 BUILD

INEMAD

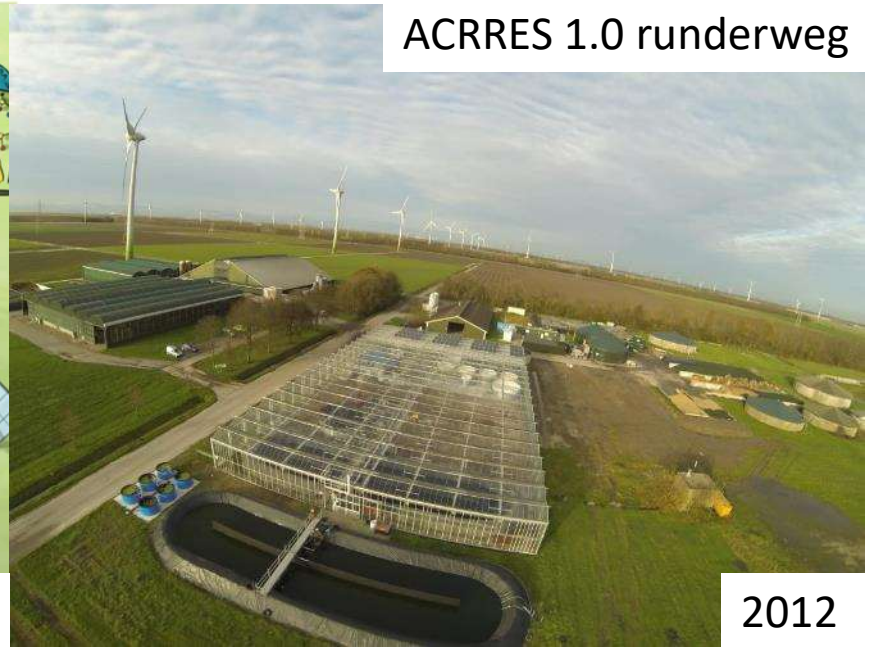
PUFA Chain

GO-GRASS
Grass-based circular business models
for rural agri-food value chains

ACRRES: Application Centre for Renewable RESources



2008

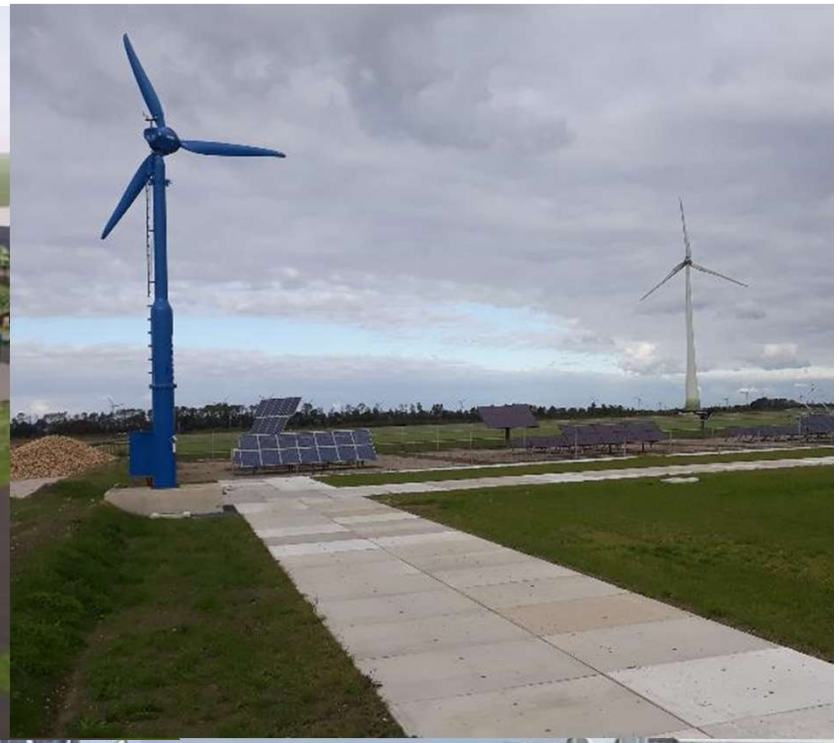


ACRRES 1.0 runderweg

2012

Cooperation several science groups Wageningen Research in Lelystad-NL

ACRRES 2.0: edelhertweg 2021



Facilities Lelystad (2022):

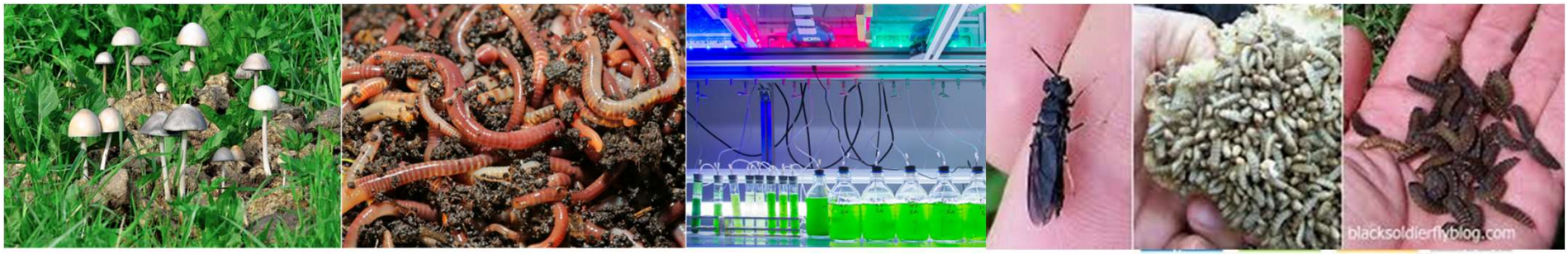
Energy:

- Microschale: 50 kW sun, wind and elecotrolyser and small biodigester
- Macroschale: 36mW wind, sun and battery

Green products:

- Biodigestor/fermentors
- Machinery for treatment materials and fluids (crushers, fliters centrifuge...)
- Production systems algae, aquatic plants, insects and worms (1l-m3)
- Biomass storage and treatment place (manure, residual fluids, biomass, compost,...

At a large arable farm with experimental fields...

