

# Salinity in water and food systems and its long-term perspectives in a dynamic delta

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# Overview

1. Introduction
2. Food system approach in deltas
3. Our experiences
4. Conclusions



Short CV

Vincent Linderhof

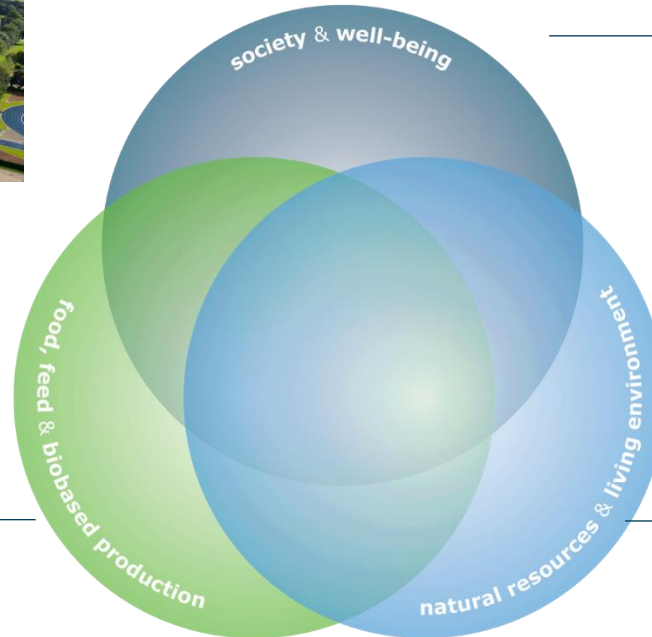
- Senior researcher and senior scientist, Wageningen Economic Research
- Environmental economist with large interest in the food systems
- Partial/general equilibrium models, system dynamics modelling, econometric analysis, food systems, water quality including salinization, biodiversity, participatory research methods
- [vincent.linderhof@wur.nl](mailto:vincent.linderhof@wur.nl)
- <https://research.wur.nl/en/persons/v-linderhof/publications/>
- <https://weblog.wur.eu/fnh-ri/combined-insights-stimulate-sustainable-food-production-in-deltas-under-pressure/>
- [www.wur.eu/food-in-deltas](http://www.wur.eu/food-in-deltas)

# Wageningen domain: Food and Living Environment

Mission:  
to explore the  
potential of nature  
to improve the  
quality of life



- Sustainable production and food processing
- Animal feed and biobased products
- International food chains and networks
- Food security and food health aspects



- Food and Living environment
- Lifestyle
- Perceptions
- Governance
- Market and chains
- Social innovations

- Nature and landscape
- Land use
- Water, sea and natural resource management
- Biodiversity



**100years**

# Wageningen University and Research (WUR)

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



## Wageningen University

- 12,000 BSc/MSc students from > 120 countries
- 2,000 PhD candidates
- 2,640 FTE of faculty and staff
- Revenue in 2018: € 363 million
- Top 3 of the world in its domain in international rankings

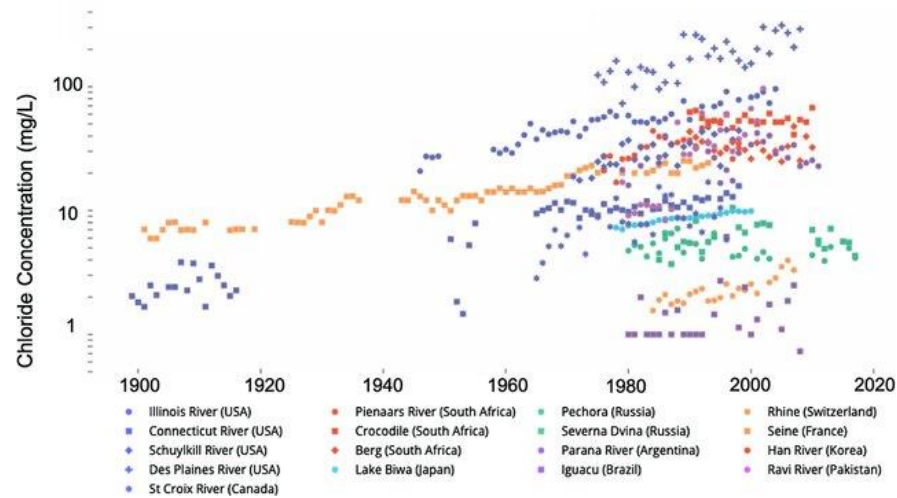
## Wageningen Research

- 2,491 FTE of faculty and staff
- 9 research institutes
- Revenue in 2018: € 323 million

