Towards a ‘Micro-digester App’

Advising African farmers on Anaerobic Digestion &
Use of bioslurry as a fertilizer

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Background

- Number of anaerobic digesters in Sub-Saharan Africa increasing rapidly
  - SNV's Africa Biogas Partnership Programme (ABPP): 50,000+ biodigesters in multiple countries including Kenya
  - Dutch entrepreneurs
- Seed money project: supported by SNV & Kenya Biogas Programme (KBP).
  - Kind of Green Consulting
  - Biomass Research
  - WUR-FBR, WUR-PPS

(Photo: ABPP Hivos SNV)

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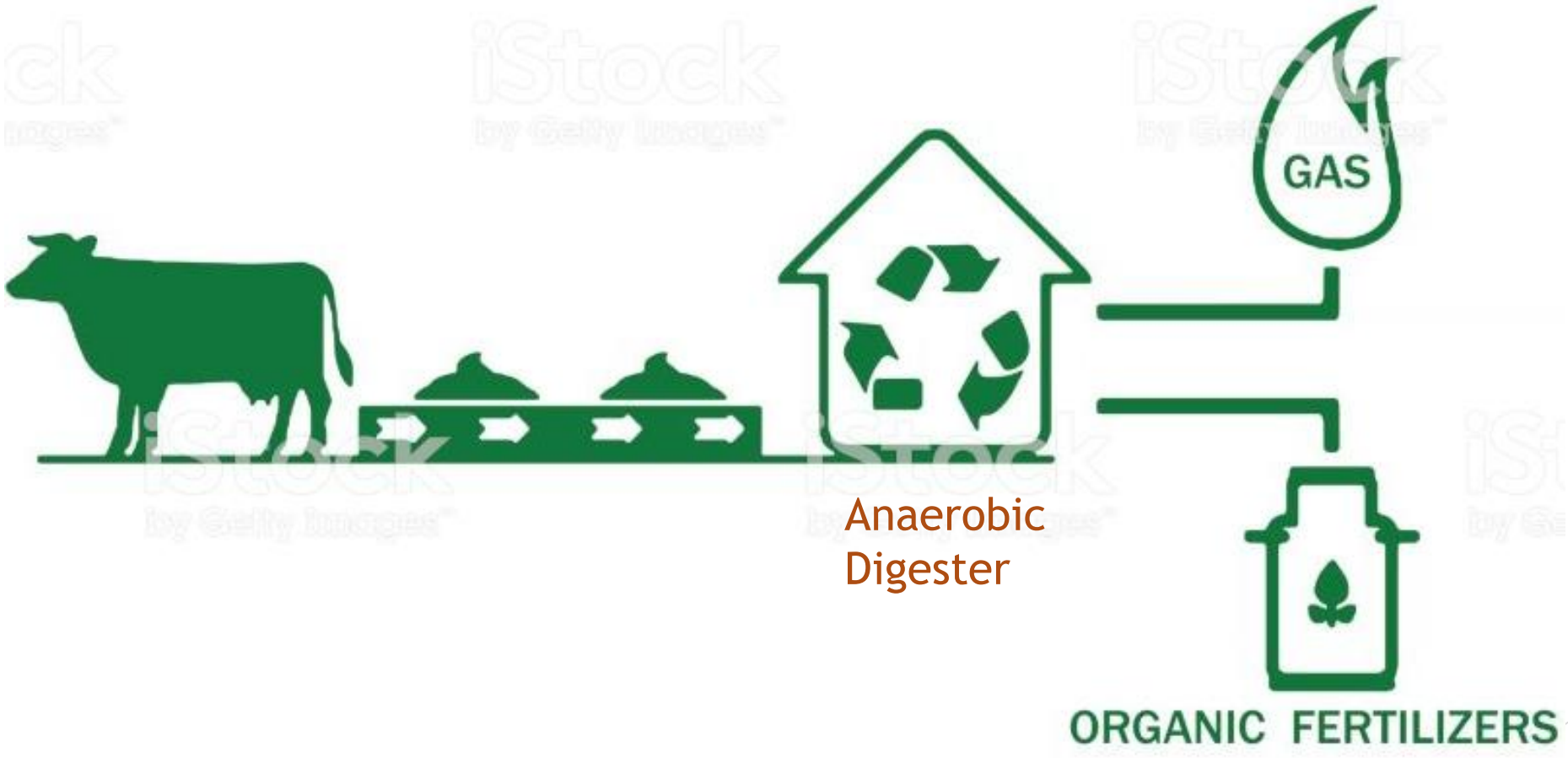

