



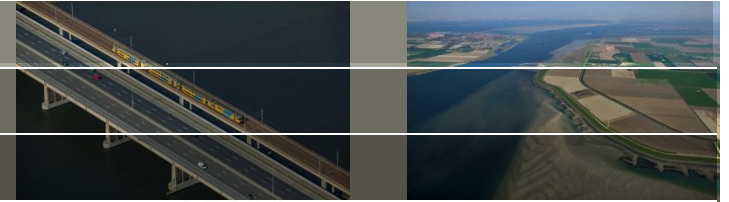
Sharing precious water volumes in the Water Farm

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1. Deltares
2. Aequator
3. Wageningen University
4. Utrecht University

Fresh water for agriculture



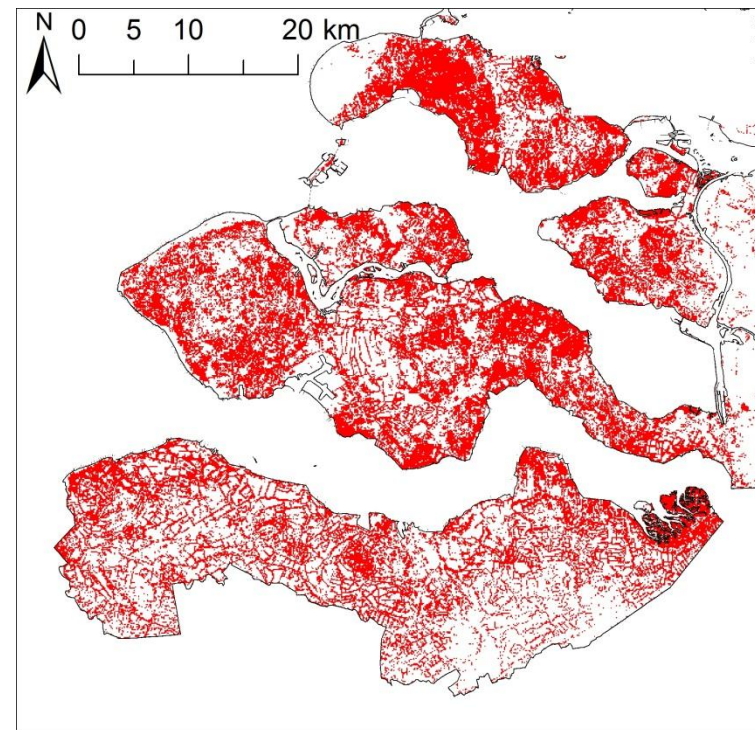
Is crucial:

- In the root zone of crops to prevent salt damage
- For irrigation to prevent drought damage



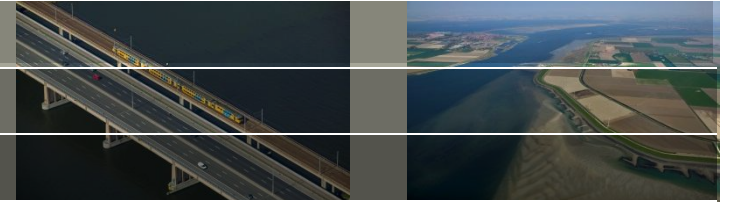
But threatened by:

- Sea level rise
- Change in precipitation patterns
- Land subsidence
- Human interventions
 - Extractions
 - Infrastructure



Salinisation groundwater 2050
under climate scenario 'W+'

Fresh water for agriculture



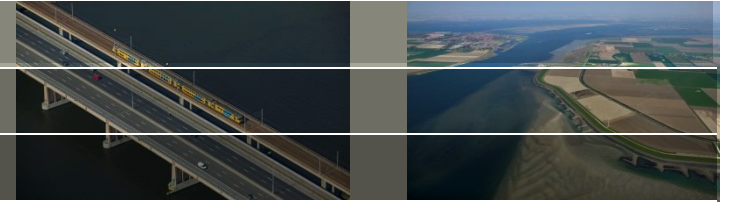
However,

- Awareness of need to act not generally present
- Individual actions at farm level can be counterproductive

Questions arise such as:

- Can water scarcity be solved?
- How to achieve cooperation between farmers?
- How to achieve effective involvement of farmers?
- How can technical measures be adopted by farmers?

Case study: Water Farm



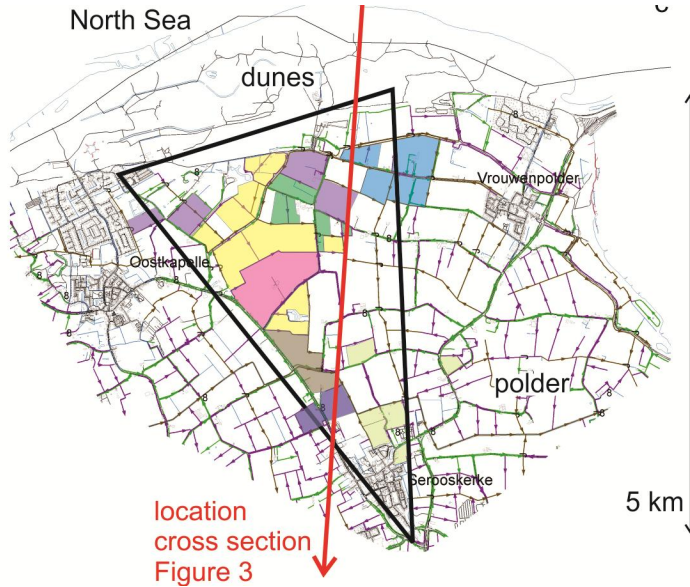
Water Farm: farmers, landowners, municipality and water board collaborate to manage fresh water in the region in such a way that it is not necessary to use water from elsewhere

Freshwater management: the capture, storage, use, processing and delivery of fresh water.