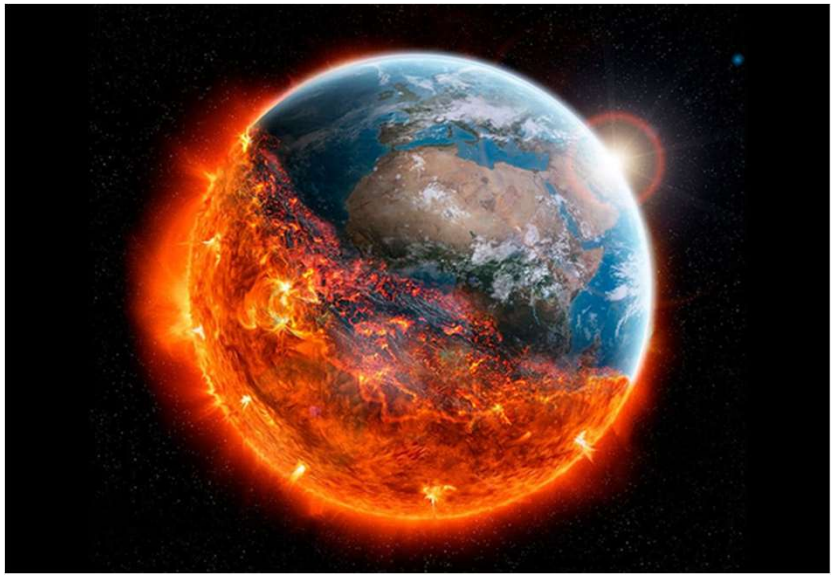


Farm of the future in Lelystad

BOERDERIJ van de Toekomst
Dichterbij dan je denkt

Why ACRRES?

- Global warming and finite resources



FAO report 2009

How to Feed the World in 2050

- World population in 2050: 9.1 billion people
- Increased income levels
- Need to increase food production by 70%
  - Meat production: 229 → 465 Mtonnes
  - Milk production: 580 → 1043 Mtonnes

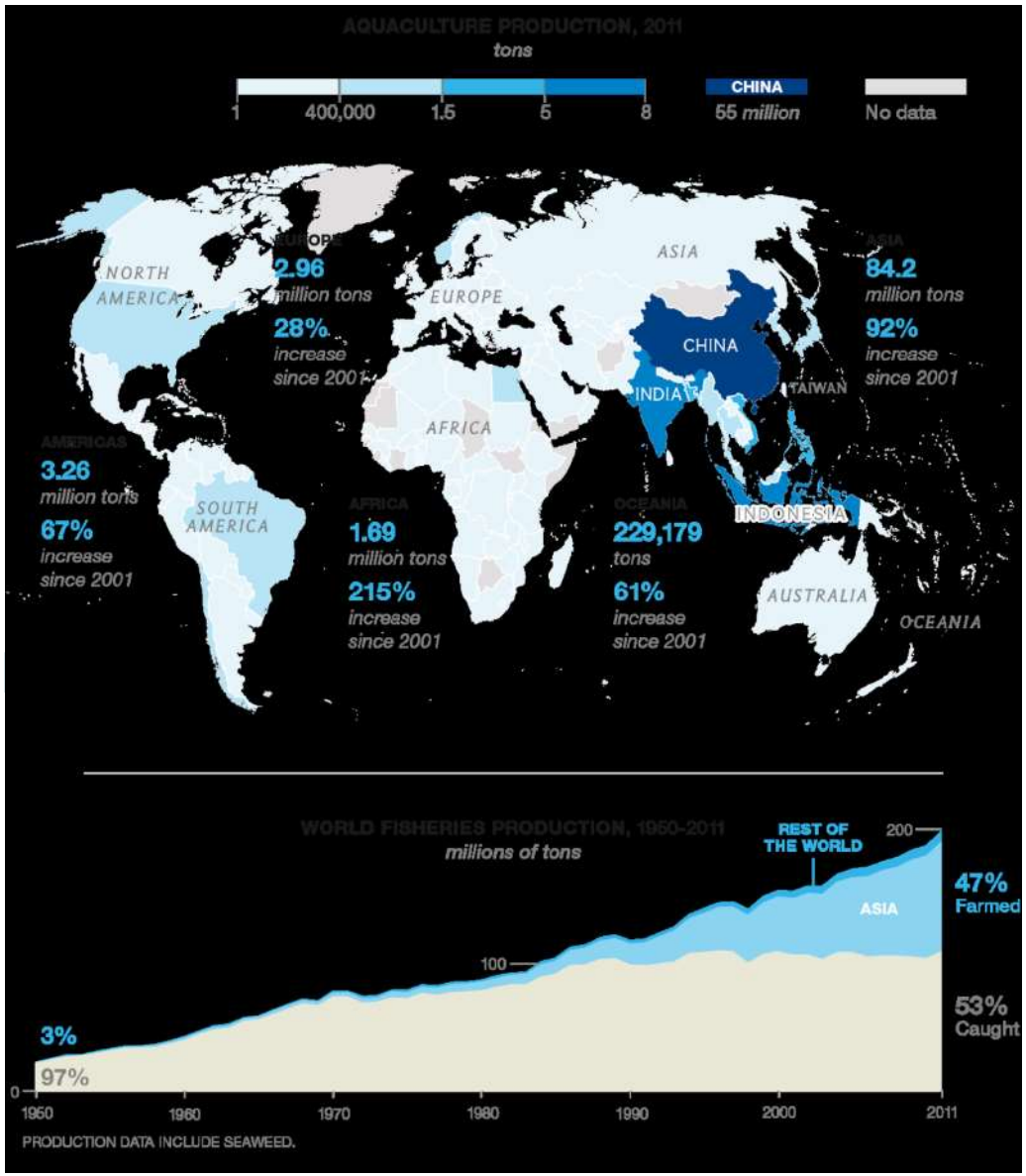
Max production but more people

Fish catch:

- Catch at max 1990
- More -> fish-farming

Commodities:

- 70% surface in use
- Shortage sweet wate
- Short P on term
- Increase CO2 level



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Need for new proteins

- Limited amount of fallow hectares
- Increasing crop yield can contribute
- Closing nutrient cycles to prevent waste
- High yield/ha proteins
  - Algae
  - Water plants
  - Insects