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Background

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- Health
- No Firewood
- Women empowerment
- Etc.

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Background

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- Replace mineral fertilizers -> less GHGs, reduced acidification
- Improved fertilizer quality compared with fresh manure, less pathogens
- Etc.

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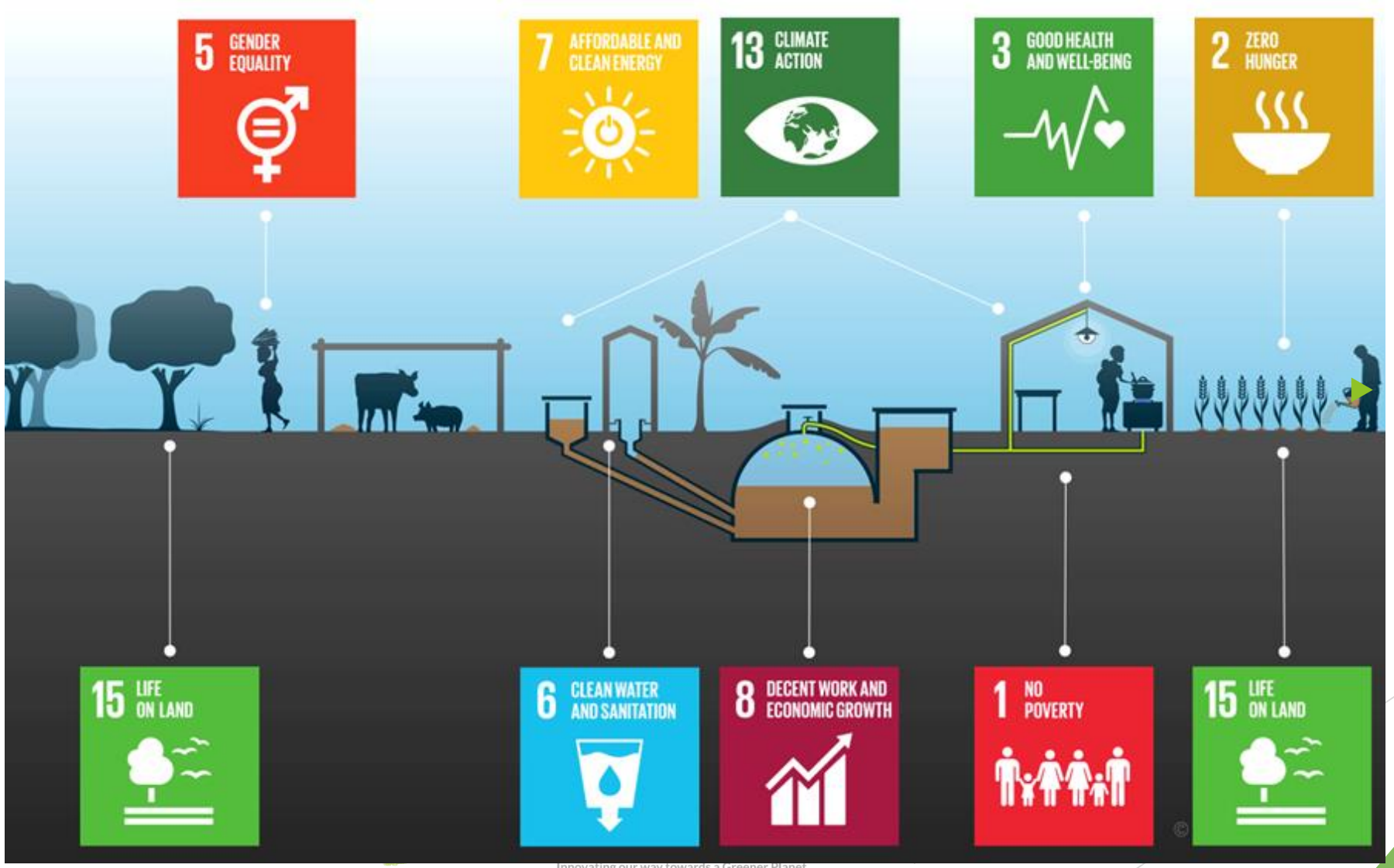