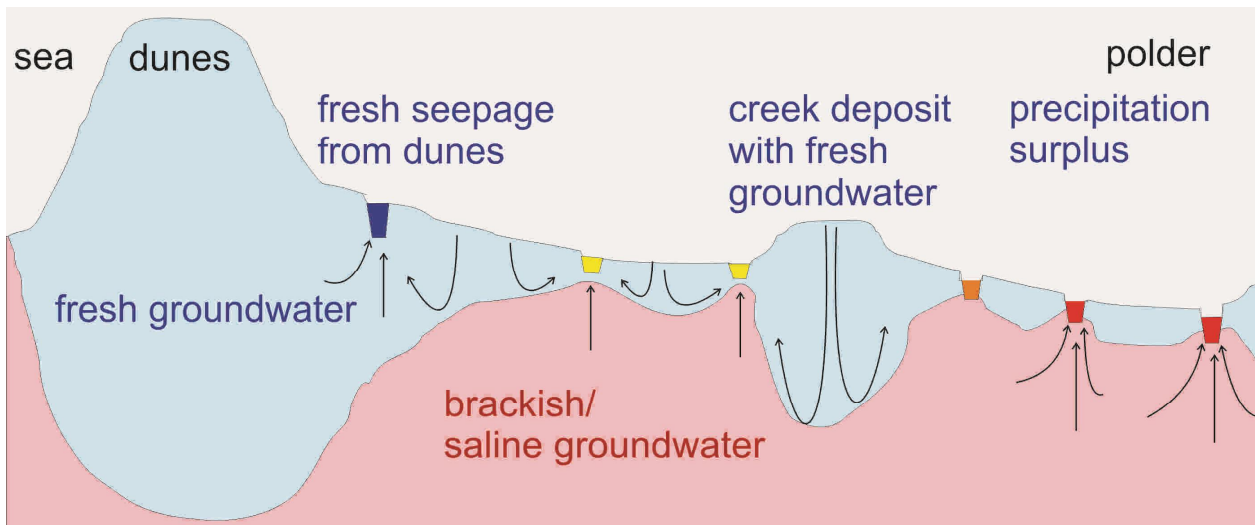
The Water Farm



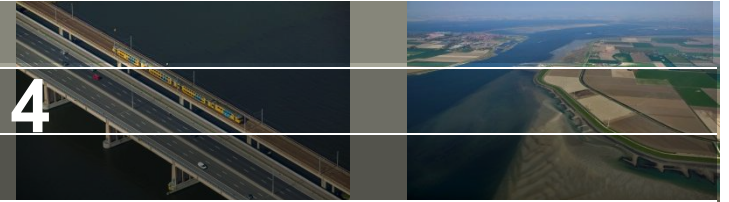
Case study: Water Farm



- 3 km² area
- 8 farms
 - 4 arable farming
 - 2 horticulture
 - 2 fruit
- start case study 2010



Water Farm: some results 2014



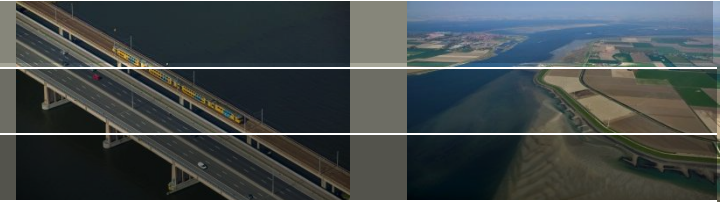
Process

- Registered foundation Walcheren Water Farm
- From research-driven to farmers-driven
- Awareness of the concept Water Farm outside Walcheren

Hydrology

- Understanding groundwater system and freshwater resources
- Subsurface storage of the precipitation surplus
- Conservation of fresh water in soil
- Separation fresh and saline surface water

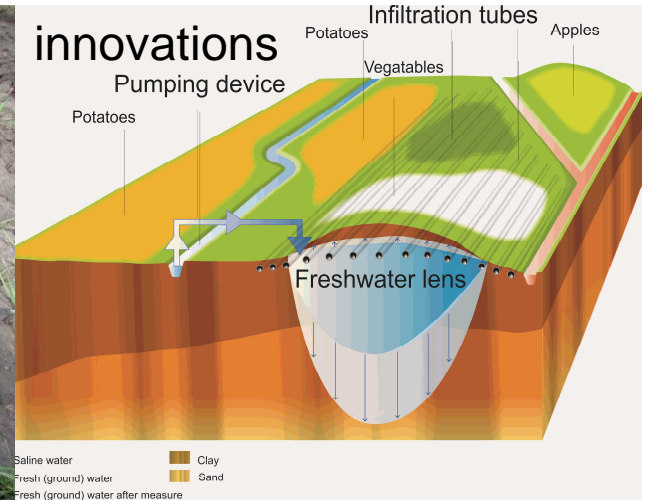
Dynamic interaction



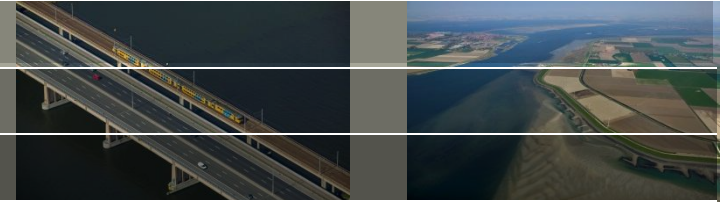
Through dynamic interaction between people, knowledge and innovations a change can be achieved from individual action to joint action towards a regional freshwater supply

Requirements:

1. Participation of water users (people)
2. Knowledge of the hydrological system
3. Possibility to apply technical innovations