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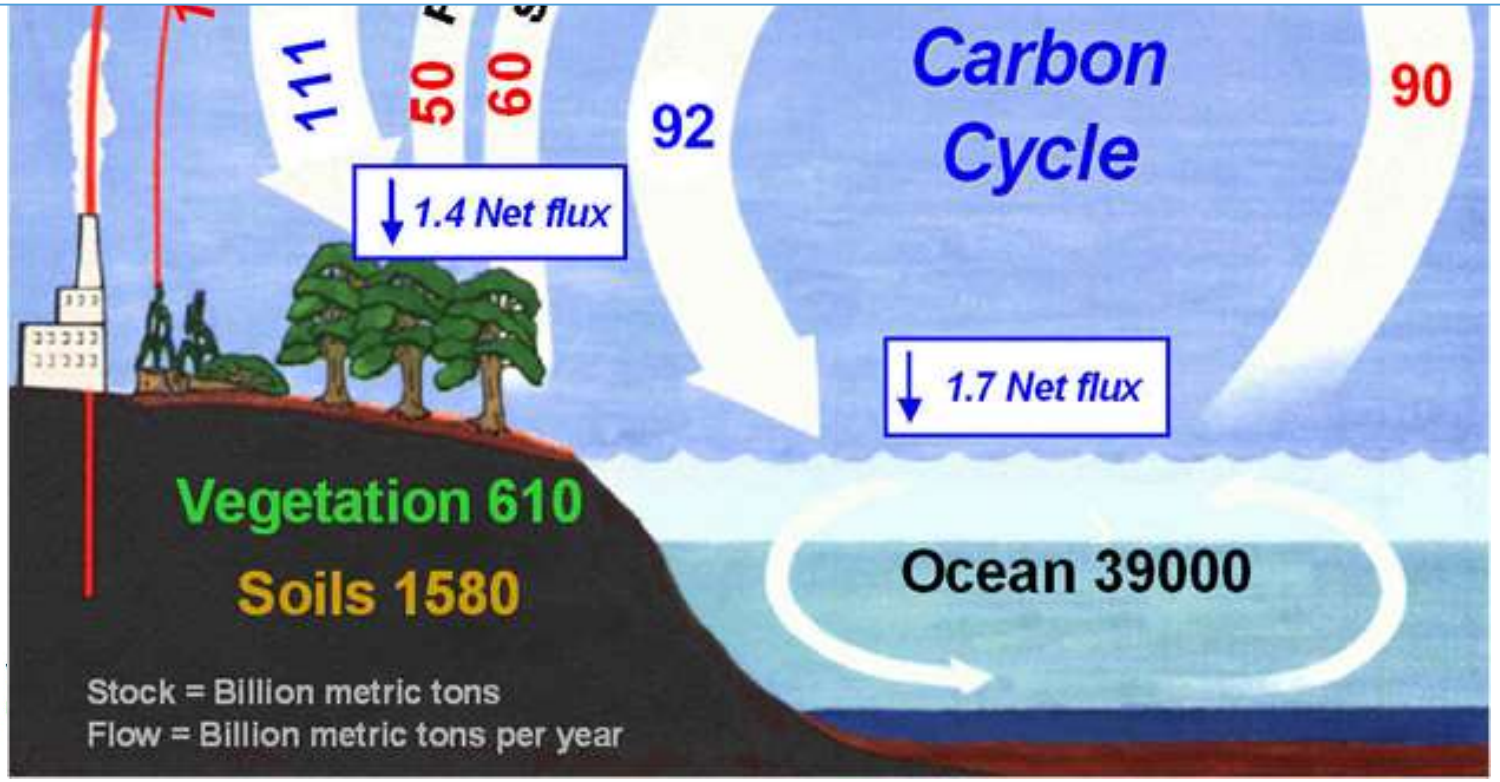
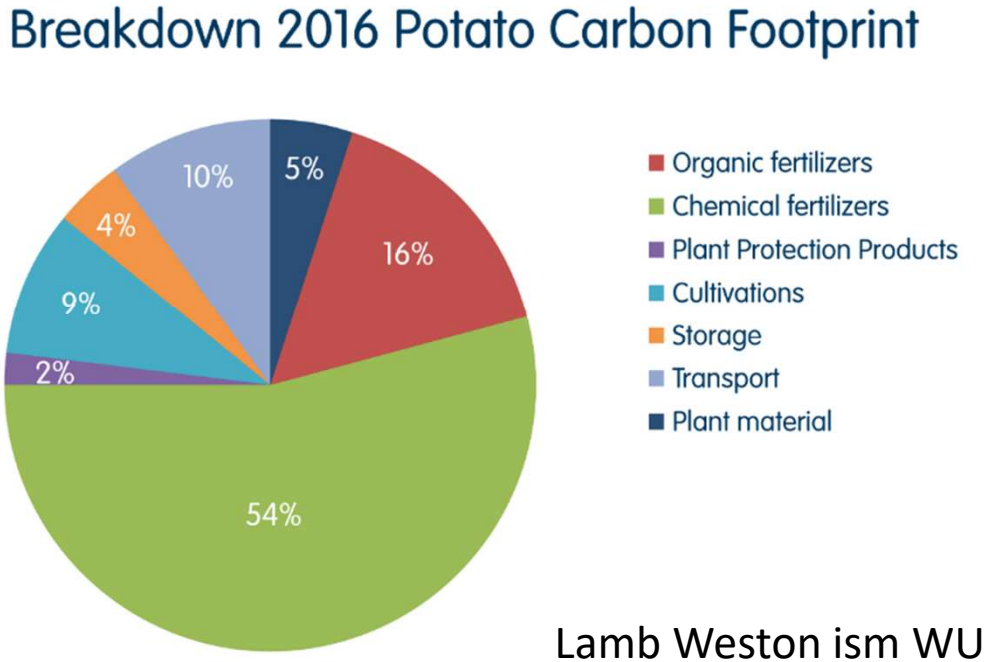
Reduction of greenhouse gas

How Fish Cool Off Global Warming: Fish save the world billions of dollars in damages by helping store carbon dioxide in the oceans (in Scientific American June 9, 2014)



Trade companies direct on lowering footprint

- Friesland Campina: e.g. manure digestion and solar
- Suikerunie: sugarbeet rest digestion and green gas production
- Lamb Weston: decrease footprint of the culture



Lamb Weston ism WUR

Goals ACRRES - WUR

- Production of renewable energy
- Production of green products to replace the fossil based
- Maximizing the production and valorisation of locally produced biomass for food/feed, chemicals or energy
- Maximised local re-use of nutrients and side streams
- Reduction of greenhouse gas

-> research, coinnovation and (stimulation of) realisation in agricultural context

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Innovation for closing nutrient loops and the local protein and green materials production

