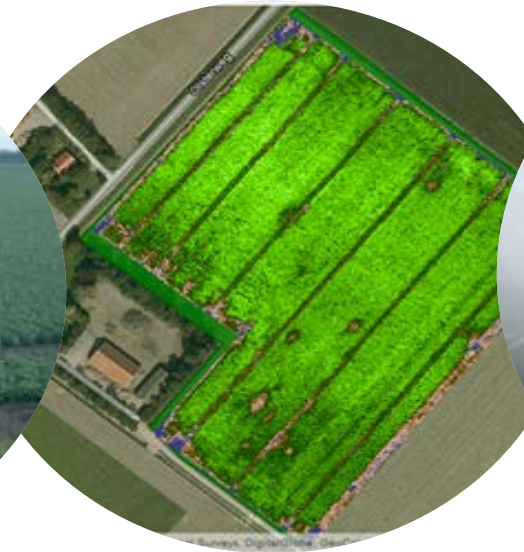


# Precision farming on Dutch arable farms: status, challenges and outlook

Corné Kempenaar

Farminar on Smart Soil Improvement; July 8, 2020



# Development of agriculture



- 12.000 years of agriculture
  - First revolution (10.000 BC) start of cultivation of crop plants on land
  - Arab (800-1300) and British (1750-1900) agricultural revolutions
  - Third or Green revolution (1930-1960)
  - **Fourth revolution**
    - Precision agriculture/farming (first mentioned around 1990)
    - Continuum to smart farming/digital farming/pixel farming/data driven farming/.....



# Dutch AgriFood Statistics and agricultural sectors

## Trade

Nederland is **2<sup>e</sup>** exporteur van agrarische producten in de wereld

Export AgriFood **91,7** mld. euro

Tech export AgriFood **9,1** mld. euro

Market share van **6,3 %** (WTO)

Businesses Meer dan **106.000**

De Nederlandse agrarische sector heeft relatief de **laagste impact op het milieu** van alle landen in de wereld.

## AgriFood

Turn over AgriFood ca. **140** mld. euro

R&D investering **0,5-1%**

Toegevoegde waarde **<10%**  
**744.000** banen  
**8%** van de Nederlandse beroepsbevolking is werkzaam in de AgriFood sector

Circa **47,6%** van het Nederlandse handelsoverschot in goederen is te danken aan de handel in landbouw- en landbouw gerelateerde goederen.

## Tech

Turn over Tech voor AgriFood ca. **17** mld. euro

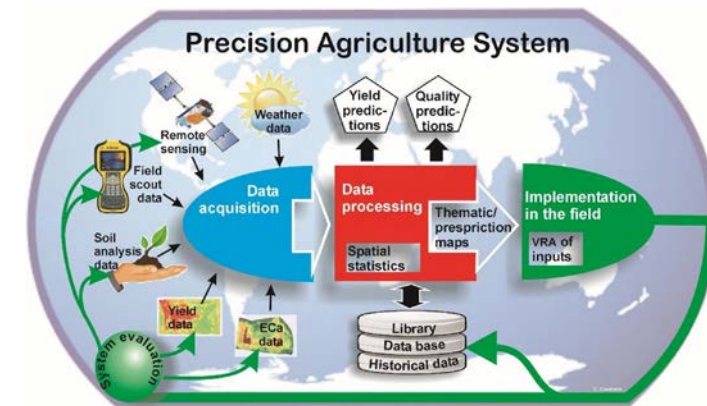
R&D investering **6-7%**

Toegevoegde waarde **>50%**  
**135.000** banen  
**1,5%** van de Nederlandse beroepsbevolking is werkzaam in de Tech voor AgriFood



# Precision Agriculture / Smart Farming / Digital farming / Pixal Farming .....

- A farm management concept based on measuring and responding to temporal and spatial variability in crops, livestock and the environment
  - Sensing -> decision making -> implementation
    - Operational, tactical, strategical operations
    - **Focus on Variable Rate (operational)**
- Many enabling technologies (IoT) are available:
  - Sensors, computers, DSS, FMIS, GIS, GNSS, satellite data, robotics, .....
- Expected benefits (in short): More with Less & Better



# Requirements for precision farming

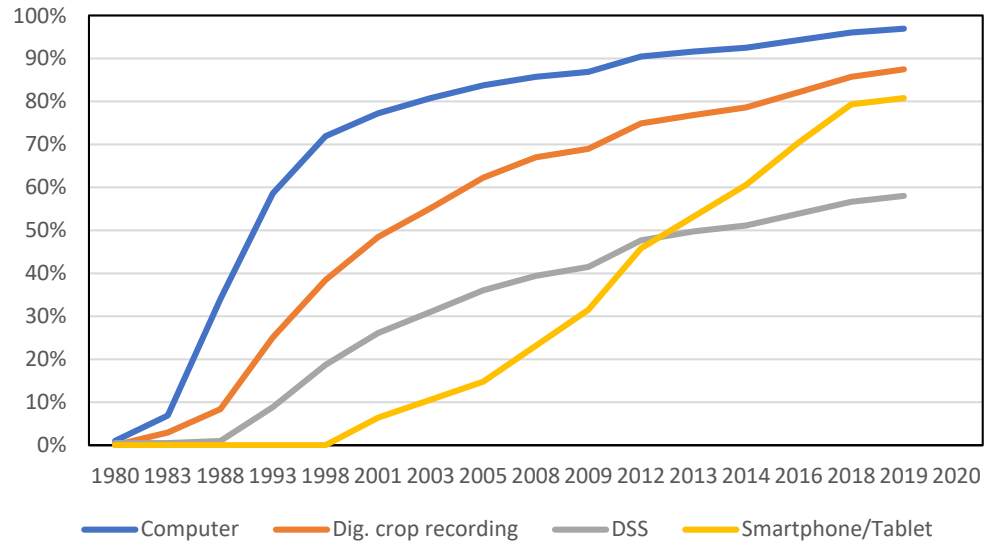
- Farm management information system
- GNSS on the farm
- Data: soil, crop and yield variability maps
- Access to other data at farm level: soil, climate, pests, ...
- Decision support
- Machines prepared for VRA



