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Producing sustainable bio-based fertilizers from food wastes, the role of electrodialysis

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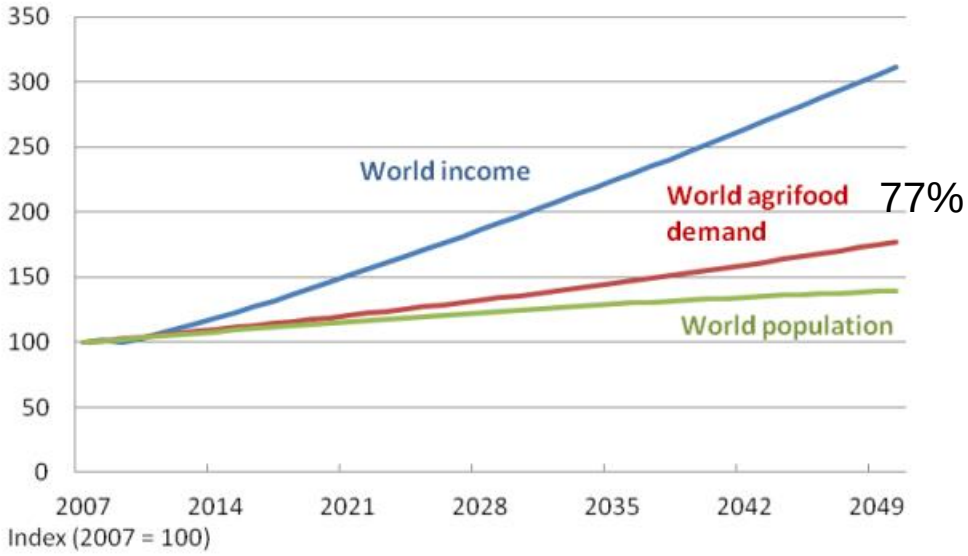
RUSTICA

Demonstration of circular bio-based fertilisers and implementation of optimized fertiliser strategies and value chains in rural communities

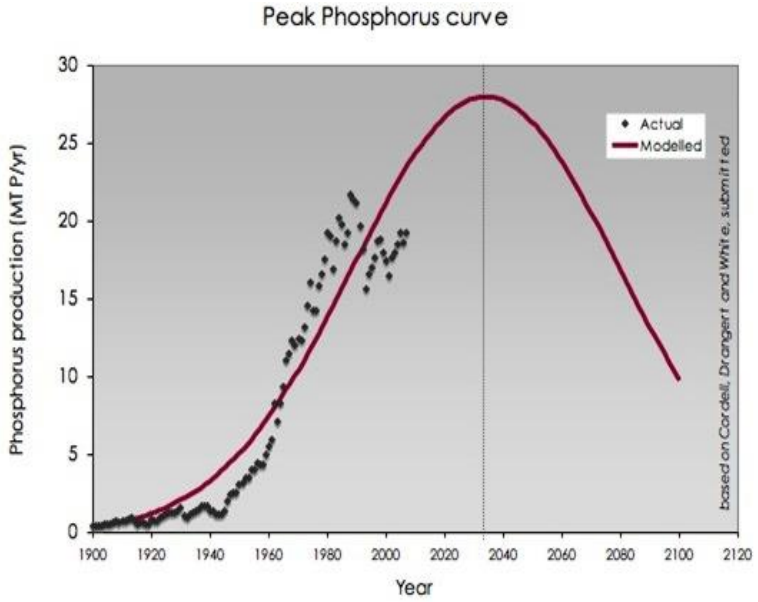
THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO 101000527