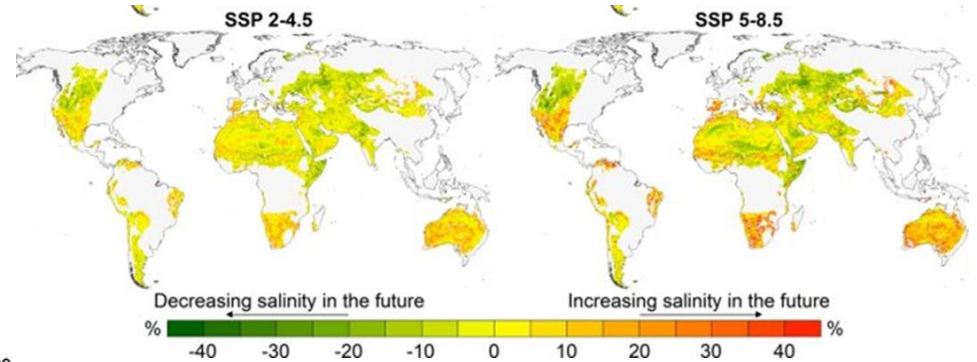


# Salinity increasing worldwide

Freshwater Salinization Syndrome on a Global Scale



Soil salinity change for 2071-2100 relative to 1961-1990



- Fresh water salinity is increasing
- Soil salinity is projected to increase/change around the world with spatial variation

# Uncertainty and complexity : need for systematic approach



# Need for systematic approach

- Do we need to start from water?
- Do we need to start from land?

Integrated approach

Starting from agriculture (widest sense)