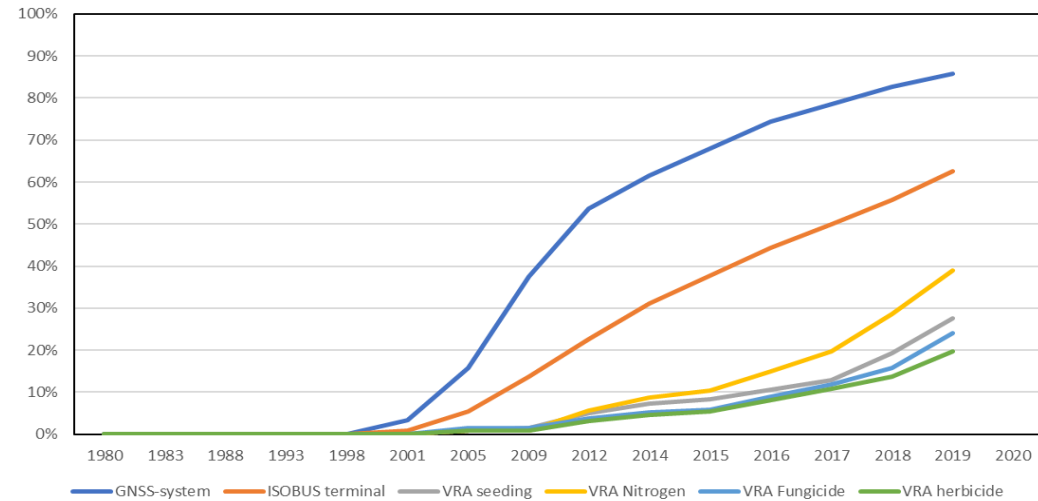


# Technology adoption by Dutch farmers with interest in PA

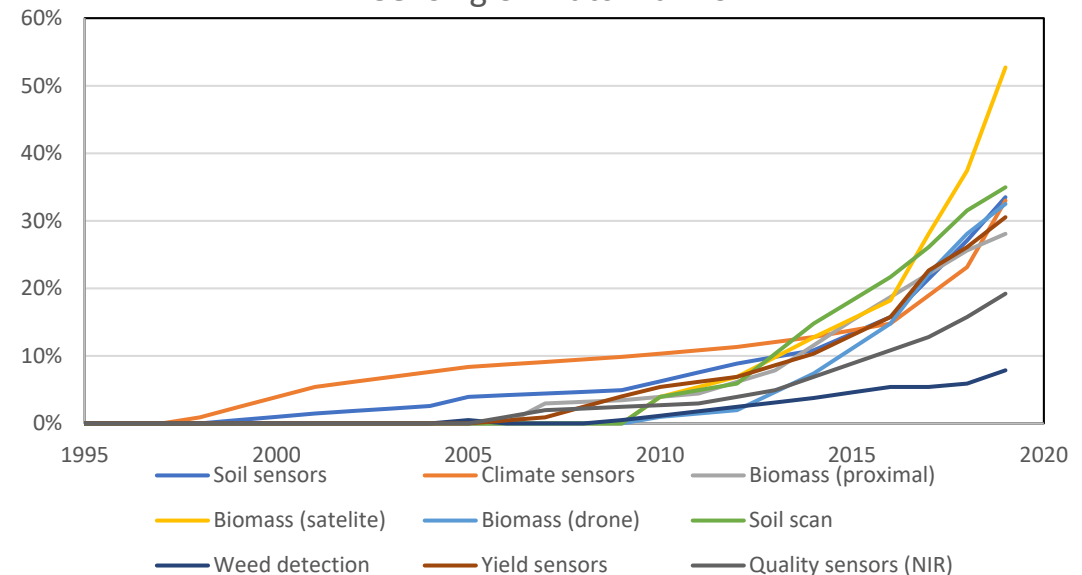
## ICT and DSS on Dutch farms



## GNSS, CTF and VRA on Dutch farms



## Sensing on Dutch farms



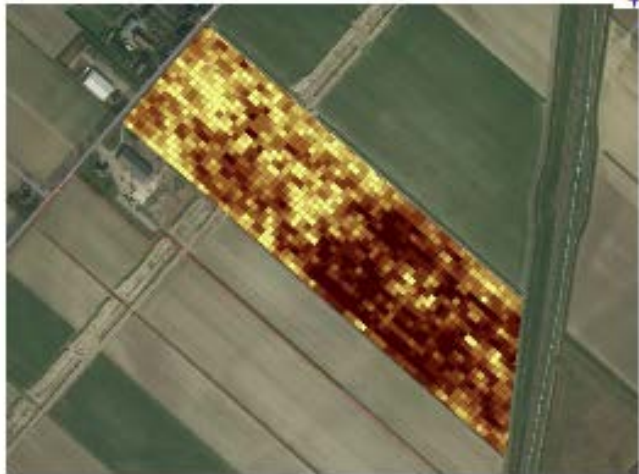
# Soil sensors systems for mapping of soil properties