Biodigesters contribute to 10 of the 17 SDGs (Image: ABPP Hivos SNV)

Seed money project

- Links with TKI innovation agendas:

Er zal gezamenlijk worden ingezet op de volgende innovatiethema's:

1. **Duurzame plantaardige-, dierlijke- en aquatische productie:** resistent en stressbestendig uitgangsmateriaal, ecologisch houdbaar, gezonde bodem, plant- en diergezondheid, optimaal dierenwelzijn, biodivers, eiwittransitie;
2. **Circulaire systemen:** klimaatneutraal, energieneutraal, waterefficiënt, verwaarden mest, (nieuwe) groene grondstoffen, schoon en efficiënt transport, vermindering voedselverspilling, duurzame verpakkingen;
3. **Gezond en veilig:** gezonde en veilige producten, gezonde leefstijl, gezonde, groene (stedelijke) omgeving, vermindering antibiotica gebruik, beheersing zoönosen;
4. **Slimme technologie:** ICT/big data, robots, sensoren, innovatieve materialen en andere technologie die bijdraagt aan robuust, klimaatslim, circulair produceren en meer gezondheid;
5. **Consument en maatschappij:** aankoop en consumptie van duurzame, veilige en gezonde producten, maatschappelijk draagvlak, informatie en transparantie, eerlijke prijs, consumentenvertrouwen.

TOPSECTOR HORTICULTURE & STARTING MATERIALS

Topsector Agri & Food

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Seed money project

Problems:

- Huge variation in bioslurry composition
- Knowledge on its application amongst African smallholders lacking
- Lack of clear and safe recommendations for bioslurry application in the field

This project:

- Compile knowledge on the influence of AD on fertilizer value of different feedstocks (animal manures, crop residues, food waste, etc.)
- Work with end-users

Envisaged output:

1. **FACTSHEETS & CALCULATION RULES**
2. **PROTOTYPE MOBILE APP**
3. **FOLLOW-UP PROJECT!**


(ABPP Hivos SNV)

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Results: Fact Sheets

1. Fact sheet 1: Anaerobic Digestion. Highlights:
   - Nutrient composition of cattle manure digestate/bioslurry
   - Changes in composition during anaerobic digestion of cattle manure
   - Relationship Biogas vs. loading rate
2. Fact sheet 2: Fertiliser value of bioslurry. Highlights:
   - Nitrogen cycle and processes
   - Forms of N,P and K taken up by plants.
   - Synchronisation of supply and demand of nutrients
   - Fertilizer needs for maize grain yield in Kenya
   - Fertiliser & Economic value of bioslurry
   - Acid soils and bioslurry value
   - Fertilizer recommendations for Banana, Napier and Coffee
3. Fact sheet 3: compost production from cattle manure digestate in Kenya. Highlights:
   - Prerequisites for optimal composting
   - The fate of nutrients in the composting process
   - Composting mixtures of cattle manure digestate and maize stalks