Food system

Make co-creation possible

# Food System Approach

## Sustainable development goals

*SDG 2 - Zero hunger*

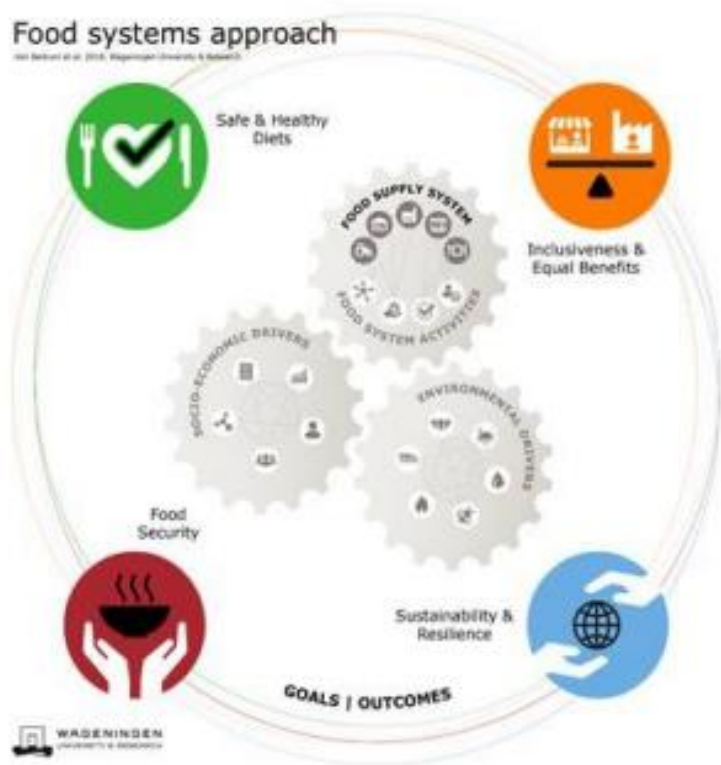
*SDG 6 – Water*

*SDG 13 – Climate Change*





# Food System Approach: Changing agriculture and food situation in deltas



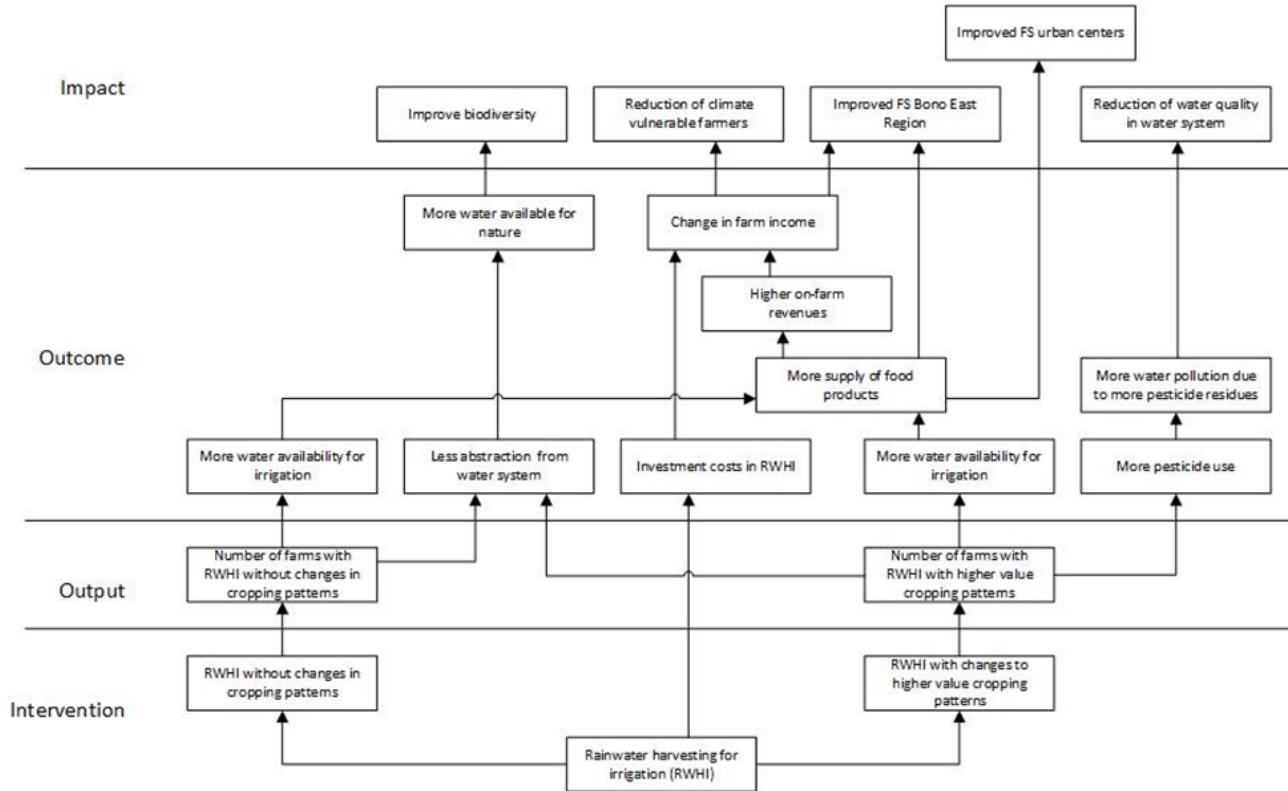
- Value chain
- Environmental factors
- Socio-economic factors

1. Focus on food production alone is not enough, food and nutrition security
2. Need for a systems approach: Bringing balanced approach in the picture
3. Need to deal with uncertainty and complexity