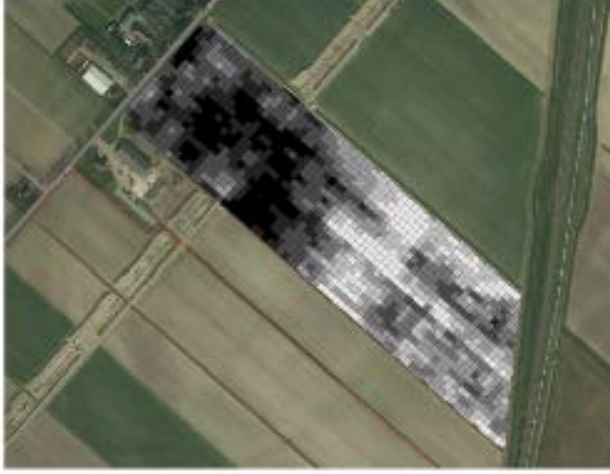
VORR ORGANSUBST. N-DE KAPPE



VORR TITELM RANDE



|                                  |             |         |
|----------------------------------|-------------|---------|
| Klant: boyer nederland           | 6,0 - 6,7 % | 1,78 ha |
| Bedrijf: 2017                    | 5,2 - 5,9 % | 1,02 ha |
| Perceel: thuis links van bedrijf | 5,4 - 6,0 % | 2,72 ha |
| Naam: trum DC OM HG CCC 10 r     | 5,1 - 5,3 % | 2,83 ha |
| Min: 3,5 %                       | 4,8 - 5,0 % | 1,83 ha |
| Max: 6,7 %                       | 4,5 - 4,7 % | 1,48 ha |
| Gem: 5,3 %                       | 3,5 - 4,4 % | 1,44 ha |



|                                  |               |         |
|----------------------------------|---------------|---------|
| Klant: boyer nederland           | 20,2 - 20,8 % | 1,20 ha |
| Bedrijf: 2017                    | 28,3 - 30,1 % | 1,20 ha |
| Perceel: thuis links van bedrijf | 26,3 - 28,2 % | 2,75 ha |
| Naam: lulu h BL UM HG LCU - 10 L | 24,4 - 26,2 % | 2,01 ha |
| Min: 14,0 %                      | 22,5 - 24,3 % | 2,11 ha |
| Max: 32,9 %                      | 20,6 - 22,6 % | 1,71 ha |
| Gem: 25,4 %                      | 14,8 - 20,5 % | 1,30 ha |



# Crop biomass data from light reflection sensor systems, delivering crop biomass maps

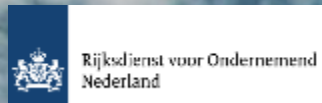




# Satellite image of potato crop (NDVI biomass map)





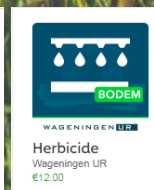
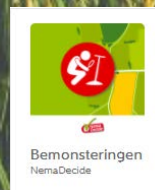
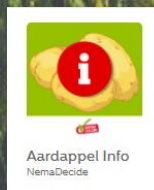
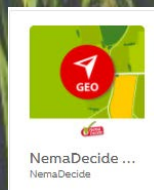
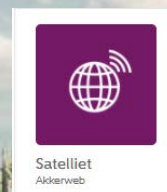
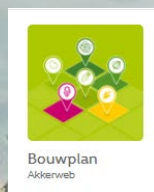


From data in the Cloud



akkerweb.