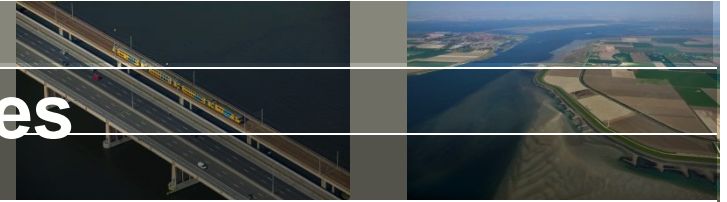


Dynamic framework



| ←Time | Participation | Hydrology | Technical innovations |
|-------|---|-----------|-----------------------|
| | Step 1. Policy | | |
| | Step 2. Local stakeholders | | |
| | Step 3. Goals and opportunities | | |
| | Step 4. Stakeholders from cothinkers to coworkers | | |
| | Step 5. Development | | |
| | Step 6. Field testing | | |
| | Step 7. Consolidation | | |
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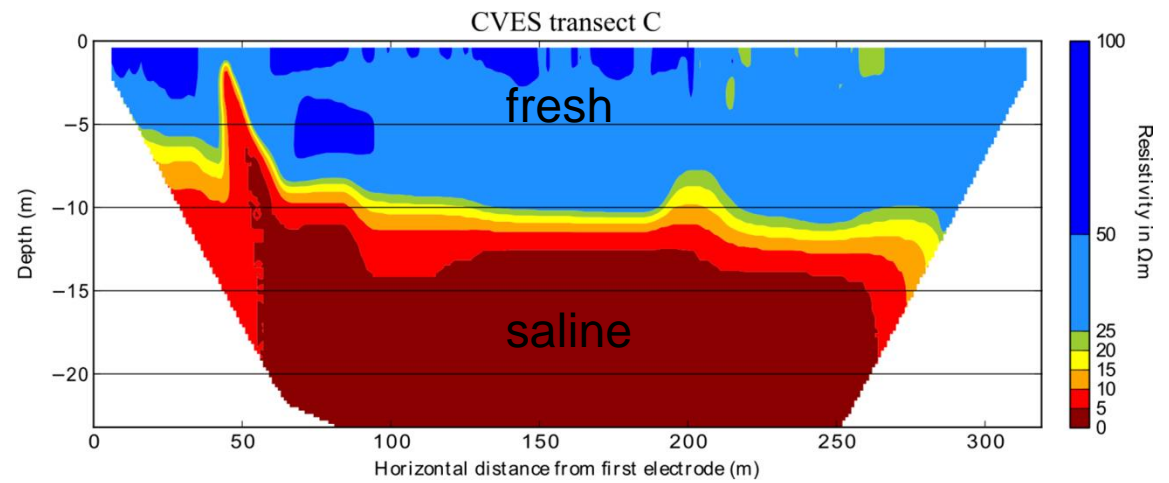
Step 3. Goals and opportunities



Cothinking



Information on local situation



Step 4. Stakeholders from cothinkers to coworkers

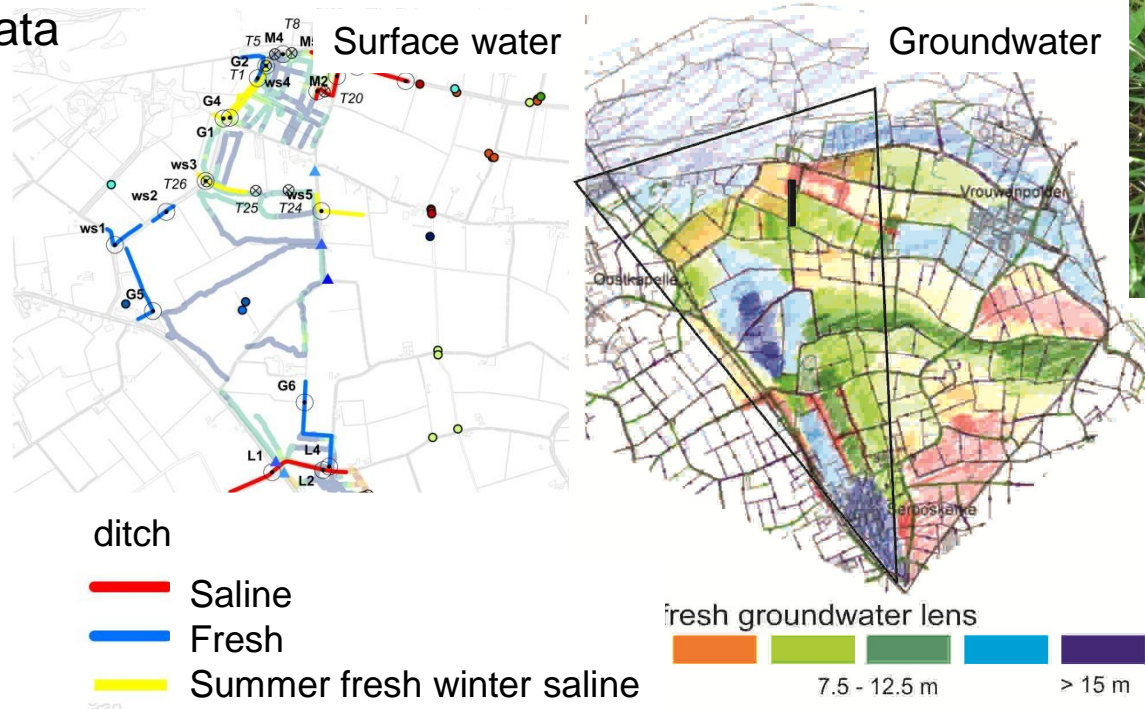
Stakeholders performing project tasks: participative monitoring



