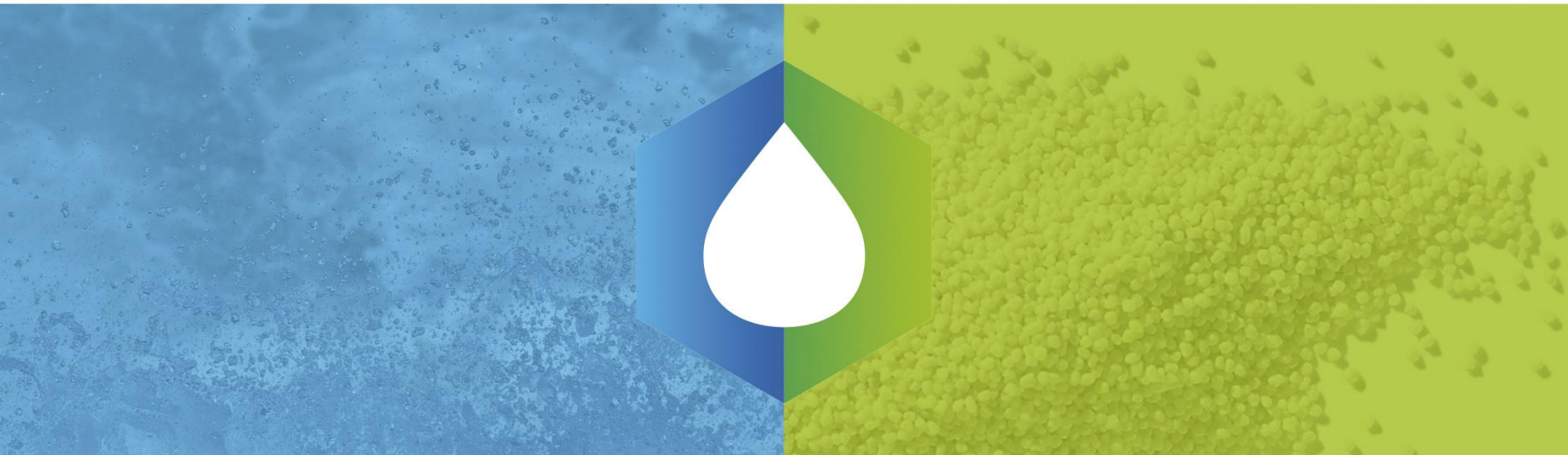


Humics:

Legislation, research and possible applications

Olaf van der Kolk



AquaMinerals

- Observer DOC2C'S
- Collective valorisation residuals watertreatment
- PWN and De Watergroep are shareholder/participant in AM
- 4 Years involved in valorisation humics from drinking water
- 'Observer' project Dutch Water Boards: humics from municipal wastewater



Study '13: use of brine

- Discharge at sea
- Discharge in sewage system
- Use as process water (e.g. cooling, compost)
- Salt aquaculture (e.g. seaweed)

Processed (mainly desalted):

- Biostimulant agriculture
- Additive feed
- Human health

Strong connection with technology: separation and purification needed: fulvic and humic acids

Fulvic- and humic acids: functional

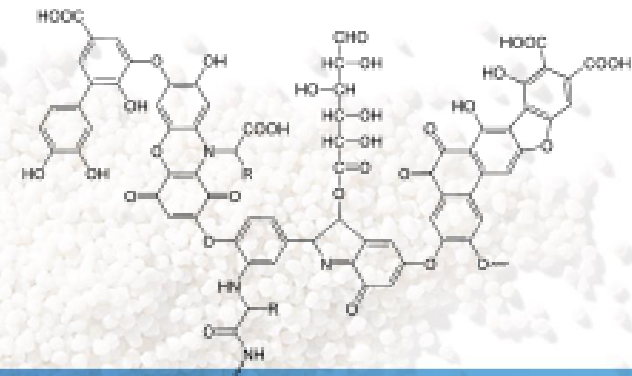
Excellent transporter of metals, nutrients

Better uptake of nutrients and therefore positive effect on plants, animals and humans

Existing markets, yet a lot unknown (dosing, effect with changing environment, etc)

High value: up to € 500 - € 1.000 per ton

Market wants proof!