To applications in the field

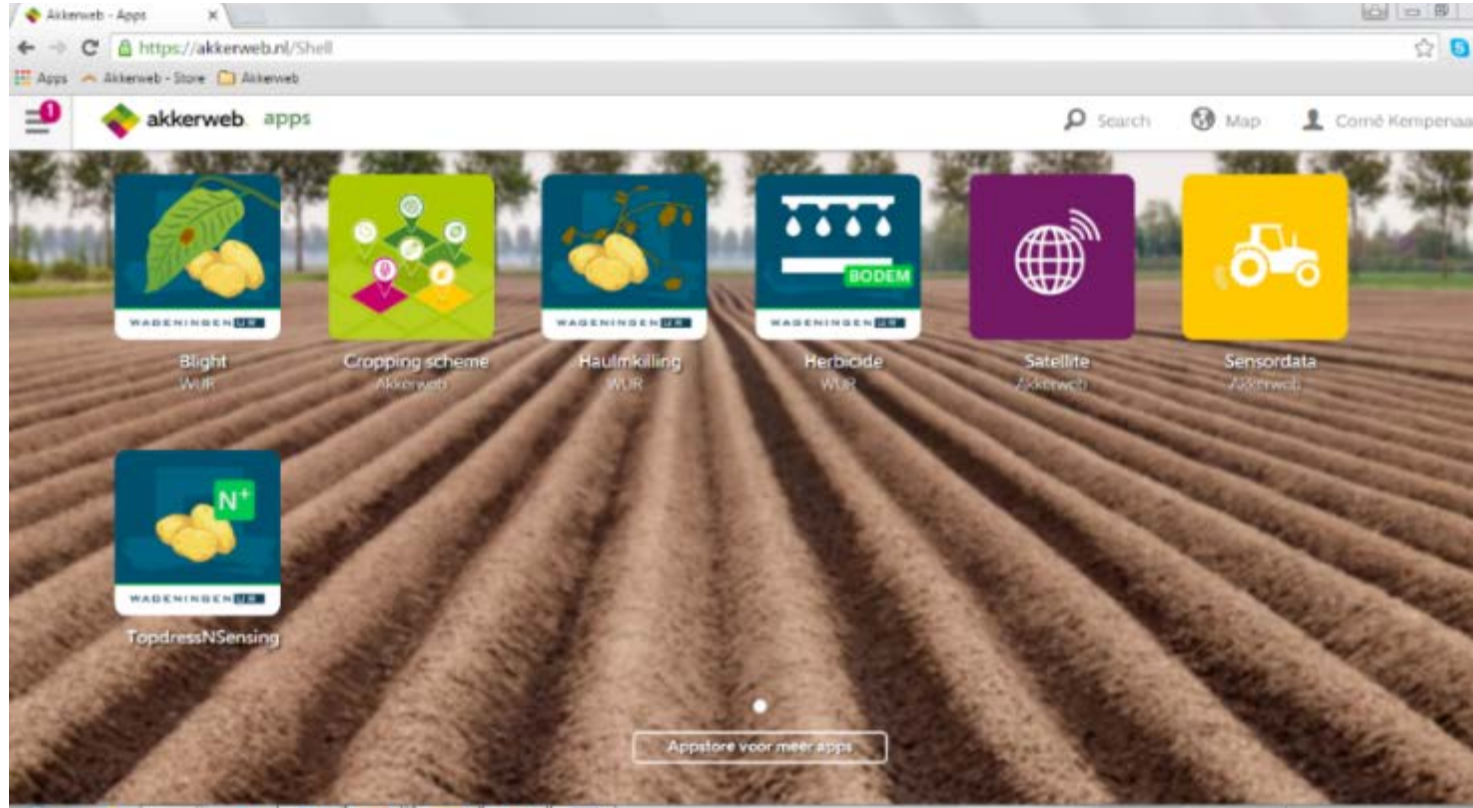


W  
UN

# Akkerweb data platform ([www.akkerweb.eu](https://www.akkerweb.eu))

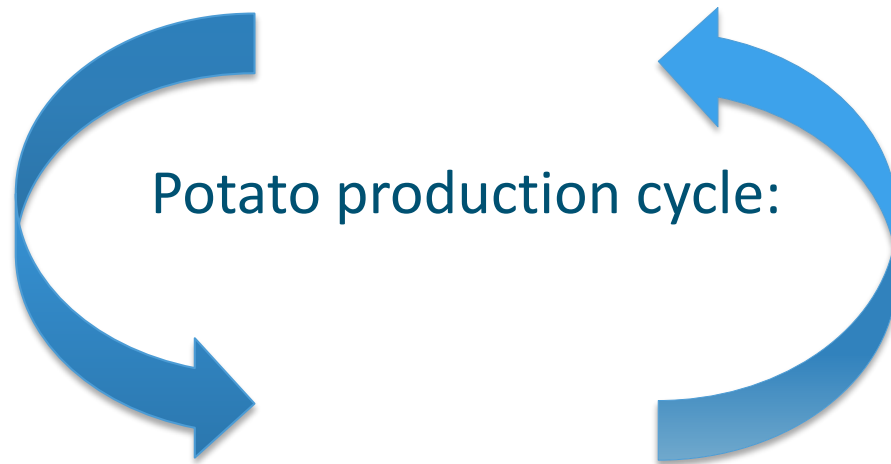
## ■ Apps for

- VRA Potato haulm killing
- VRA soil herbicides
- Topdress N
- Blight
- GAOS
- Grip on Grass
- Nematode management
- VRA planting density
- And more .....



WAGENINGEN  
UNIVERSITY & RESEARCH





The collage illustrates the potato production and storage cycle through 14 images arranged around a central circular diagram. The central diagram features two blue curved arrows forming a circle, with the text "Potato production and storage cycle" in the center.

The images depict various stages of the cycle:

- Top Left:** A tractor with a potato planter in a field.
- Top Center:** A large pile of harvested potatoes.
- Top Right:** A long, covered storage structure for potatoes.
- Right Side (Top to Bottom):**
  - A large indoor storage facility with rows of potato bins.
  - A close-up of a large pile of potatoes in a storage bin.
  - A green storage building in a field.
- Bottom Right:** A tractor with a potato harvester in a field.
- Bottom Center (Left to Right):**
  - A tractor with a potato harvester in a field.
  - A tractor with a potato harvester in a field.
  - A tractor with a potato harvester in a field.
  - A tractor with a potato harvester in a field.
- Bottom Left:** A tractor with a potato harvester in a field.
- Far Bottom Left:** A logo for Wageningen University & Research.