Increasing Food Demand But Limited Fertilizer Available



Data source: United Nations (2011a), ABARES model output

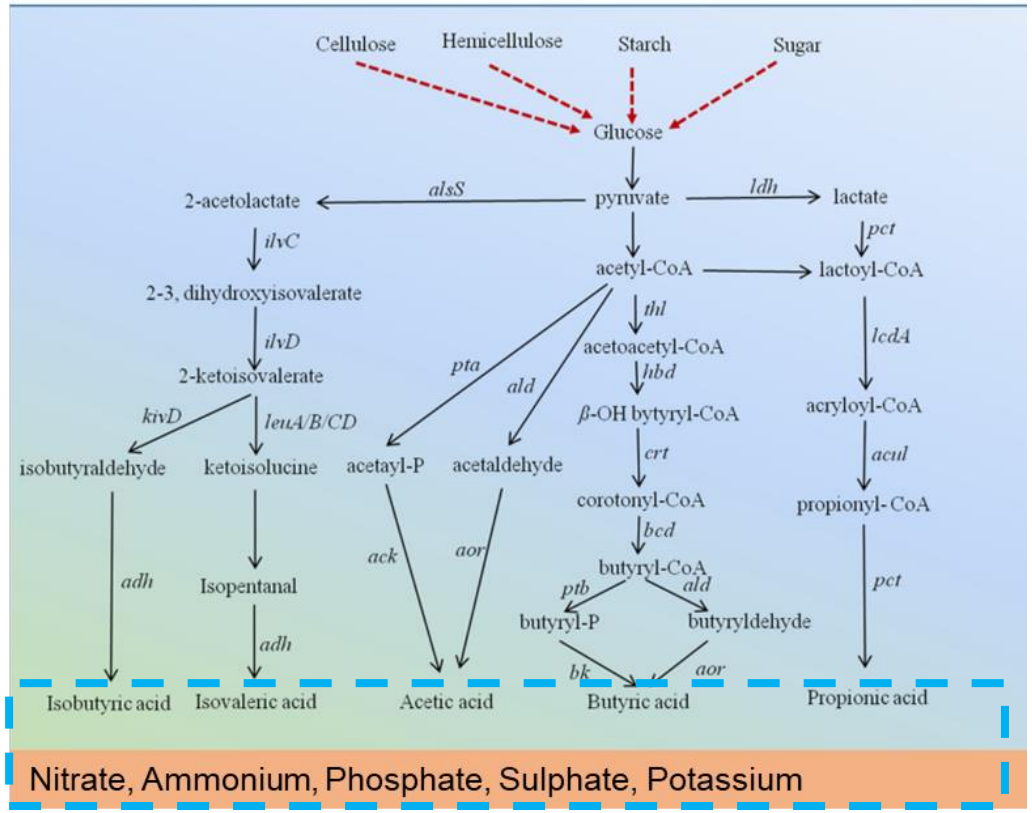
World agrifood demand, population and income



Phosphorus and Potassium fertilizer reserves deplete in 50–100 years

Alternative Nutrients Production

One-third (~1.3 billion tonnes) annual foodwastes generation



Shashi K.B., Yung-Hun Y. ; Rev Environ Sci Biotechnol 16, pp 327–345, 2017
DOI 10.1007/s11157-017-9431-4

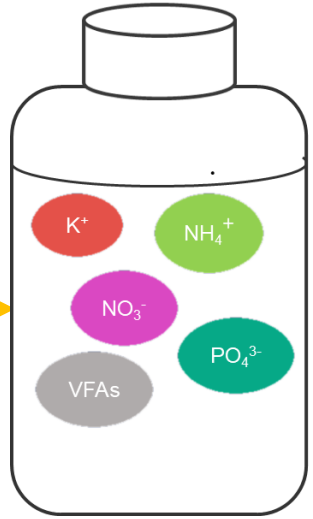
Major challenges:

- Very low NPKs concentrations (0.2-2g/L)

- Difficult selective separation between NPKs & VFAs from fermentation

Main Goals

Fermented foodwaste



- Recover, concentrate NPKs (>90%) & VFAs from fermentation

- Selectievely separate NPK from VFAs (>80%)