Exposure to existing applications: fieldtrips



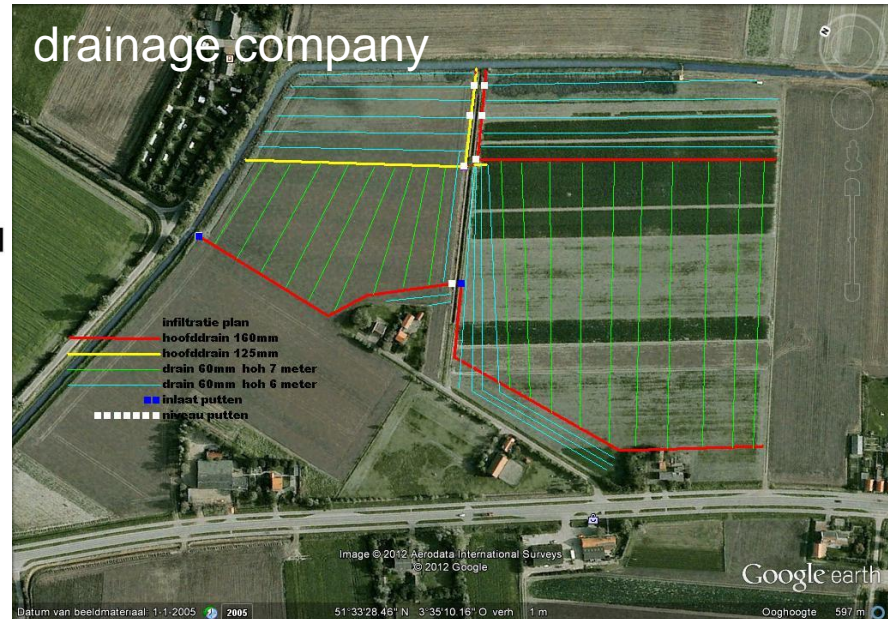
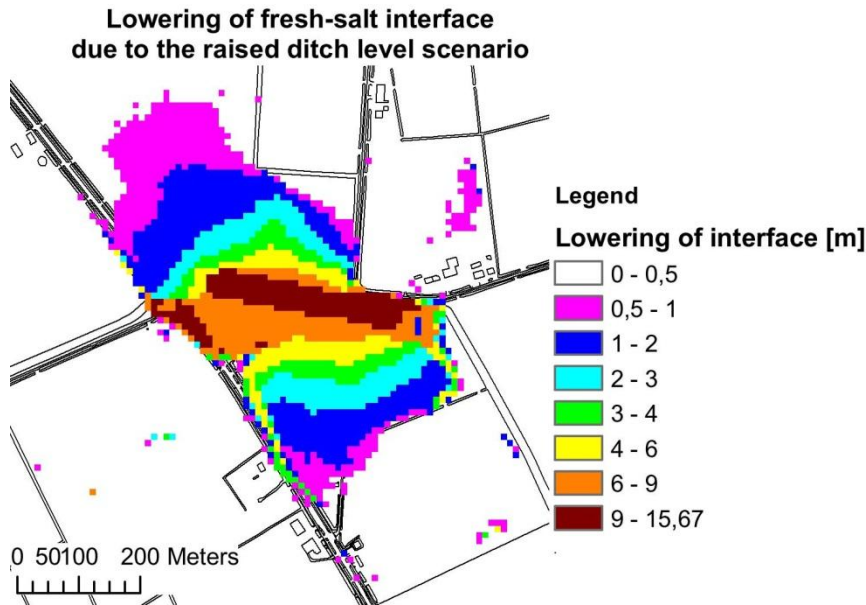
Analysis data



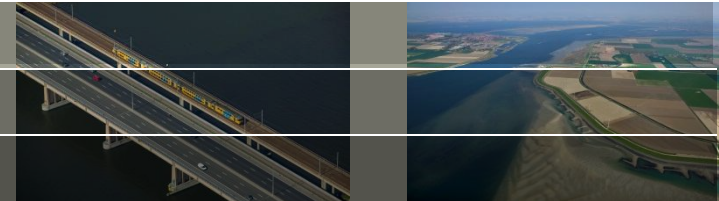
Step 5. Development

- codesign measures
- communication to outside world

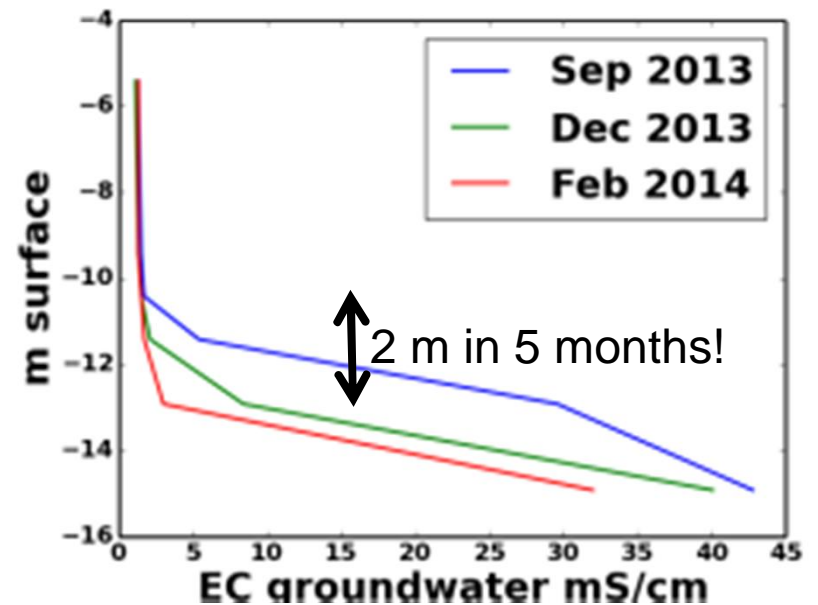
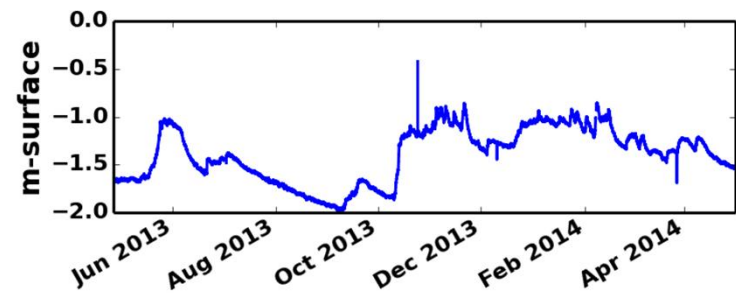
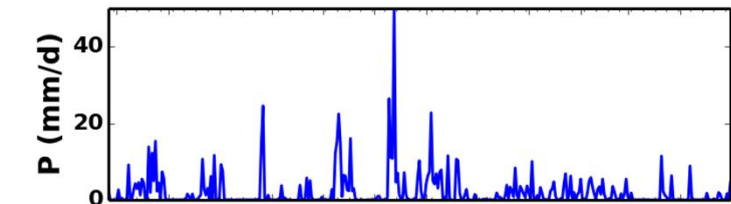
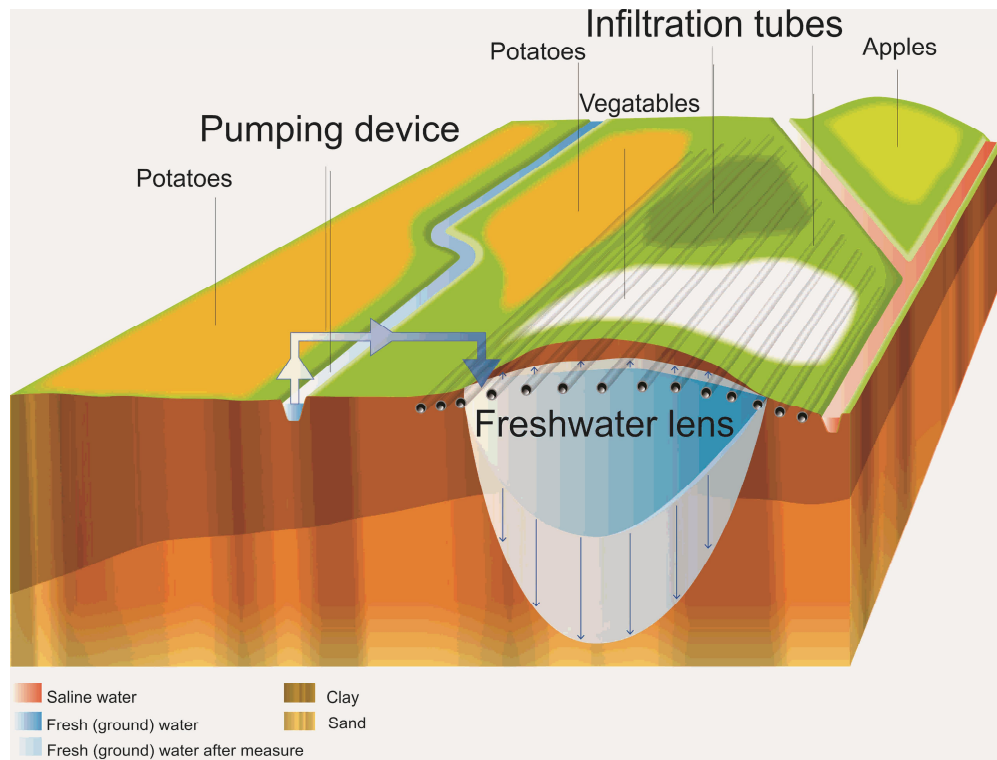
Researchers: scenario analysis