|                                       | Hoeveelheid Eenheid                    | Prijs Eenheid                           | Bedrag |
|---------------------------------------|--|---|--------|
| <b>Benefit (q*p) (a)</b>              | 53560 kg                               | 0.16 €/kg                               | 8,332  |
|                                       | 1.Closing the yield gap, still ca. 40% |   | 8,332  |
| <b>UITGANGSMATERIAAL</b>              |  |   |        |
| pootgoed                              | 2700 kg                                | 0.28 €/kg                               | 756    |
| <b>BEMESTING</b>                      |  |   |        |
| kalkkammonsalpeter                    | 252 kg N                               | 1.05 €/kg N                             | 265    |
| tripelsuperfosfaat                    | 105 kg P <sub>2</sub> O <sub>5</sub>   | 1.00 €/kg P <sub>2</sub> O <sub>5</sub> | 105    |
| kali 60 (chloorhoudend)               | 180 kg K <sub>2</sub> O                | 0.64 €/kg K <sub>2</sub> O              | 115    |
| <b>GEWASBESCHERMINGSMIDDELEN</b>      |  |   |        |
| boscalid (27%), pyraclostrobine (7%)  | 0.4 kg,l                               | 66.00 €/kg                              | 26     |
| chloorprofam (300)                    | 1.6 kg,l                               | 31.00 €/l                               | 50     |
| cyazofamid (160)                      | 3 kg,l                                 | 52.00 €/l                               | 156    |
| diquat dibromide (200)                | 4 kg,l                                 | 17.00 €/l                               | 68     |
| fluopicolide (63), propamocarb (524)  | 4.8 kg,l                               | 20.00 €/l                               | 96     |
| lambda-cyhalothrin (100)              | 0.05 kg,l                              | 125.00 €/l                              | 6      |
| mandipropamid (250)                   | 3.6 kg,l                               | 36.50 €/l                               | 131    |
| metribuzin (70%)                      | 0.5 kg,l                               | 44.00 €/kg                              | 22     |
| prosulfocarb (800)                    | 4 kg,l                                 | 13.50 €/l                               | 54     |
| thiaclopyrd (480)                     | 0.15 kg,l                              | 170.00 €/l                              | 26     |
| <b>ENERGIE <sup>2)</sup></b>          |  |   |        |
| stroomverbruik bewaring               | 1071 kWh                               | 0.15 €/kWh                              | 164    |
| diesel                                | 260 l                                  | 1.10 €/l                                | 285    |
| <b>AFZETKOSTEN</b>                    |  |   |        |
| opscheppen                            | 54 ton                                 | 1.80 €/ton                              | 96     |
| <b>OVERIGE PRODUCTGEBONDEN KOSTEN</b> |  |   |        |
| berekende rente                       | 1251 €                                 | 5.50 %                                  | 69     |
| N-mineraalmonster                     | 0.1 keer                               | 43.00 €/keer                            | 4      |
| potatopol                             | 1 ha                                   | 19.45 €/ha                              | 19     |
| <b>Variable costs (b)</b>             |  |   | 2,514  |
| <b>Gross Margin (c=a-b)</b>           |  |   | 5,818  |
| <b>ARBEIDSBEHOEFTE</b>                |  |   |        |
| grondbewerking                        | 4.6 uur                                |   |        |
| bemesten                              | 0.6 uur                                |   |        |
| zaaien/poten/planten                  | 1.4 uur                                |   |        |
| bespuitingen                          | 5.3 uur                                |   |        |
| overige gewasverzorging               | 2.5 uur                                |   |        |
| oogsten                               | 15.2 uur                               |   |        |
| verwerken                             | 0.0 uur                                |   |        |
|                                       | <b>29.6 uur</b>                        |   |        |
|                                       | 3. Less labour and advisory costs      |   |        |

<sup>1)</sup> Energiekosten bij luchtgekoelde bewaring tot eind januari, inclusief opwarmen voor aflevering.



# Variable rate application soil herbicide





# Where is the PA / DF business case in potato for VRA Herbicide use

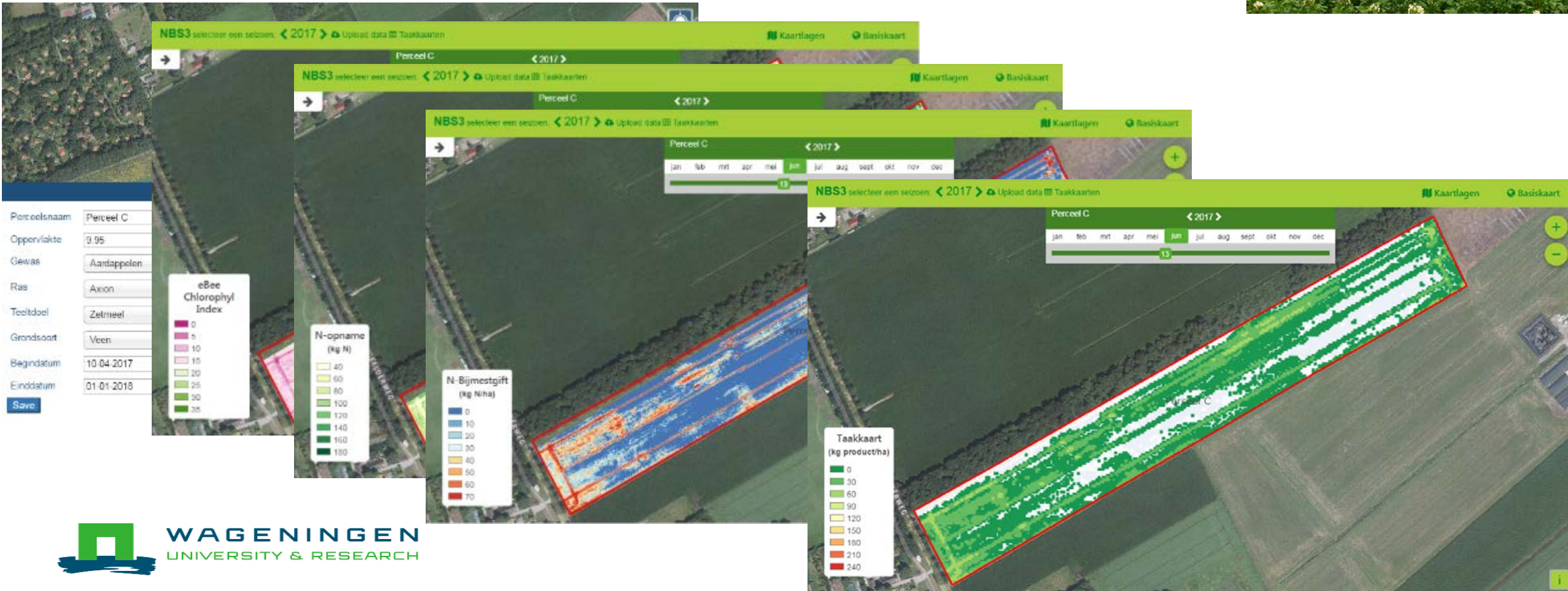
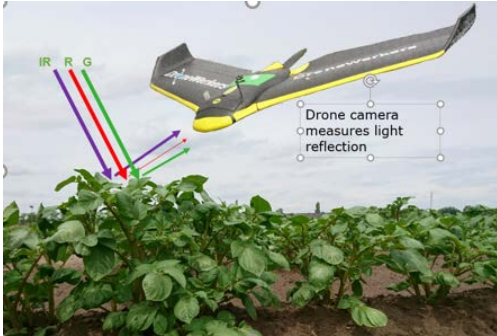