Results: Fact Sheets

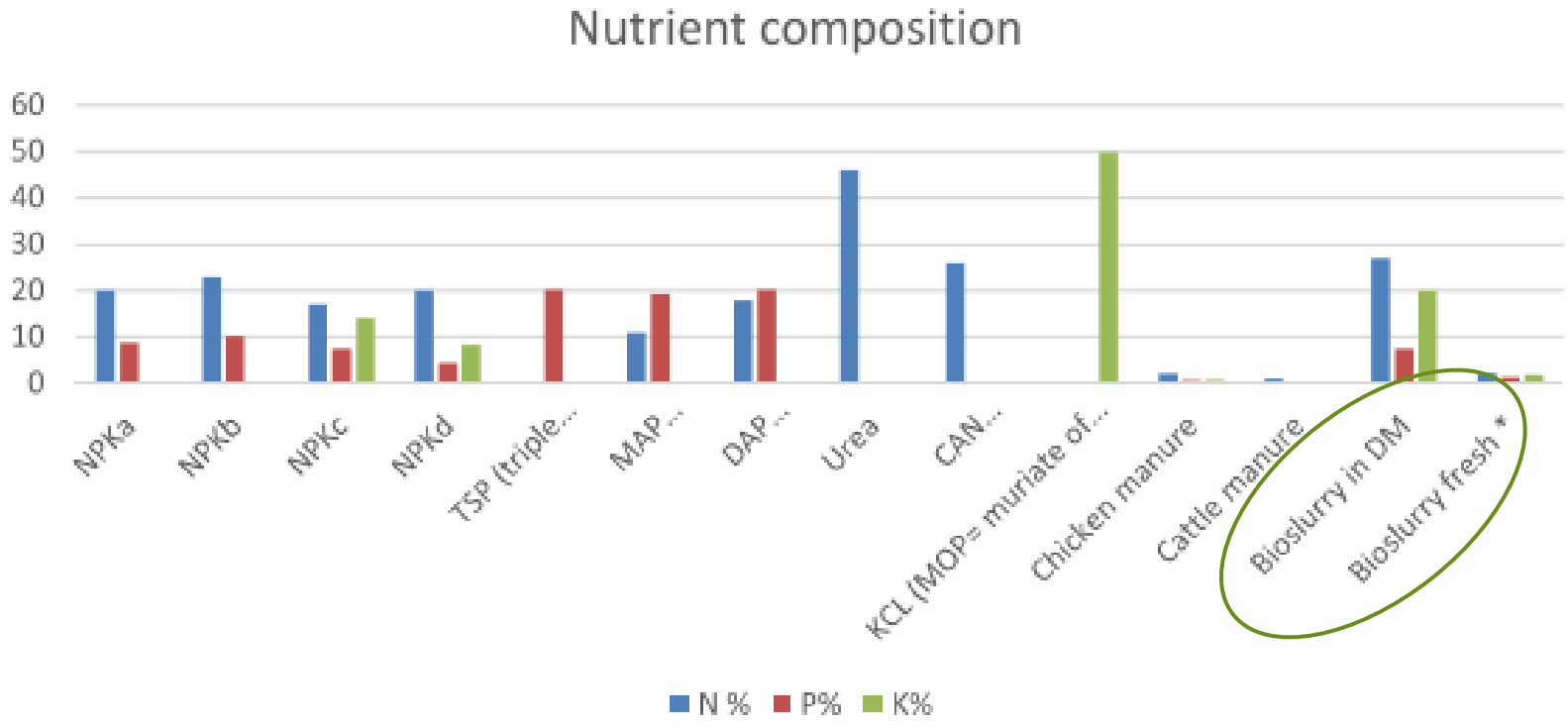
- Bioslurry composition highly variable

Property	Unit	Value
Total Solids	% of Fresh Matter	1.5 – 45.7
Volatile Solids	% of Total Solids	38.6 – 75.4
pH		7.3 – 9.0
N Total	% of Dry Matter	3.1 - 14
idem	% of Fresh Matter	0.12 – 1.5
Nitrogen NH_4	% of total N	35 - 81
Total phosphorus	% of Dry Matter	0.2 – 0.35
idem	% of Fresh Matter	0.04 – 0.26
Total potassium	% of Dry Matter	0.19 – 4.3
idem	% of Fresh Matter	0.12 – 1.15