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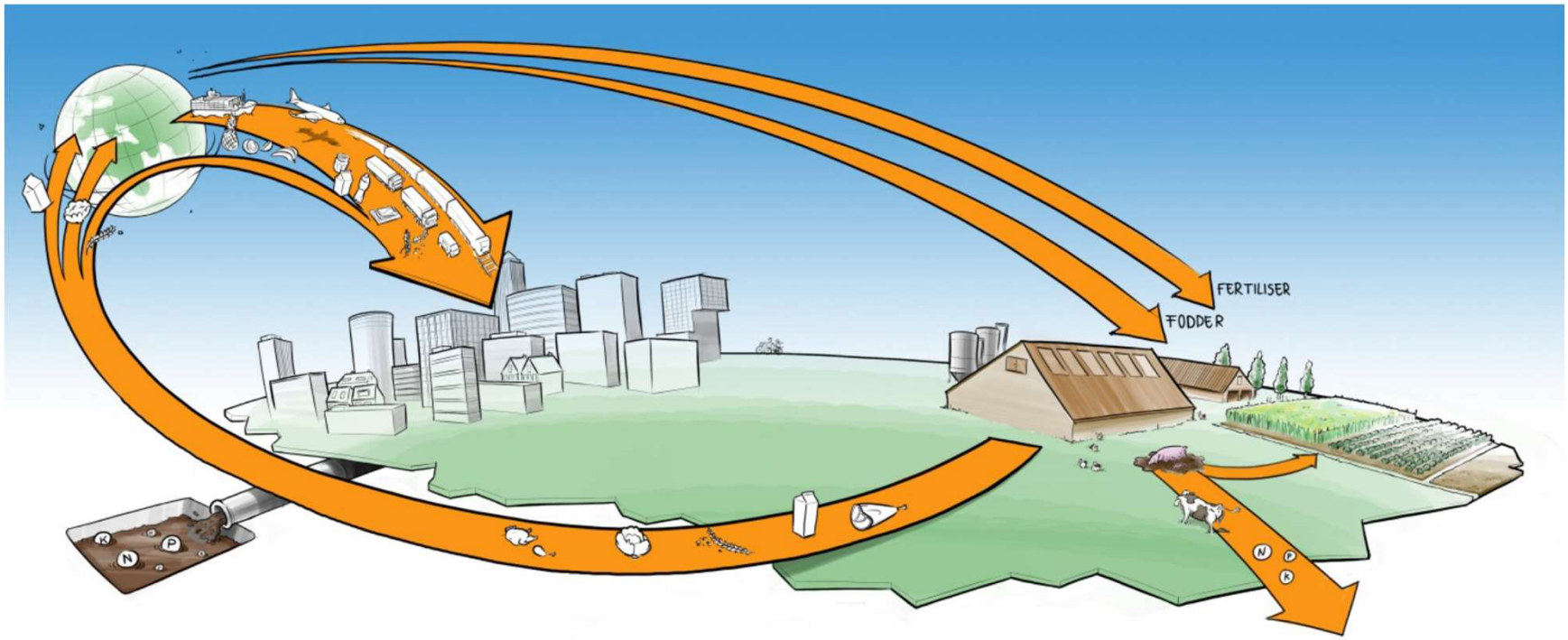
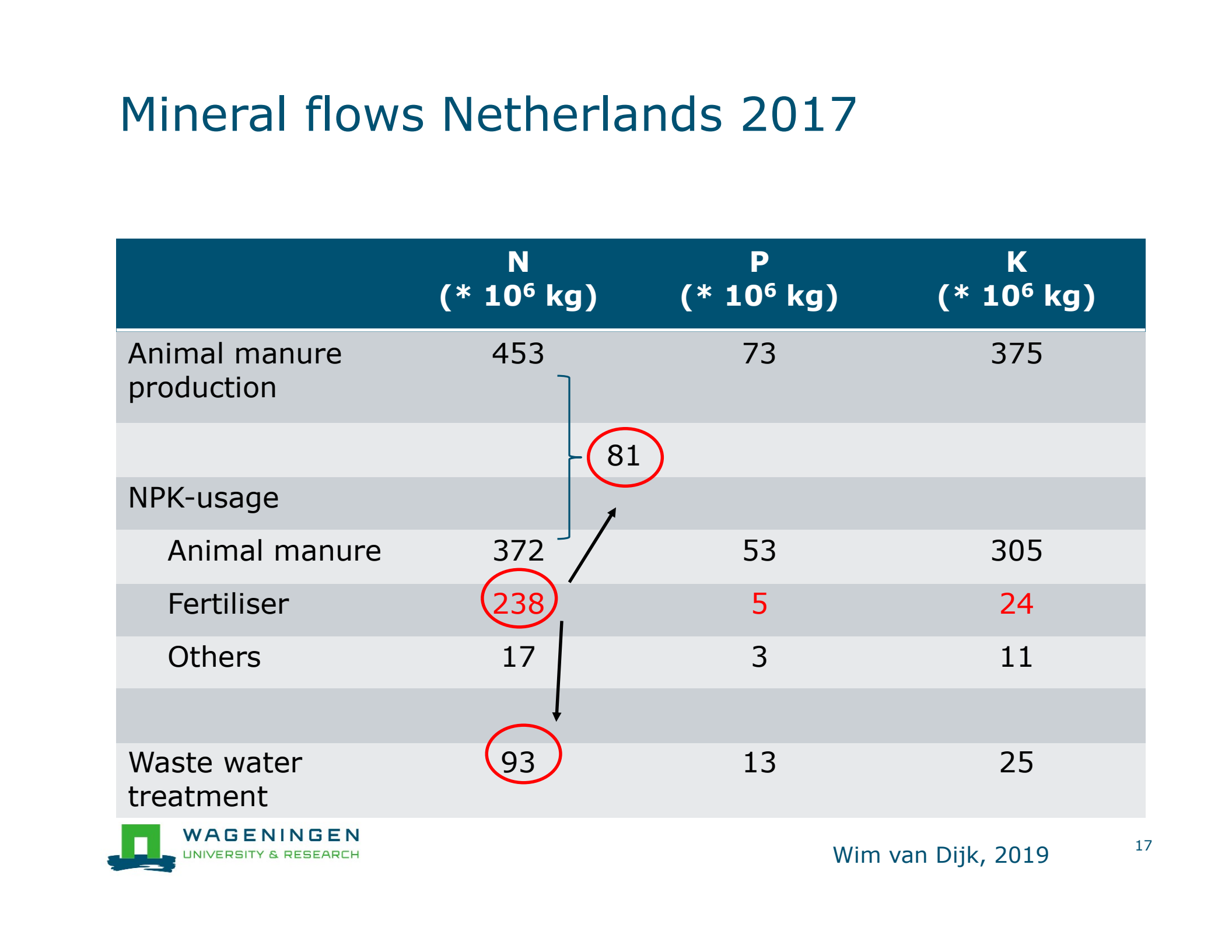
Fosfate flows city Almere