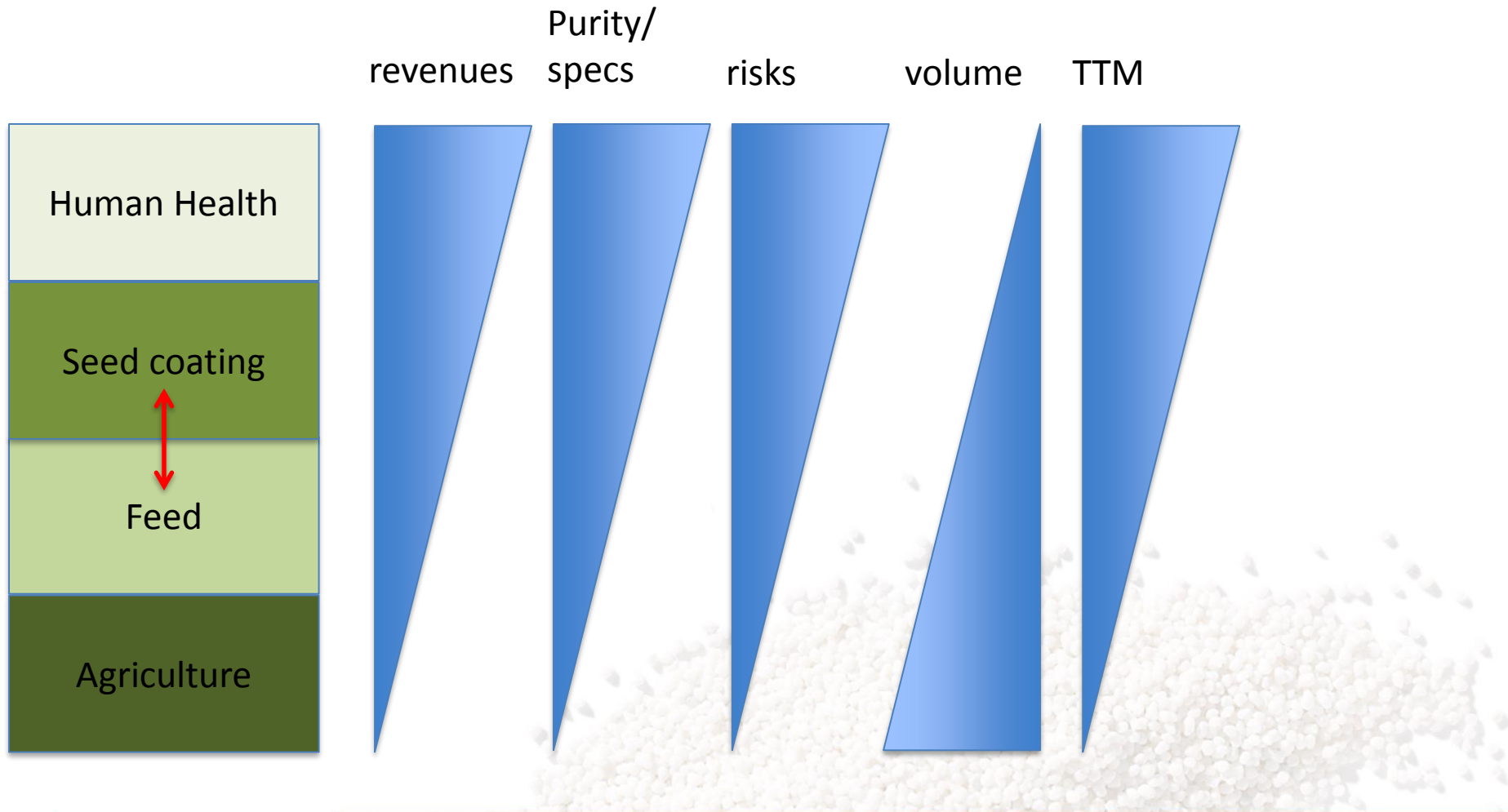
Market interested?

- Yes: 'natural' alternative for current products
- Most companies have heard of positive effects
- These positive effects have an impact on costs/revenues and environment

However:

- A lot is unknown
- Product is relatively expensive
- Legislation not ready for biostimulants

Fulvic- and humic acids: Markets



Agriculture; specific effects

- Humic acids

Are relative big and bind auxines ('plant hormones')

It therefore stimulates root growth and growth in general

Use on soil at start growth season

- Fulvic Acids

Are very small and can enter (e.g.) plants

Can bind and transport otherwise insoluble iron, manganese, etc

Various uses: foliar spray

Environment (e.g. pH, water, crop, soil) huge impact on effect(s)

Agriculture; tests

- Horticulture, several tests on basil
- Fulvic acids from PWN Andijk: desalted and dewatered



- Up to 10% growth rate and 20% Fe uptake were measured
- However: sodium levels were still too high

Feed (animal-)

Sodium a lesser problem (?)

Literature:

- Better food uptake (saving food costs for farmer)
- Less manure (saving costs)
- Better health (less antibiotics)
- More meat and faster growth

However: not keen on animals testing and where to start?

Characterisation & cooperation with feed producer

Characterisation 2.0

- Study done by University of Udine (It)
- Isolation and characterisation of humics
- Three samples (PWN, De Watergroep, municipal wastewater)

Results:

- > 95% fulvic acids
- 50% humic-C, 50% non-humic-C (WW 25/75%)
- HS from brine better soluble (advantage above traditional)

Advice: further spectometry analysis and in vitro tests

Finance

- Salt recovery seems feasible
- Cost production fulvic acids and revenues sales +/- in balance, where:
 - dewatering dominant in costs
 - trade off in purification and sales value
 - 'hidden costs' in storage, certification, transport
 - demand volatile and insecure

And now....?

- Humics in top-5 projects AquaMinerals
- Further characterization
- Further lobbying on legislation
- Cooperation with Water Boards
- (In vitro) Tests in close cooperation with (end-)users
- (Cooperation) Contract with end-user within next 12 months
- Minimize costs, maximize revenues

Thank you



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