Source: adapted from Nkoa (2013; cattle manure)

Results: Fact Sheets

- Average composition Kenyan bioslurry (NPK) estimated from composition of cow manure and chemical changes during AD: $N:P_2O_5:K_2O$ = 40:18:43 (8% DM)
- High pH => stop acidification. High K => banana, coffee
- Fertilization and commercial value calculated, compared to chemical fertilizers



Results: Fact Sheets

Fertilizer needs for maize in Kenya

- Yield gap/potential

Table 1 Yield gaps and main N inputs needed to close them

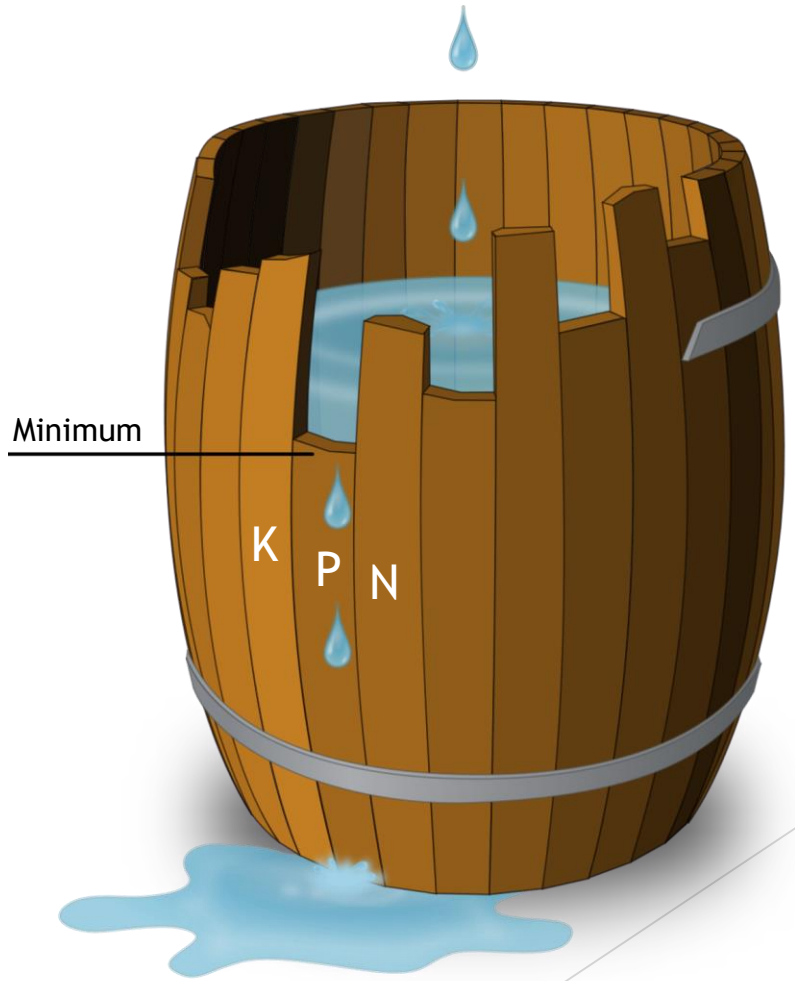
				MIN N INPUT (kg/ha) to close YW-YA by		
STATIONNAME	YA	YW	YW-YA	30%	50%	80%
Dagoretti	1.0	3.2	2.2	18	30	55
Eldoret	3.3	13.8	10.5	80	133	242
Kakamega	2.2	10.2	8.0	59	98	178
Kericho	2.6	11.3	8.7	65	108	197
Kisii	2.0	10.8	8.8	62	104	189
Kisumu	1.0	5.2	4.2	30	50	91
Kitale	3.3	10.1	6.8	58	97	176
Nakuru	2.0	2.8	0.8	16	27	49
Kenya average	**1.9**	**7.9**	**5.9**	**45**	**76**	**138**