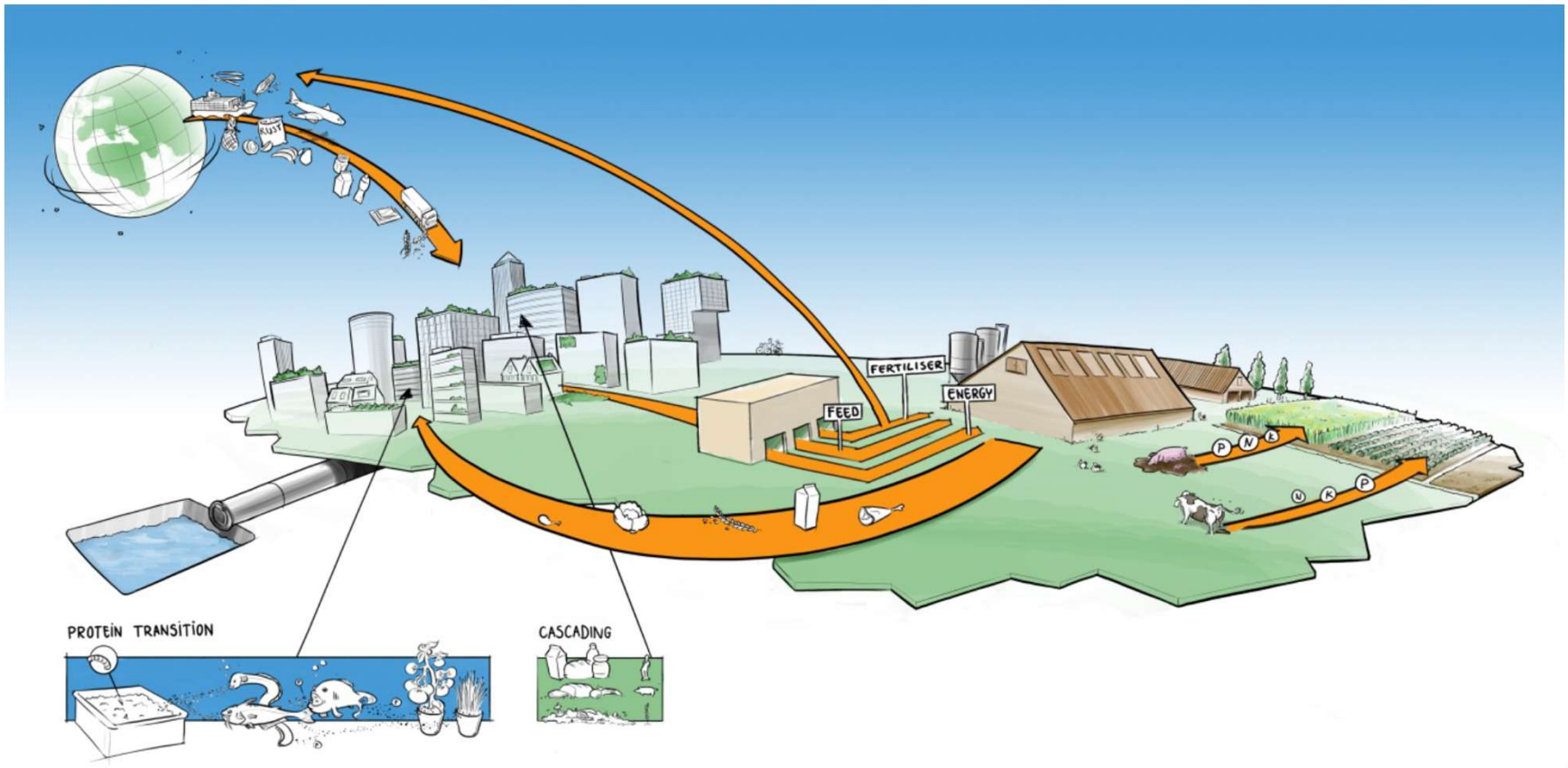
Van Dijk, Jansma... & Visser (2017)

Mineral flows Netherlands 2017

	N (* 10^6 kg)	P (* 10^6 kg)	K (* 10^6 kg)
Animal manure production	453	73	375
	81		
NPK-usage			
Animal manure	372	53	305
Fertiliser	238	5	24
Others	17	3	11
Waste water treatment	93	13	25

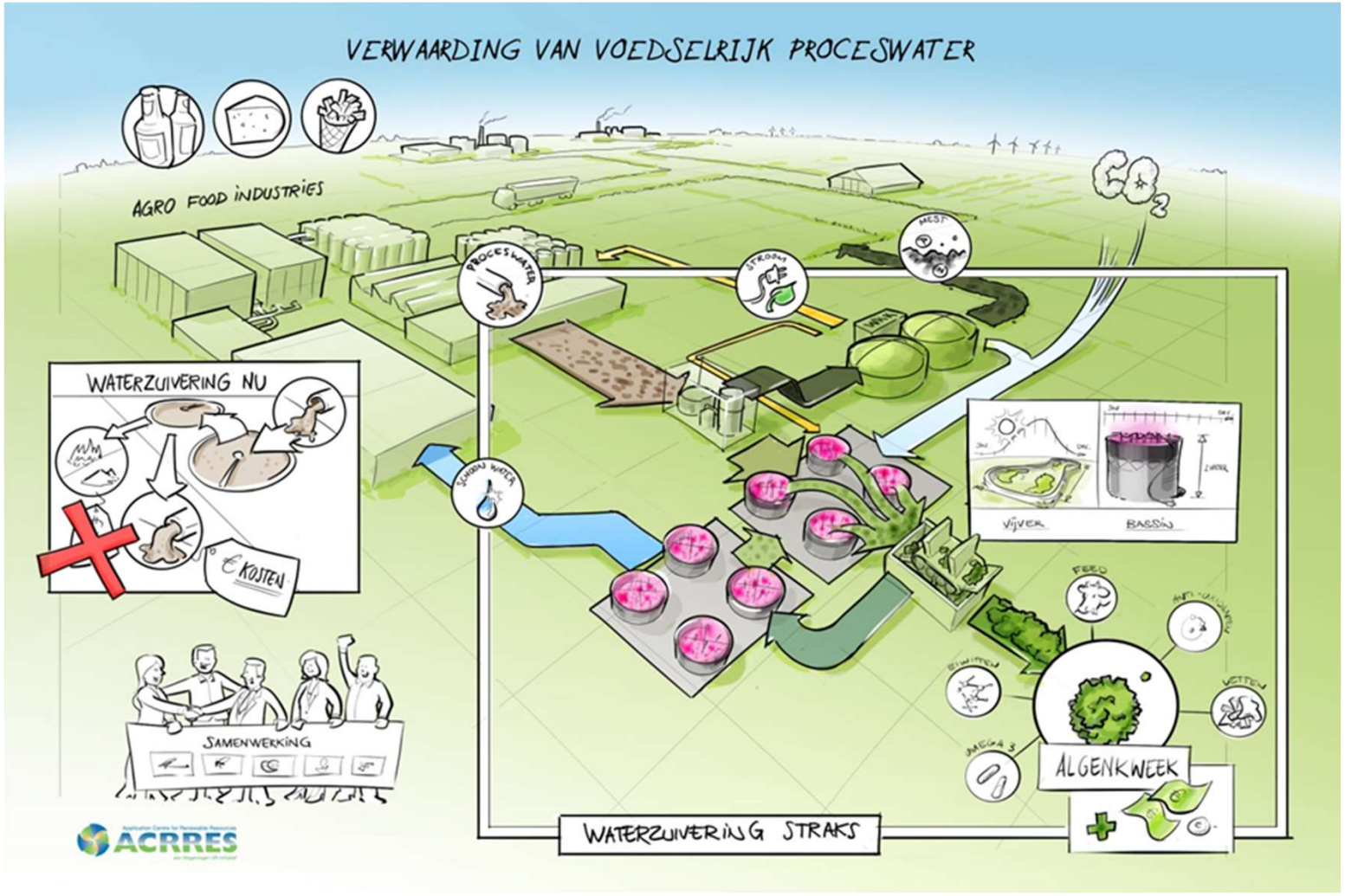


Increasing circularity Almere



Van Dijk, Jansma... & Visser (2017)