Nutrients
Fertilizer
NH_4^+
K^+
NO_3^-
PO_4^{3-}
SO_4^{2-}

Soil

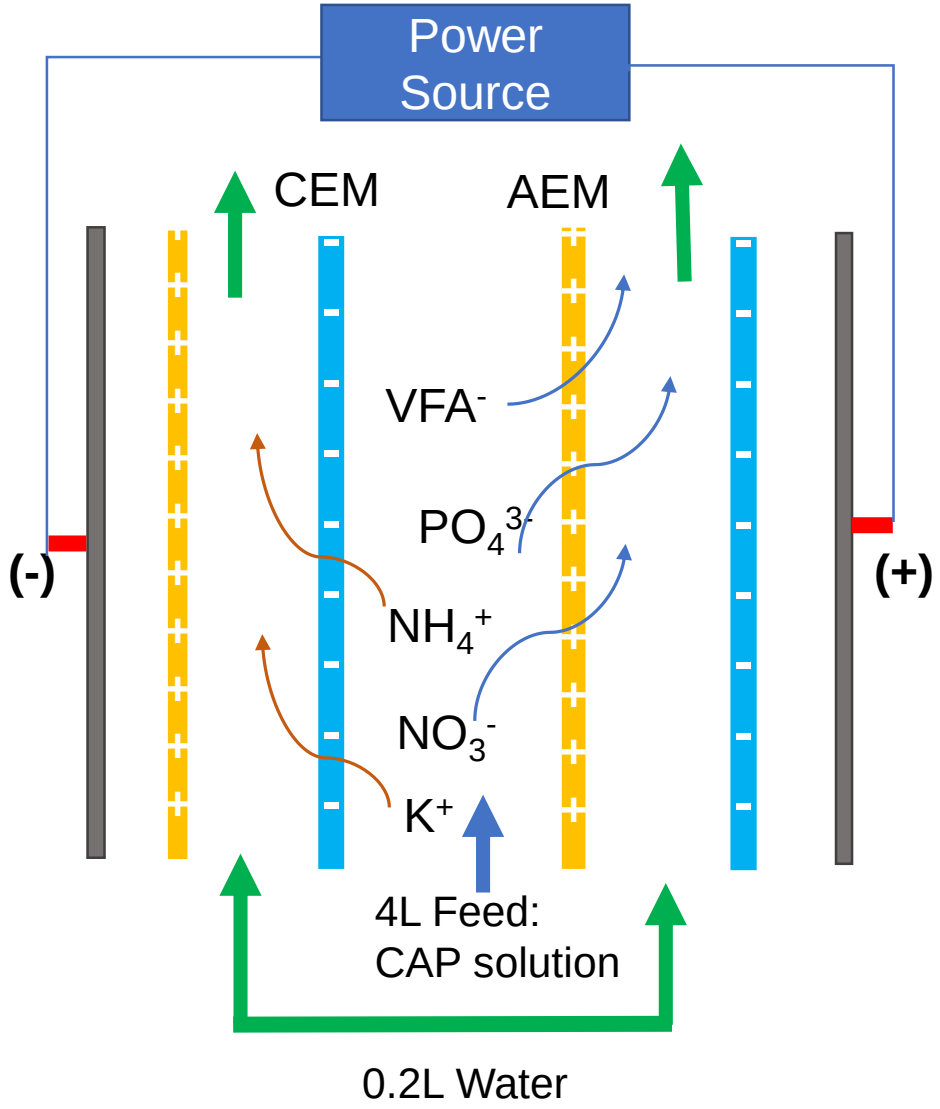
VFAs
Acetic acid
Propionic
Butyric
Valeric
Caproic