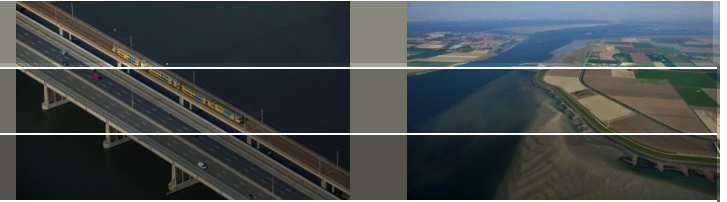
Step 6. Field testing



Joint implementation
Creekridge Infiltration System



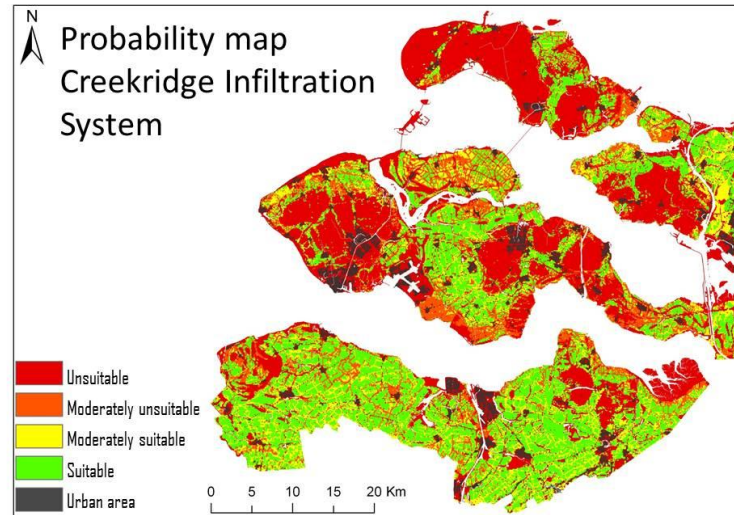
Step 7. Consolidation



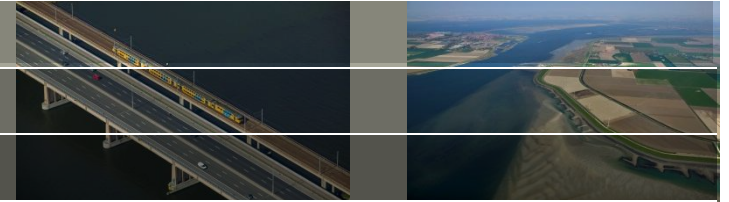
1. Possibilities subsurface storage Case Study area



2. Toward regional approach...



Conclusions

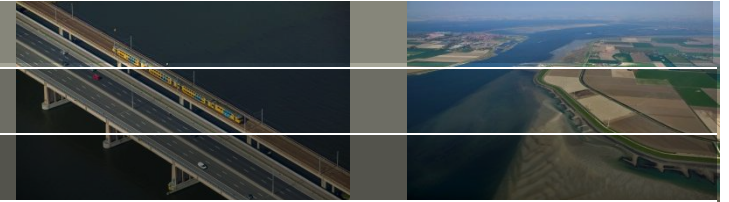


The case study has revealed that a careful process design in combination with hydrological system knowledge and technical innovations is essential to ensure results such as:

- Farmer behavior from individualistic to collaborative
- Farmer awareness of their own responsibilities and possibilities
- Successfully implemented technical innovations:
 - CreekrIDGE Infiltration System
 - conservation of fresh water in soil
 - separation of fresh from saline surface water

This was confirmed by stakeholders during interviews.