Algae for effluent polishing process water



Protein production aquatic plants

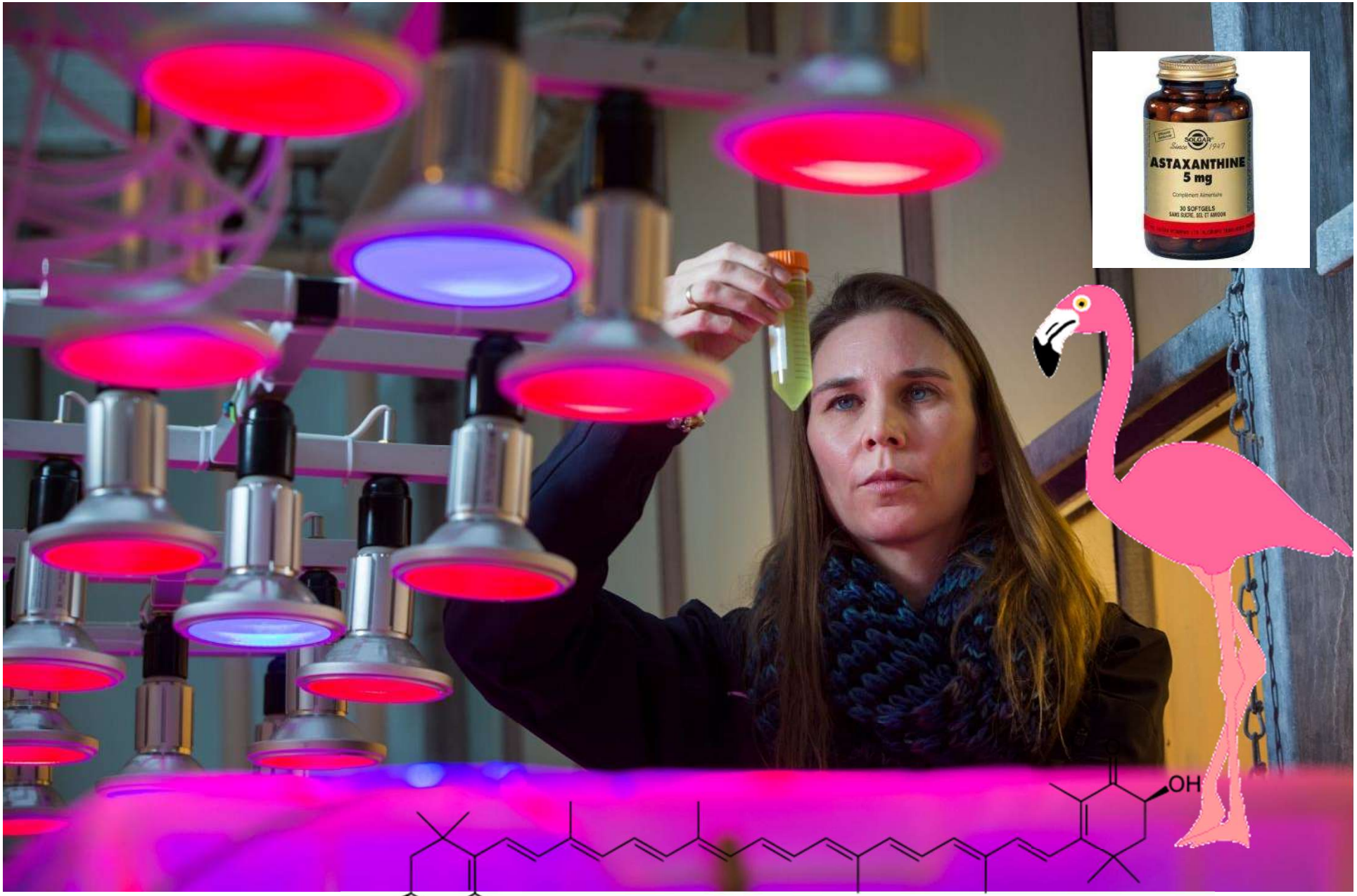
- Production on nutrient rich waste streams
- Refining proteins

soort	Ton DS/ha/jaar	DS Eiwit/ha/jaar
microalg	8-15	4-8
eendekroos	12-16	2-7
waterhyacint	24-32	3-8
hoornblad	10	2
lisdodde	32	3-5

Health improving effects algae

- For human (astaxantin,.....)
- For animals
- For plants/soil

Transcriptional response of cultured porcine intestinal epithelial cells to micro algae extracts in the presence and absence of enterotoxigenic Escherichia coli.
Hulst, Marcel; Weide, Rommie Van der; Hoekman, Arjan; Krimpen, Marinus Van
Genes & Nutrition 14 (2019)1. - ISSN 1555-8932



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Algen -> Astaxantine: antioxidant

Consuming insects?

Insects as feed

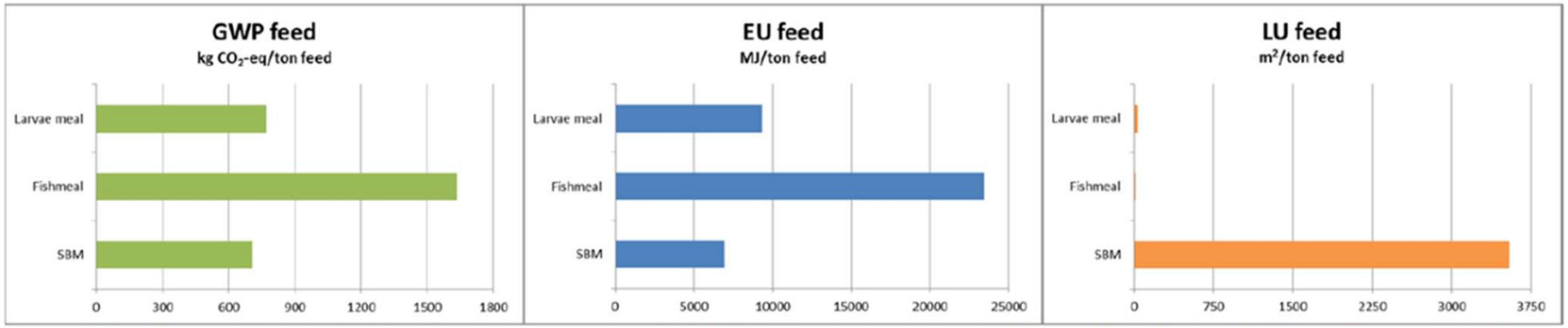

Figure 3. Comparison of global warming potential (GWP), energy use (EU) and land use (LU) of larvae meal, fishmeal and soybean meal (SBM) based on ton dry matter feed

9th International Conference LCA of Food San Francisco, USA 8-10 October 2014

Can the environmental impact of livestock feed be reduced by using waste-fed housefly larvae?