## Quantitative Information French Fries Potato Production in Flevoland, NL, clay soil (Source: KWIN of WUR, 2015)

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|---------------------------------------|--------------------------------------|---|--------|
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|                                       | <b>29.6 uur</b>                      |   |        |

<sup>1)</sup> Energiekosten bij luchtgekoelde bewaring tot eind januari, inclusief opwarmen voor aflevering.

# Variable rate Topdress N-application on Potato field



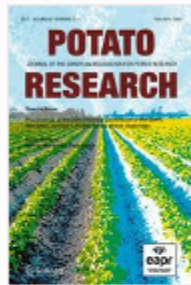






# Summary precision ag. applications in potato

- In potato most crop management activities can be done variable rate at a scale of 30-50 m<sup>2</sup>
- Savings on input are in order of 25 % compared to common practice
- Yield increase up to 5%
- Cost benefit ration becomes interesting when farm size is over 100 ha of potatoes



## [Potato Research](#)

December 2017, Volume 60, [Issue 3-4](#), pp 295-305 | [Cite as](#)

## Advances in Variable Rate Technology Application in Potato in The Netherlands

Authors

[Authors and affiliations](#)

Corné Kempenaar , Thomas Been, Johan Booij, Frits van Evert, Jean-Marie Michielsen, Corné Kocks

# National Fieldlab Precision Agriculture (NPPL)

The project will run 4 years (2018 – 2021)



The project is initiated by Misset and WUR. Financial resources are mainly from Ministry of Agriculture (LNV).

NPPL aims to achieve “more sustainable agriculture” by stimulation of adoption of Precision Agriculture applications.

# NPPL applications 2018



VRA lime application



Nematode management



VRA Topdress N



VRA soil herbicide



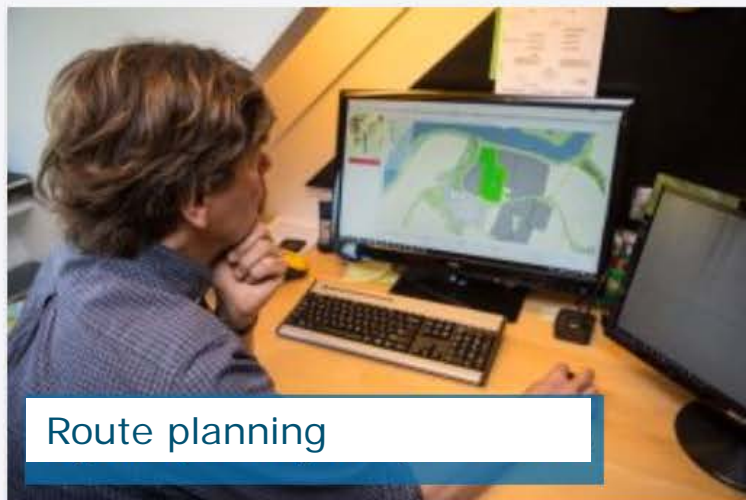
VRA leaf dessicant



VRA planting density



# NPPL applications 2018



Route planning



VRA fungicides in potatoes and flowerbulbs



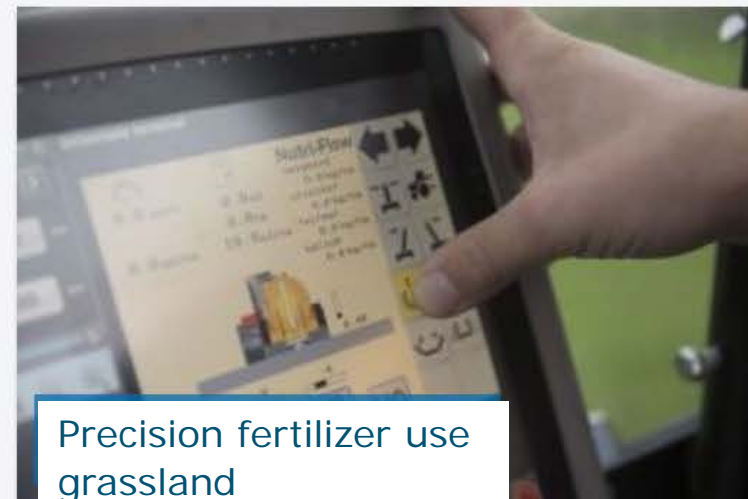
Weed detection and selective control



Precision irrigation



Detection and protection birds in grassland



Precision fertilizer use grassland



# NPPL applications 2020



Precision irrigation (2)