What's next



Towards regional freshwater supply

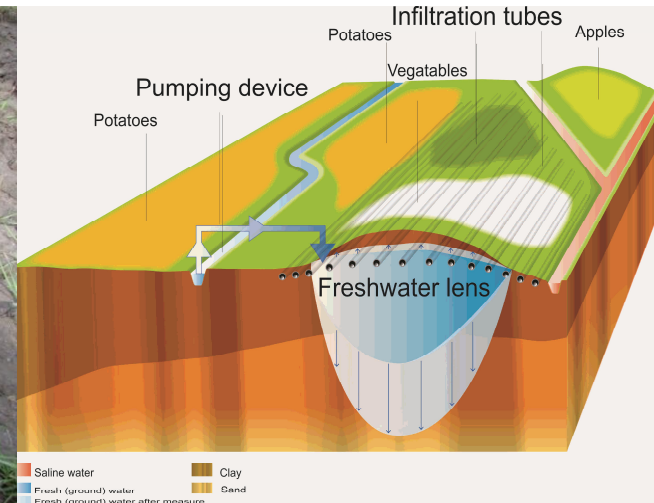
- Knowledge of the hydrological system area wide
 - AEM coastal zone Netherlands
- Upscaling technical innovations
- Techniques ready for implementation elsewhere
- Bottom-up approach

Approach can be used for other areas, such as:

- Israel / Palestine
- North Tunisia
- Po Delta Italy
- Vietnam



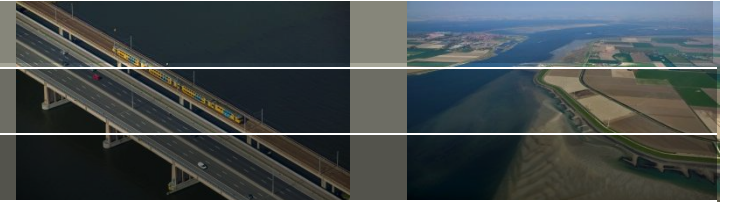
Questions?



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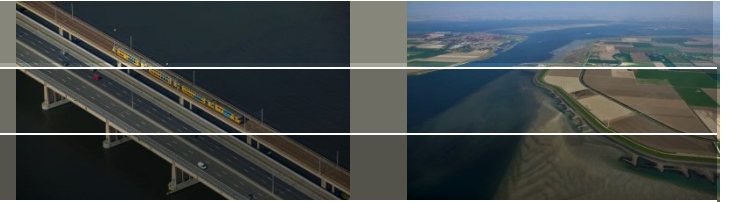
Esther van Baaren, Bouke Ottow, Marco Arts, Pieter Pauw and Gualbert Oude Essink, 2014 concept. The Water Farm: an innovative process + content approach to fresh water management for agriculture. Submitted to journal of water resource management.

Israel / Palestine



In Israel/Palestine there are several transboundary river basins (e.g. Kidron/Wadi Nar, Yarkon/al Oujia) including different groundwater systems (Zeitoun 2007), in which stakeholders act individually, but experience shared problems such as water scarcity, flash floods and pollution that can be solved only by concerted action. In a process in which all stakeholders participate, new hydrological knowledge enhances the understanding of all stakeholders about the system they live in; coupled with the introduction of practical technical innovations, dialog and joint investment are stimulated, possibly leading to joint, or at least, concerted solutions.

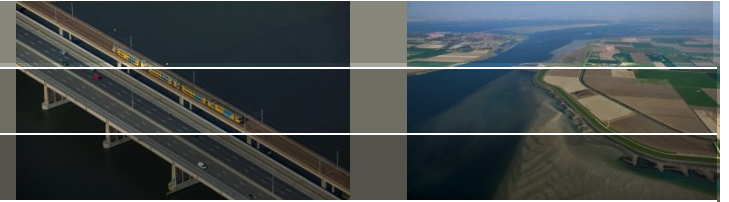
Tunisia



Another example is in Mornag, in north Tunisia, where the availability of surface water is limited and this water is becoming extensively polluted (Charef *et al.*, 2012). Several adaptation strategies are possible to improve the quality of surface water and groundwater and to secure freshwater supply for the (near) future. New technologies, tools and approaches are needed to improve water resources management in this coastal zone. The framework demonstrated here could be very useful in the communication between the Tunisian authorities, universities and farmers.

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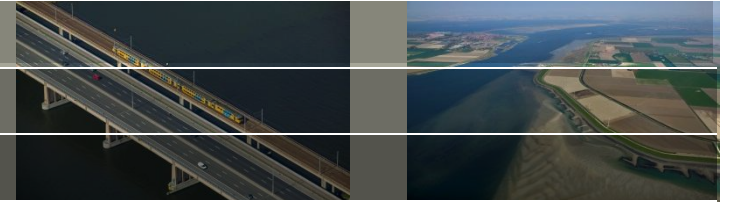
Po delta Italy



In Europe, the Po delta in Italy is similar to the Rhine-Meuse estuary: a low-lying subsiding delta with multiple water users in dry summers (Antonellini *et al.*, 2008). The water users initiate large abstractions, causing subsidence and severe drainage, and the regional availability of freshwater is expected to decline (Giambastiani *et al.*, 2007). Research is being done to elucidate this complex hydrogeological system, but interaction with the other stakeholders could be improved by applying our framework, bringing together the different stakeholders for joint action toward an effective regional approach for freshwater supply.