Pharmaceuticals
Biofuels
Bioplastics
Cosmetics
Food Industry
Textiles

Role1: ED for increasing nutrients concentration

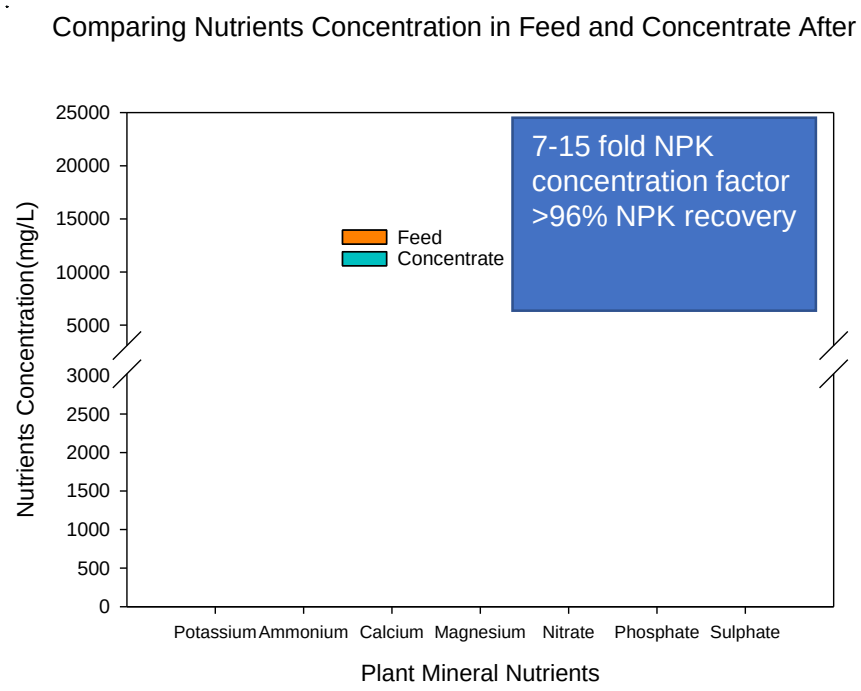
Electrodialysis (ED)

Concentration ratio=4/0.2=20



Increasing nutrient concentration by ED

Electrodialysis (ED)



NPK Concentrate

>96%recovery

~7-15x concentrated

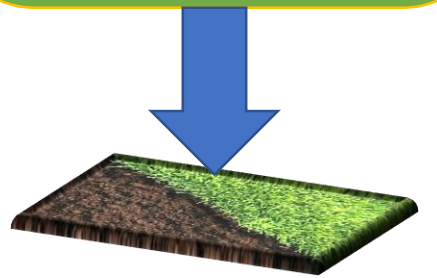
Concentration Range:

NH_4^+: 3g/L

K^+: 23g/L

NO_3^-: 4.9g/L

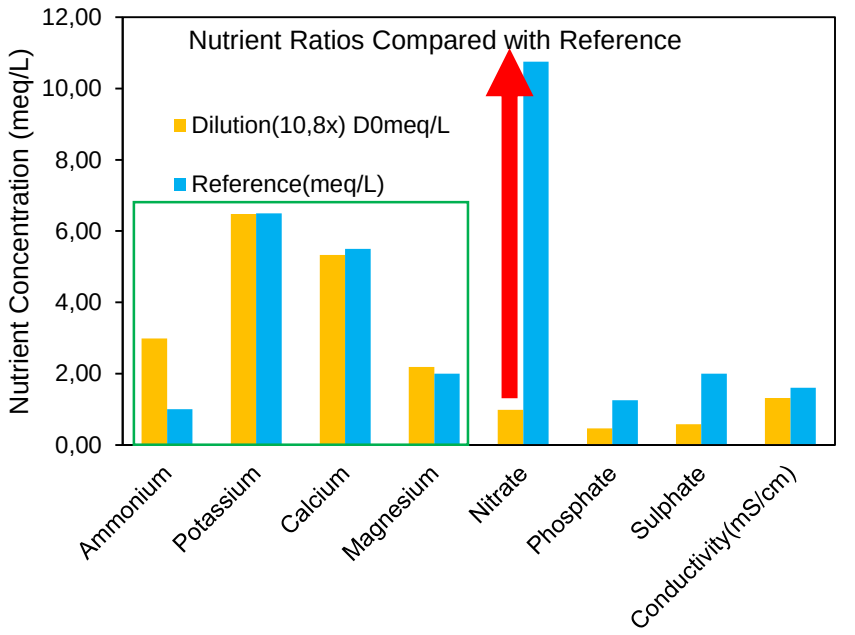
PO_4^{3-}: 2.7g/L

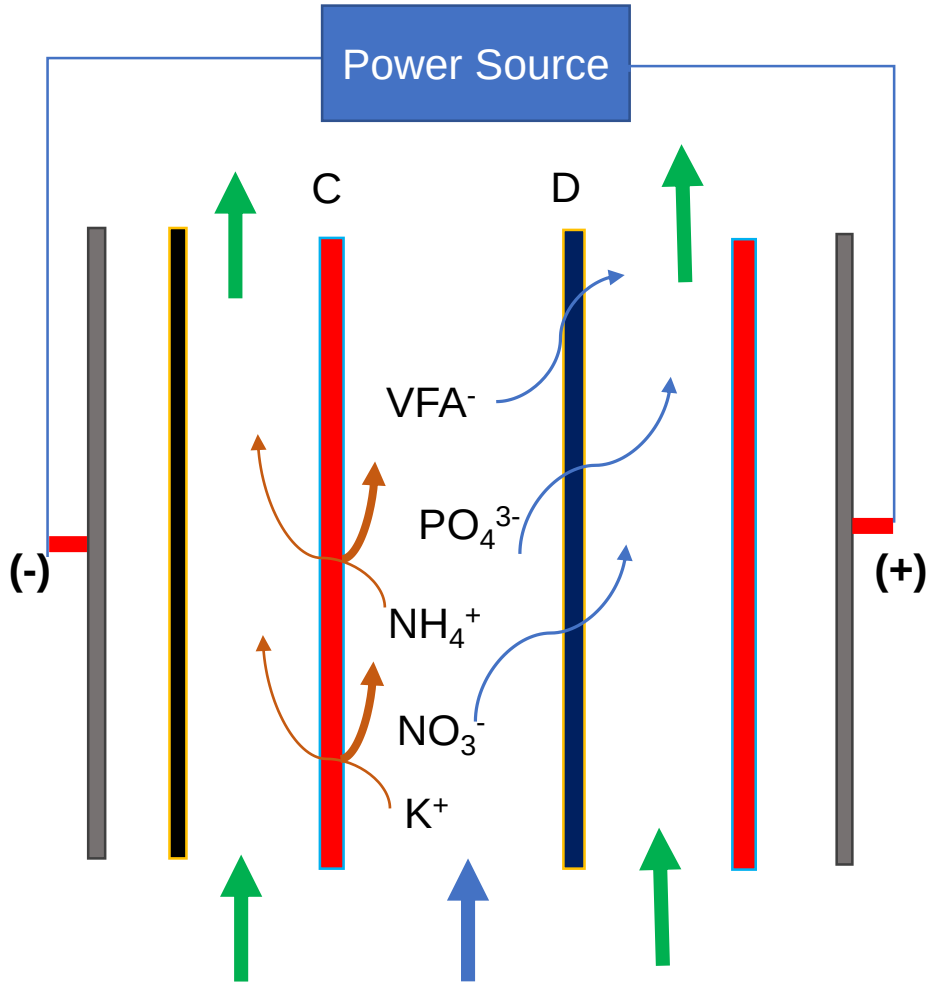


Soil

Role 2: ED for adjusting nutrient ratios

Cucumber and **Tomato plantation**

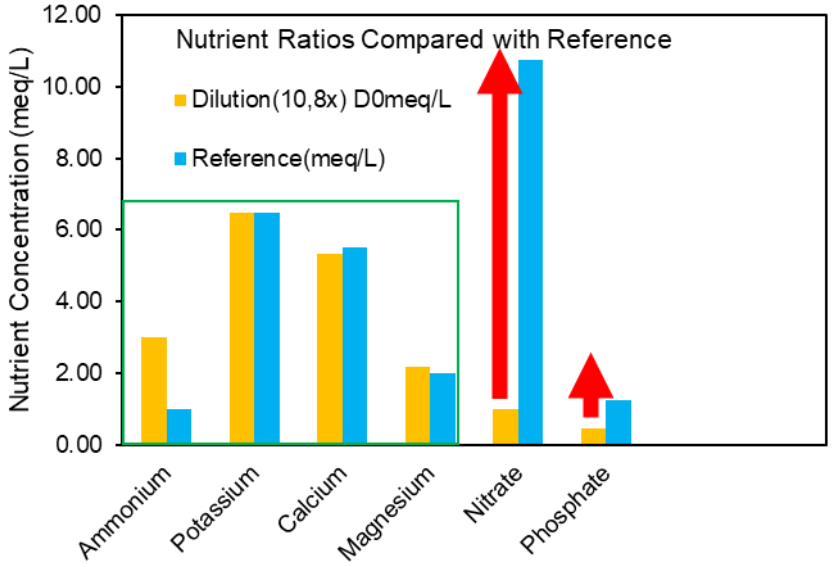


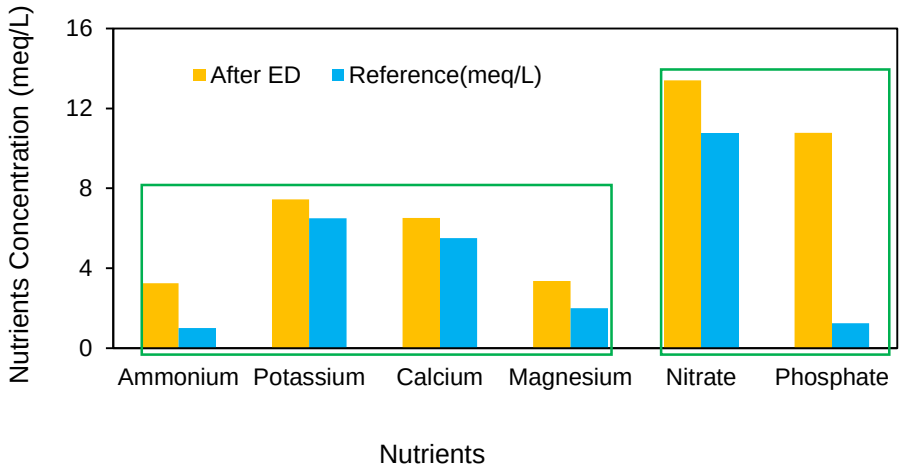


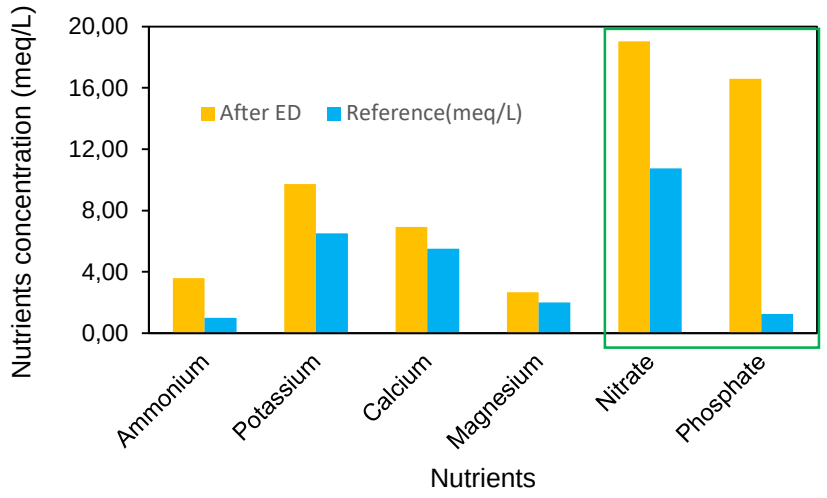
0.2L Water
Or Start up
concentrate

4L Feed:
CAP
solution

ED for adjusting nutrient ratios







Conclusions

- ED plays a role of concentrating nutrients for producing bio-based fertilizer from foodwastes

- ED can adjust nutrient ratios to solve nitrate and phosphate deficiency

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Rustica Project Consortium

(KU LEUVEN) University of Leuven
(OWS) Organic Waste Systems NV
(CRAPDL) Chambre Régionale d'Agricultures des Pays de la Loire
(BIO) BioSabor, S.A.T.
(CREA) Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria
(TEC) Fundacion para las Tecnologias Auxiliares de la Agricultura
(AVE) Avecom NV
(ENT) Entomo Consulting S.L.
(PAR) Particula Group d.o.o.
(WIED) Wiedemann GmbH
(IDC) IDConsortium SL
(CROP) Stichting CropEye
(EVILVO) Eigen Vermogen van het Instituut voor Landbouw, Visserij en Voedingsonderzoek
(TNO) The Netherland's Organisation of Applied Scientific Research
(UGENT) Universiteit Gent
(CIAT) Centro Internacional de Agricultura Tropical

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QUESTIONS