Source: www.yieldgap.org

YA = actual yield; YW = water limited potential yield; YW-YA = yield gap

Results: Prototype Mobile (Android) App

1. **Advice on using bioslurry as a fertilizer: (working) prototype**
   - Balanced nutrition/'QUEFTS' approach (Janssen et al., 1990)
   - Other crops to be added (e.g. coffee)
2. **Improved digester management, optimum biogas yield: follow-up project**



Input for app:

1. **Digester & feedstock type**
2. **Location, soil type**
3. **Crop and (target) yield**
4. **Fertilizer options**

Results: Prototype Mobile (Android) App

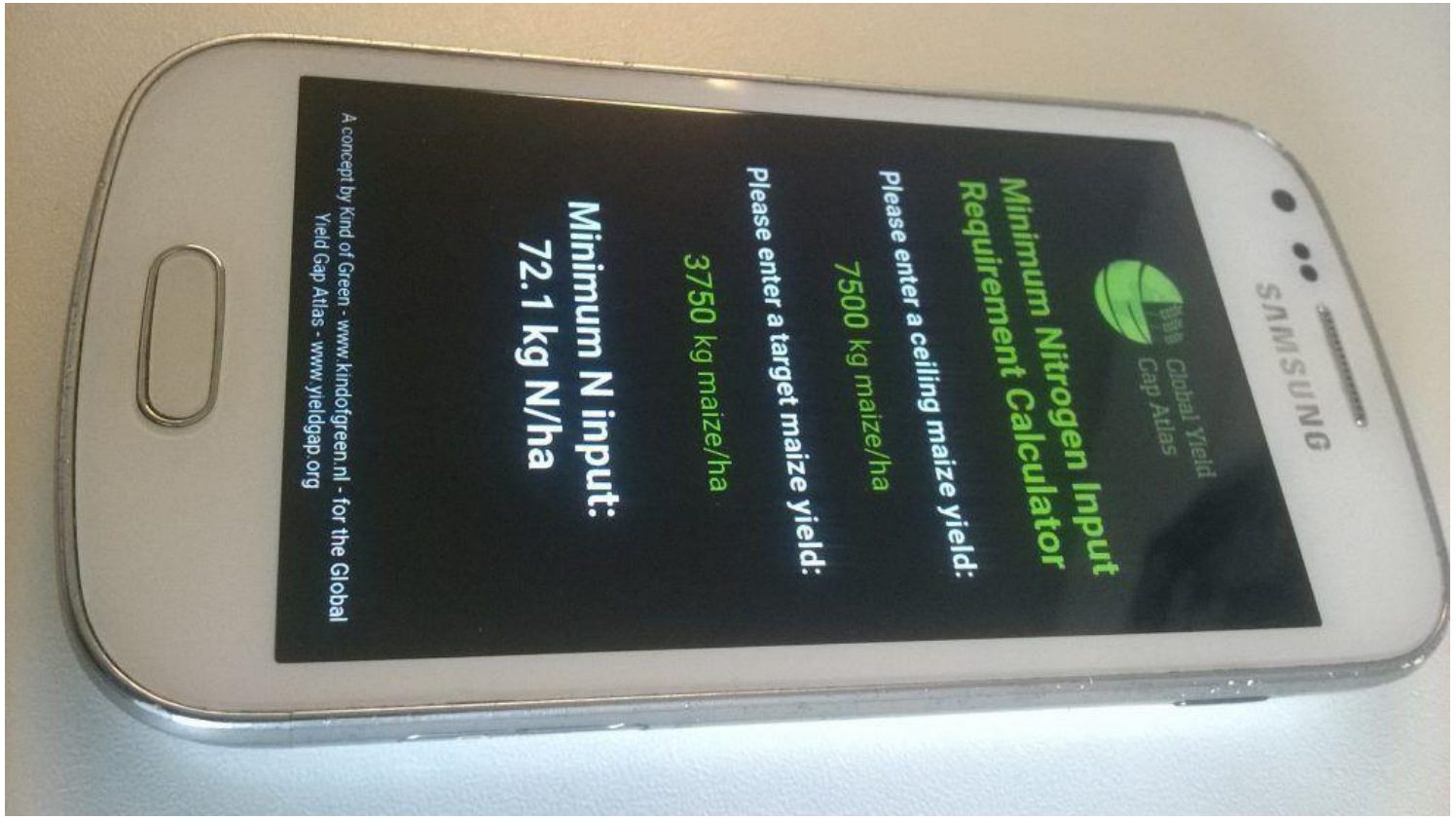
"Fertilizer options?"