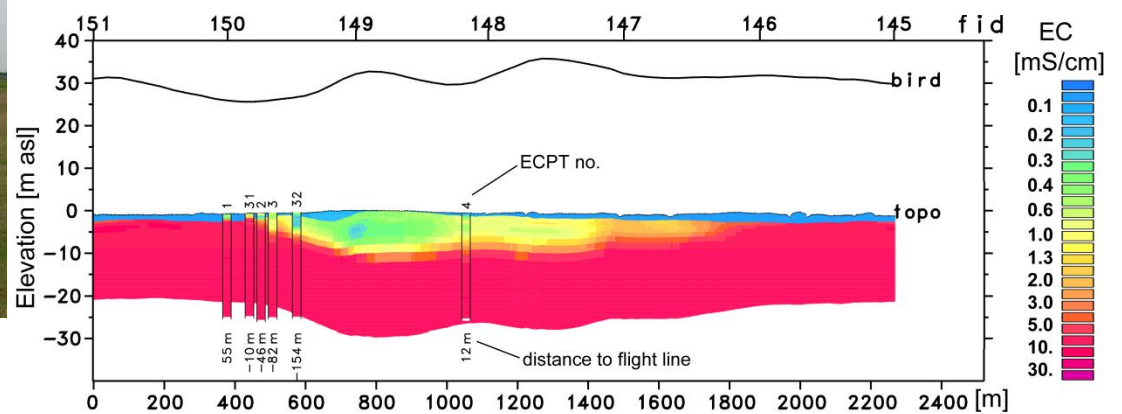
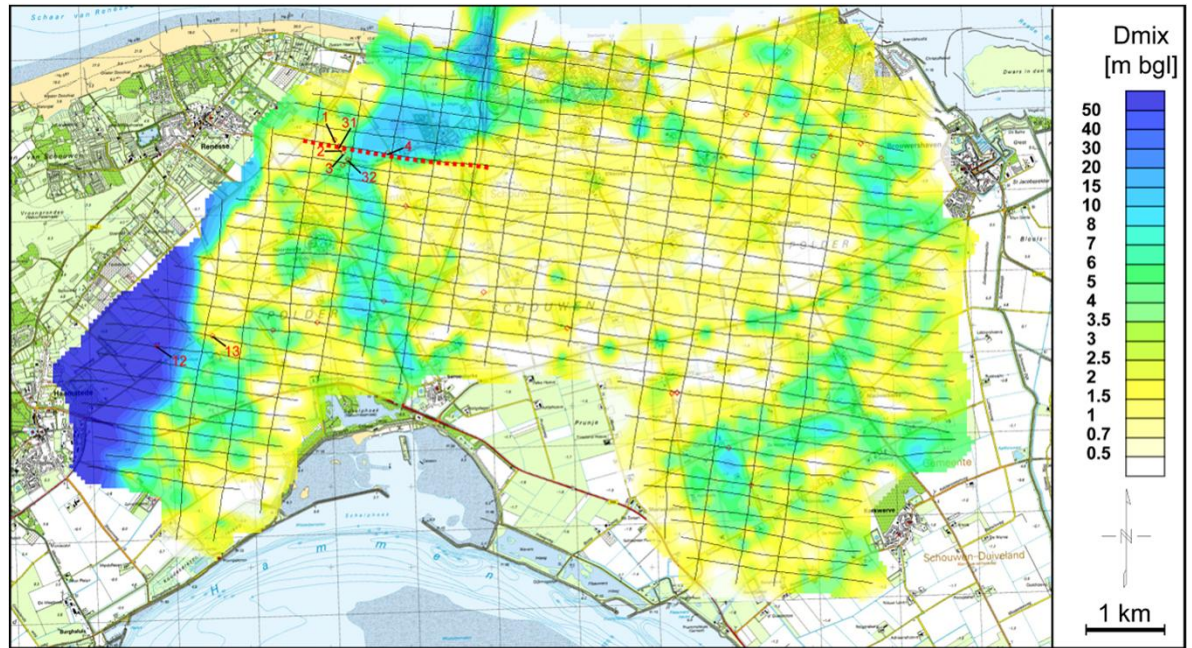
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Vietnam



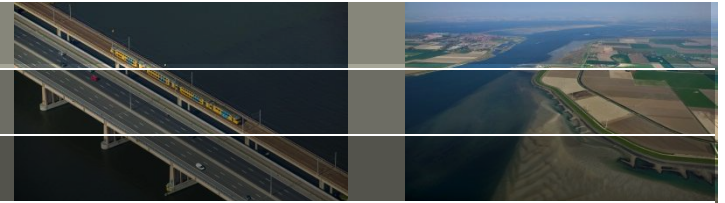
Vietnam, a relatively well-organized country with active farmer communities, might be an interesting area for implementing the framework and its corresponding measures (Tran, 2004). In Vietnam, salinity issues are severe, and during dry seasons fresh water is likely to be in short supply. Meanwhile it is not fresh water not but saline to brackish groundwater that is used as a production asset, as shrimp farms are often combined with rice production (Phong, 2003). That a process approach is definitely possible in Vietnam is shown by Huntjens *et al.* (2014) in their description of a participative process in developing a climate adaptation strategy in water management in Long An province.

Airborne Electro Magnetic surveys: 3D

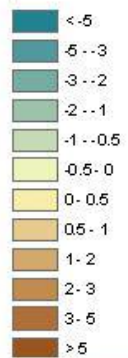


- Estimation fresh-saline interface
- Estimation geology

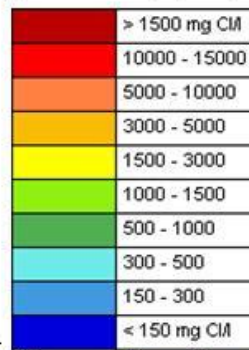
Model results (calibrated)



Surface level
[m msl]