Hannah H.E. van Zanten[1,2*], Dennis G.A.B. Oonincx[3], Herman Mollenhorst[1], Paul Bikker[2], Bastiaan G. Meerburg[2], Imke J.M. de Boer[1]

Project – roughage production:

Optimalisation roughage production in the rotation and increase soil quality, biodiversity, climate and circularity by diversifying crop combinations in space and time:

- Circular agriculture and emission reduction
- Regional cooperation and economy
- >= 65% protein own land
- Increase organic matter in soil

Ruwvoer & Bodem

Experiment different roughage options

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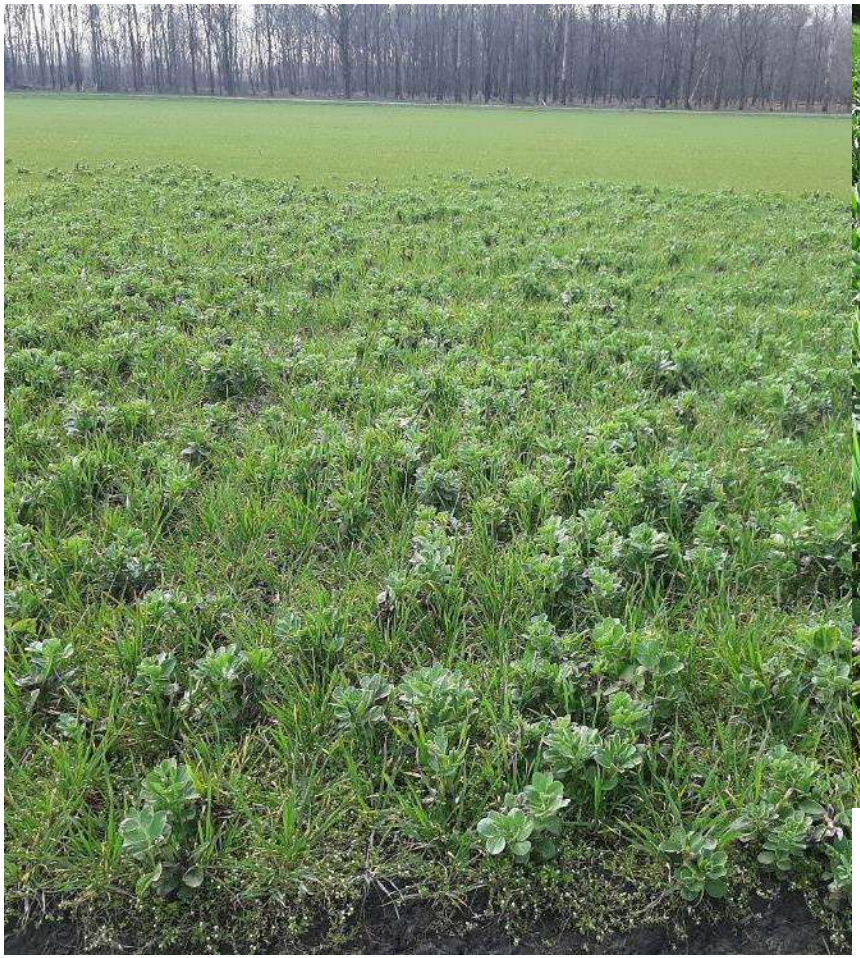
Object F: +wheat + winterfieldbeans

23 March → 28 May



Ruwvoer & Bodem

Lees breakdown of organic matter by less soil cultivation

Ploegen/Spitten

Frezen, ploegen/ spitten zaaiklaar maken

Kerend+volvelds

NKG

Woelen, zaaiklaar maken

Niet kerend+volvelds

Strokenteelt

Stroken frezen

Niet kerend, 1/6e opp. bewerkt

‘no-till’

Woelen in de rij

Niet kerend, niet bewerkt

More time for green manure crops and more carrying capacity of the soil!

Ruwvoer & Bodem

Mixed cultivation.. and agroforestry?

Foto Nordic Maize Breeding

GO-GRASS

Grass-based circular business models for agri-food value chains

This project has received funding from the European Union's Horizon 2020 research and Innovation programme under grant agreement **N°862674**.

The diverse potential of Grassland

21*%

of the EU surface Is covered by grassland

Grassland management is **relevant** and of **great interest** for rural communities.

Especially **unused grass** like less productive or less nutritive species and grass from remote/protected areas could open possibilities of **new products** and **value chains**.