- **Use organic manure (or bioslurry!), supplemented with mineral fertilizers as required, according to the 4R's:**
- **The Right elements, administered at**
- **The Right quantities, at**
- **The Right place and at**
- **The Right time.**

(image: Nutrient Platform/ Meststoffen NL)

Results: Prototype Mobile (Android) App

- Based on Kind of Green® app to estimate minimum nitrogen requirements for maize in Africa, developed for www.yieldgap.org



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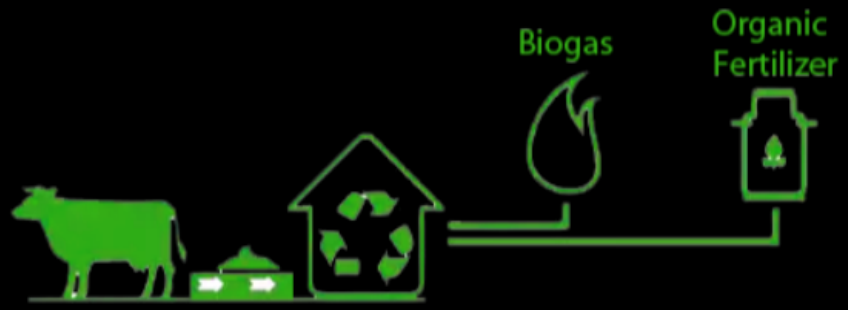
Mobile App – Working Prototype

Biogas Digestate Calculator



Please enter a crop (banana or maize):

maize

Please enter a (target) crop yield:

5000 kg/ha

Minimum nutrient input for maize:
43 / 5 / 28 kg NPK/ha

Nutrients in 1.6 t digestate DM / ~20 t FM:
43 / 11 / 32 kg NPK/ha

www.kindofgreen.nl

Follow-up?

- Incorporation as a pilot in a H2020 project?!
- Acquiring other funding
- Further development of the app
- Developing/disseminate learning materials as part of a 'biodigester academy' / MOOC
  - HIVOS
- Test application in practice
- Roll out!

  - Interested partners?
    - *Contact hans@biomassresearch.eu*
    - *or contact info@kindofgreen.nl*

Potential follow-up – EC H2020

CE-SFS-36-2020 – Diversifying revenue in rural Africa through bio-based solutions *1st-stage: 22-01-20; 2nd-stage: 08-09-20*

Wageningen Research is coordinating a proposal:
New sustainable biobased solutions to increase prosperity in East Africa (**Biobased4EastAfrica**)

Focus on developing and testing of some Key Enabling Technologies linked to existing agri-food value chains in some selected East African countries

Micro-digestion for co-production digestate-based nutrients for soil improving together with biogas for cooking will be one of the KETs that will be dealt with

2-3 European/ African stakeholders (technology providers and testing supervisors) per KET will be invited to join the consortium

Thanks for your attention!

For more information:
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