Precision crop protection orchard



Yield monitoring



Precision seeding in healthy soil



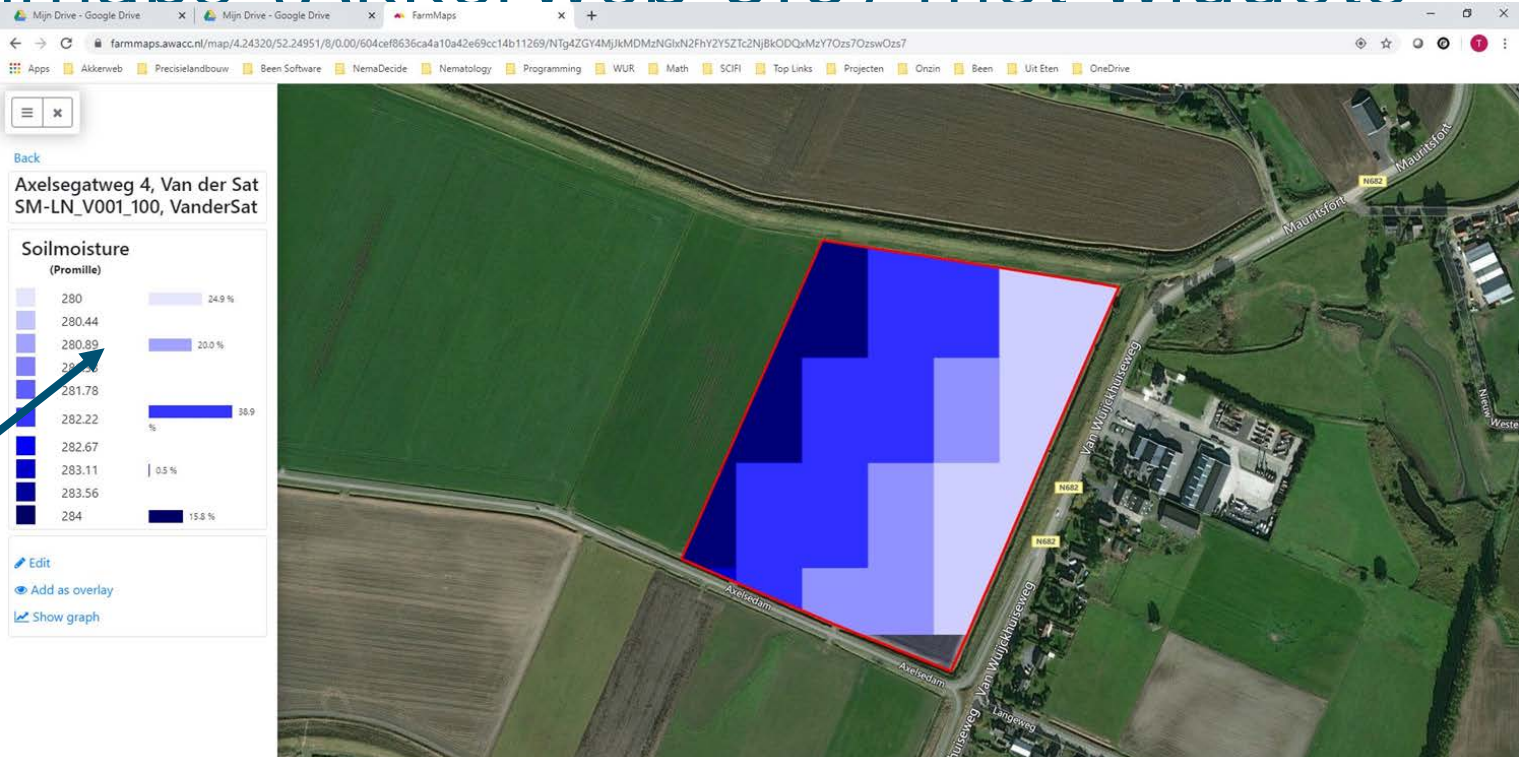
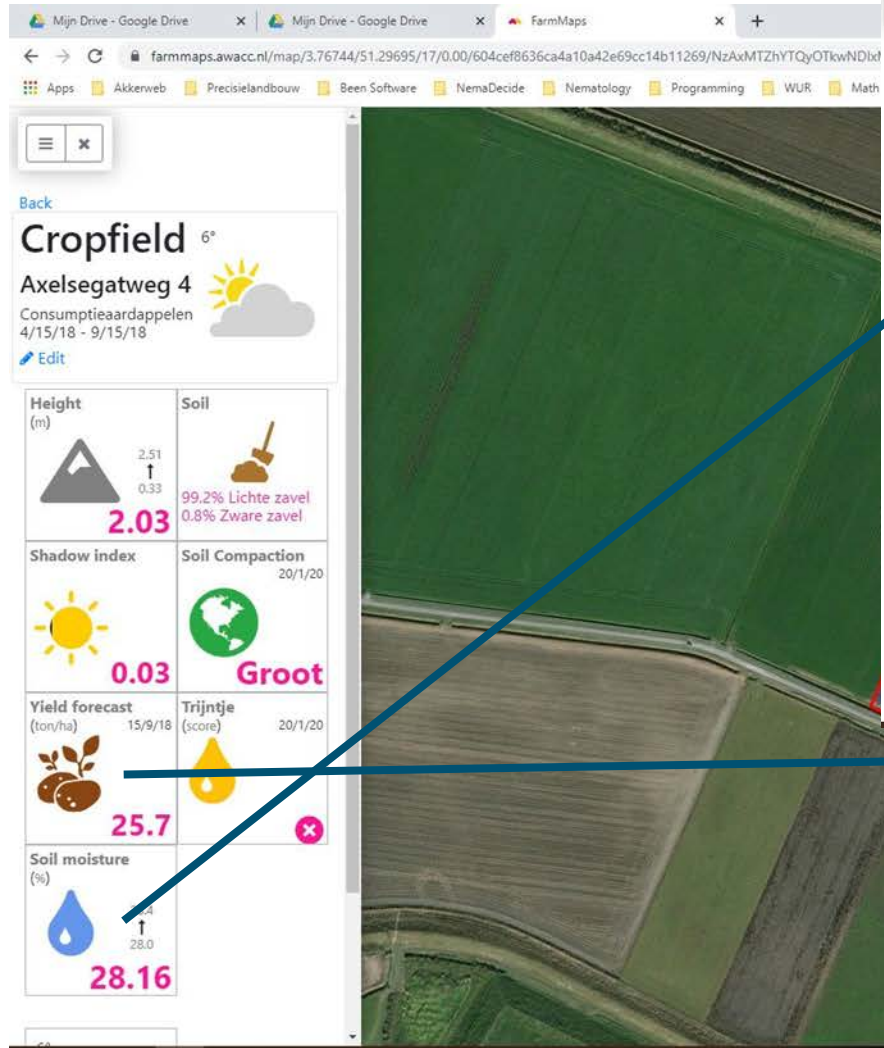
Strip farming