# Food system transformation

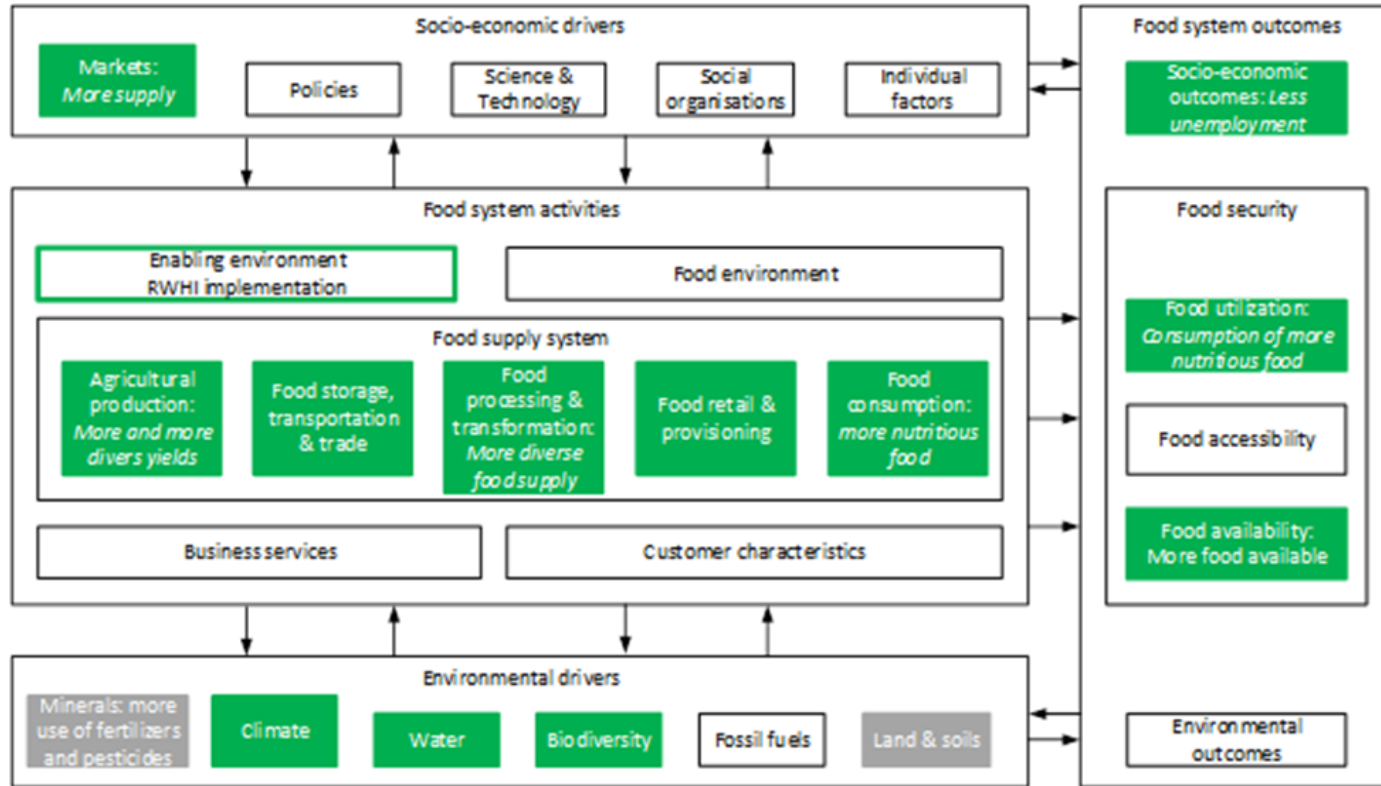
- Why: To overcome the complex and uncertain challenges!
- However, technological solutions alone will be insufficient
  - Too costly
  - Behaviour changes of stakeholders are unknown
- Roadmaps to the future will provide guidelines for change
- =>co-creation with all stakeholders so that they can share what they can do and want to do

# Examples of co-creation (1)



- RWHI in Bono East Region in Ghana
- Food ‘basket’ of Accra
- Challenge future climate change with less water availability
- Prepared with interaction with stakeholders