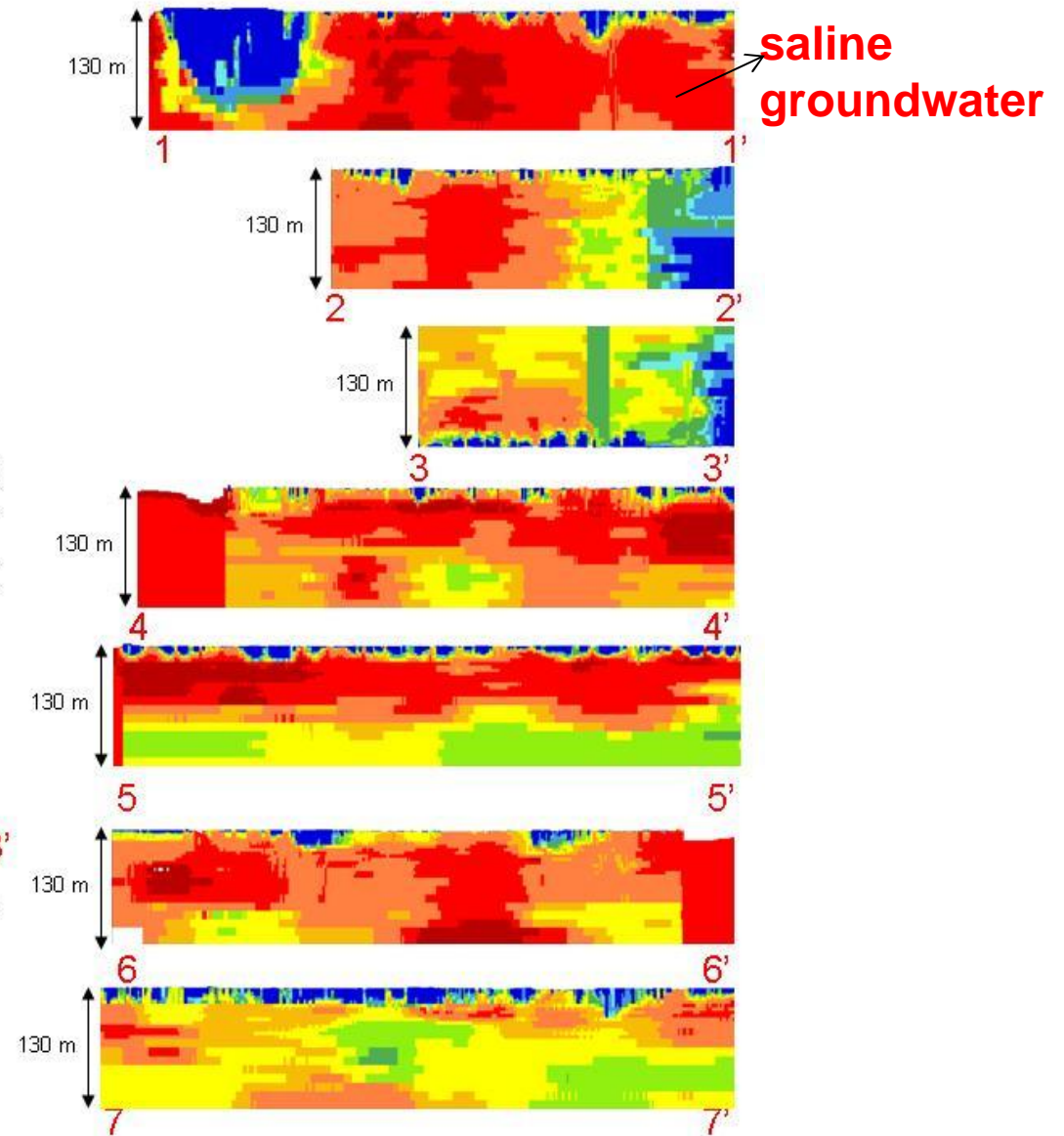
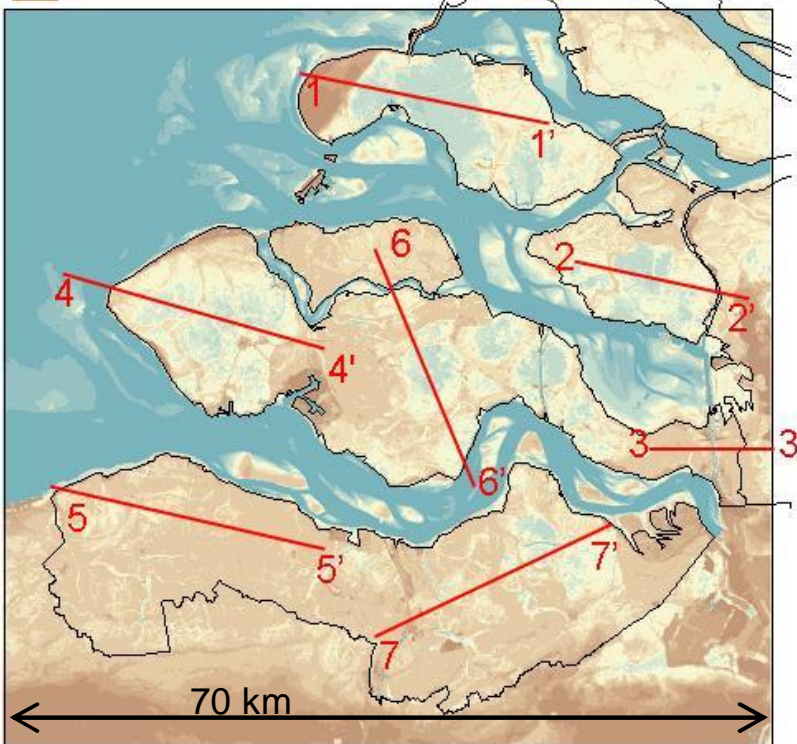
mg Cl/
groundwater



saline

brackish

fresh groundwater



| | Participation / process | Hydrology | Technical innovations |
|--------|--|---|-----------------------------------|
| ← Time | Step 1. Policy | | |
| | Sense of urgency policy makers (future scenario's) | Quantification long-term thread | Development innovative concept |
| | Step 2. Local stakeholders | | |
| | Sense of urgency local stakeholders | Scientific knowledge | Unproven innovative ideas |
| | Step 3. Goals and opportunities | | |
| | Initial engagement and cothinking | Information on local situation | Information on best practices |
| | Step 4. Stakeholders from cothinkers to coworkers | | |
| | Stakeholders performing project tasks | Analysis existing and new data, conceptual models | Exposure to existing applications |
| | Step 5. Development | | |
| | Codesign of measures and communication to outside world | Quantitative models for effects of measures | Codesign |
| | Step 6. Field testing | | |
| | Joint implementation | Monitoring | Implementation |
| | Step 7. Consolidation | | |
| | Identifying other stakeholders and policy makers | Identifying opportunities elsewhere | Proven innovative concepts |