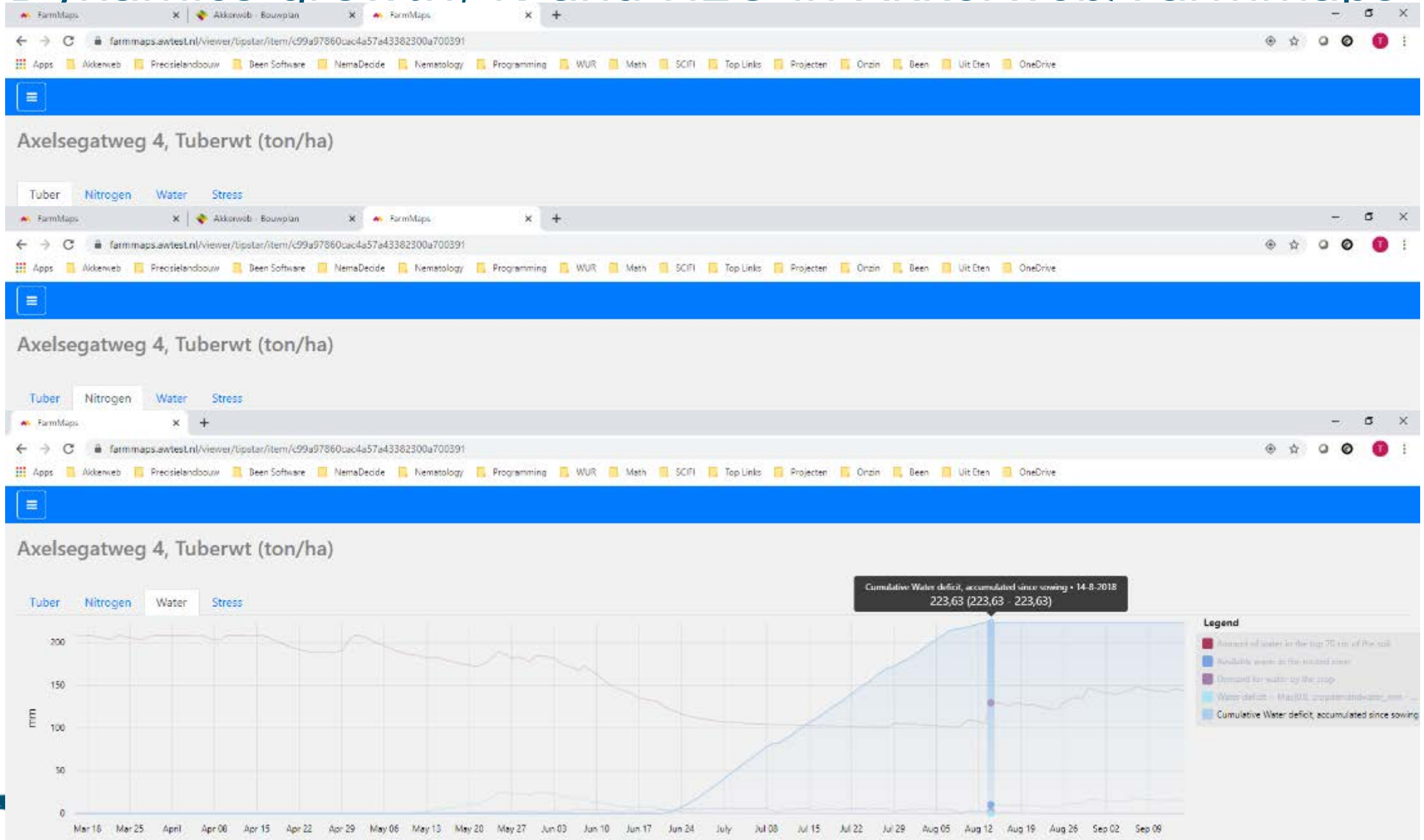
Robot applications



# Dashboards like Farmmaps (Akkerweb 3.0) met widgets



# Dynamics growth, N and H2O in Akkerweb/Farmmaps





# Thank you for your attention

[www.precisielandbouw.eu](http://www.precisielandbouw.eu)

<http://precisielandbouw-openteelten.nl/>

[www.proeftuinprecisielandbouw.nl](http://www.proeftuinprecisielandbouw.nl)

[www.farmofthefuture.nl](http://www.farmofthefuture.nl)

[www.iof2020.eu](http://www.iof2020.eu), [www.smartagrihubs.eu](http://www.smartagrihubs.eu)

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