*Source: eurostat; EU-28 countries; 2015

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **N° 862674**

Different demos

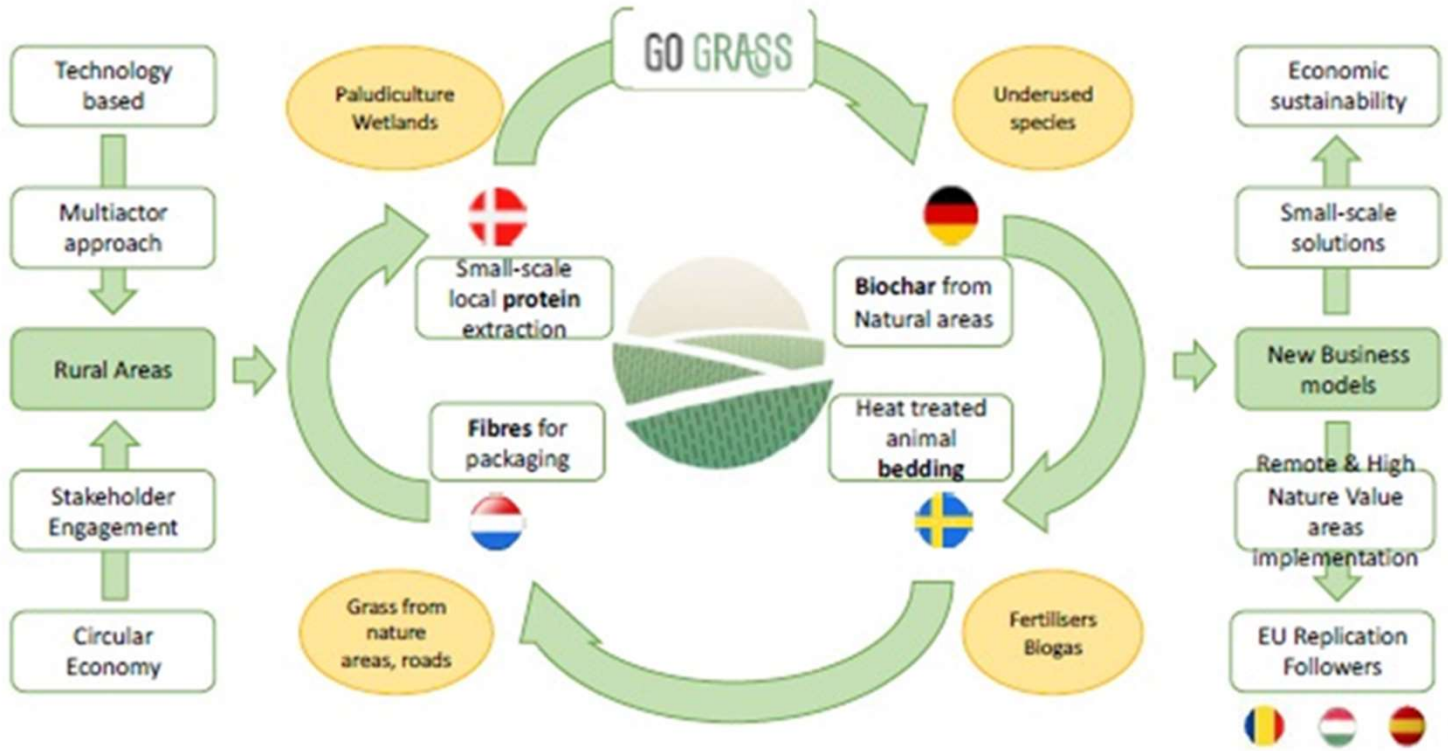


FIGURE 1: GO-GRASS OVERALL CONCEPT

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **N° 862674**

Process grass to paper

till 2021 lab; 2022.. bigger pilot

GO-GRASS

Harvest → Cleaning → Dry digestion → Alkaline treatment → Refine → Paper

Overview key technologies Europe

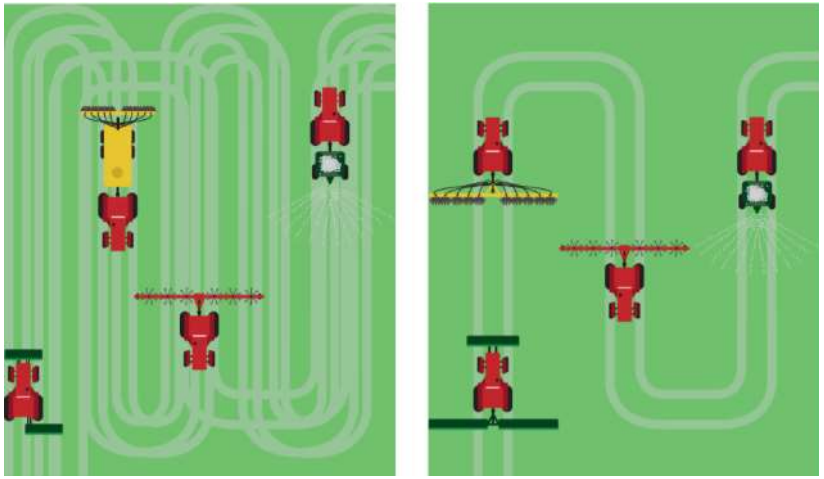
		NL	DE	SW	DK	HU	E	RO
Mowing	Flail mowing	X				X	X	X
	Rotary mowing	X	X	X	X	X	X	X
	Sickle/bar mowing	X				X	X	X
	Immediate collection	X	X	X	X	X	X	X
Collection	Tedding	X	X	X	X	X	X	X
	Rotary raking	X	X	X	X	X	X	X
	Collecting loose grass	X						X
	Collecting in bales (using machines)	X	X	X	X	X	X	X
	Collecting in bales (manual labour)							X
Bulk storage	Pit plate	X				X	X	X
	Tower silo					X		X
	Hay stack						X	X
	Trench box (bunker silo)	X				X	X	X
Batch storage	Unwrapped bales		X	X	X	X	X	X
	Wrapped bales	X				X	X	X
	Wrapped tunnel storage							X
	Outdoor storage (unwrapped bales)		X	X	X	X	X	X
	"Roofed" storage (hangar/hay barn)	X	X	X	X	X	X	X
	Additives with silage	X				X	X	X

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **N° 862674**

Grass most robust technologies , innovation in

- **Precision technologies (sensing/yield..)**
- **Increasing biodiversity (herbs) in production grassland**
- **Fixed driving tracks to increase productivity**
- **Technologies for bioraffinage to increase the value of grass as renewable resource**

(as in GO-GRASS pilots)



Picture veeteelt
GRAS MAART 2019

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement **N° 862674**

In conclusion:

- Need and use arable land year round to produce more biomass for food/feed, chemicals or energy
- Also non productive land can be used to harvest and valorise biomass
- Maximised local re-use of nutrients and side streams needed
- Minimize the food print of biomass production

Developments concerning harvesting green materials for 'new' applications

- Beside efficient 'large' harvesters also small ones (mixed crops, solar panels, soil quality,...)
- Intelligent (combined with monitoring, driving pattern,..)
- Use local renewable energy (solar, hydrogen,...)
- Separate streams separated in harvester (kernels for feed and straw for biobased products in maize; dirt and grass at road sites,...)
- Year round green fields- combined cultivations (mow in front and strip tillage at the back,...)
- .....

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More info

www.acrres.nl

Further collaboration

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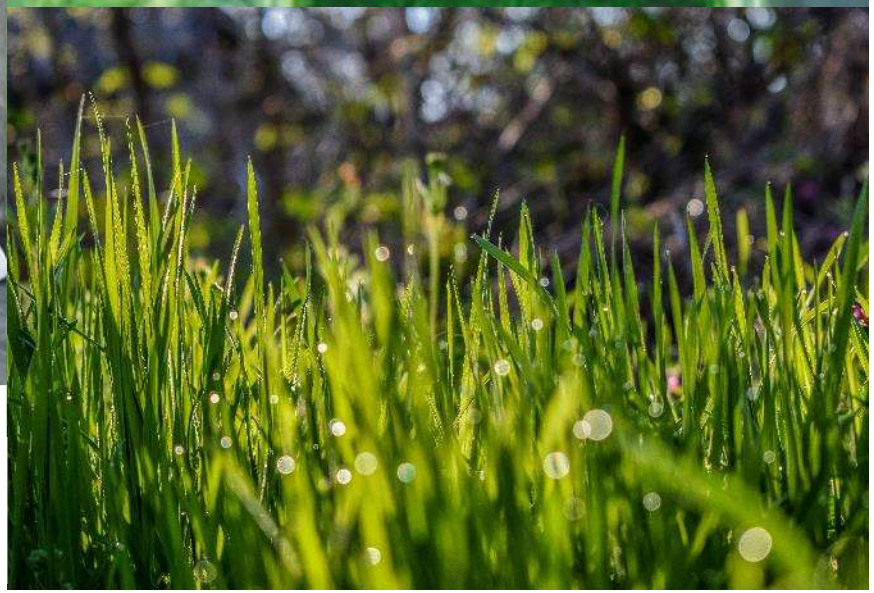

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Thank you for your attention and have a good discussion!

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