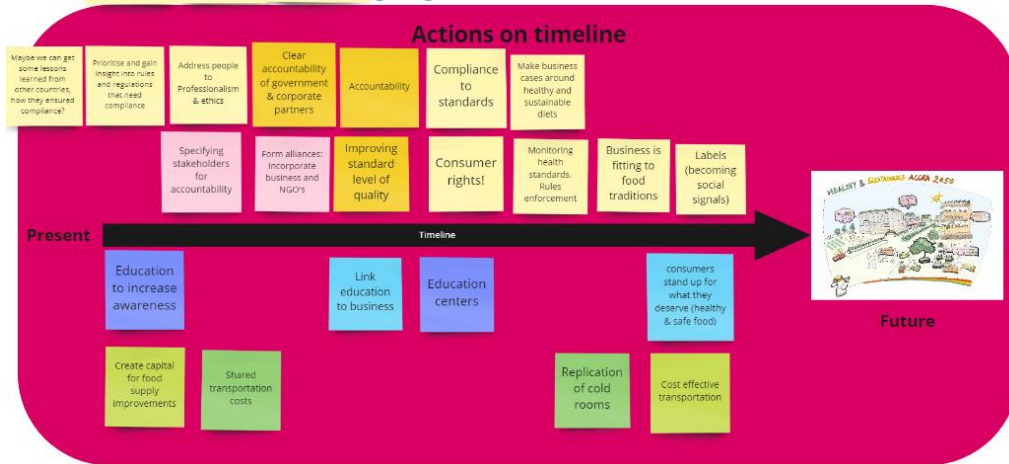
# Examples of co-creation (2)



# Example of co-creation (3)

- How do stakeholders in Accra (Ghana) think about the food security and food environment?

Example: Timeline for the action perspectives of the pathway "Changing the food value chain"



Linderhof et al. 2023. Transition pathways development for healthier diets in urban food environments of Accra, Ghana  
<https://edepot.wur.nl/587151>

# Bangladesh agriculture system change



WUR research on water management and food systems in deltas: [www.wur.eu/food-in-deltas](http://www.wur.eu/food-in-deltas)

<https://research.wur.nl/en/publications/food-systems-in-the-bangladesh-delta-overview-of-food-systems-in->

Knowledge question: can we use these (water and) food system guidelines to link BDP and AT programmes to create synergy?

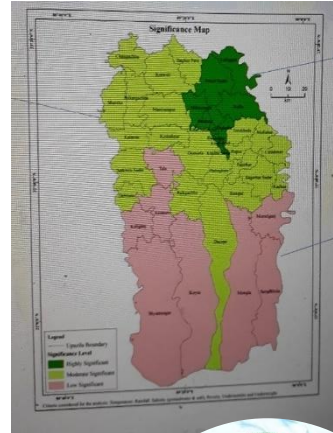


# Example: Bangladesh

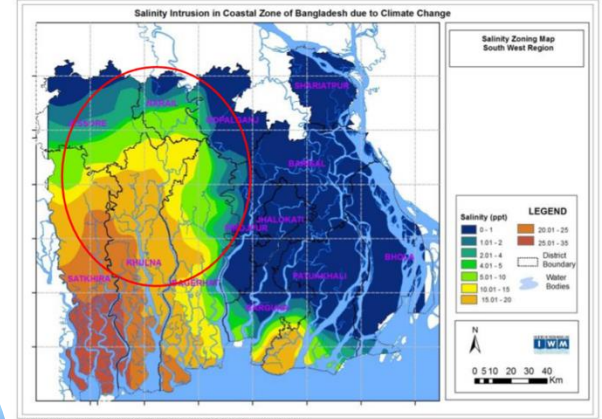


## WUR research collaboration with Solidaridad

- Dairy/salinity
- Mango export
- Shrimp/mangrove
- Vegetables



May, 2030 climate change (A1B) with minimum Transboundary flow under Ganges Treaty



**NEC approves 100-year delta plan**  
 Published: 04 September 04, 2018 17:26:17 | Updated: 04 September 06, 2018 20:15:17

The National Economic Council (NEC) has approved the long-awaited mega strategy Bangladesh Delta Plan (BDP) 2100 in a bid to tap the huge potentials of Bangladesh as a delta country through water resource management, ensuring food and water security and tackling disasters.



# Dairy / salinity Pathway - future

- More demand for milk
- Need safe drinking water
- Water more saline in future
- Start fodder cultivation
- Road development
- Personal circumstances



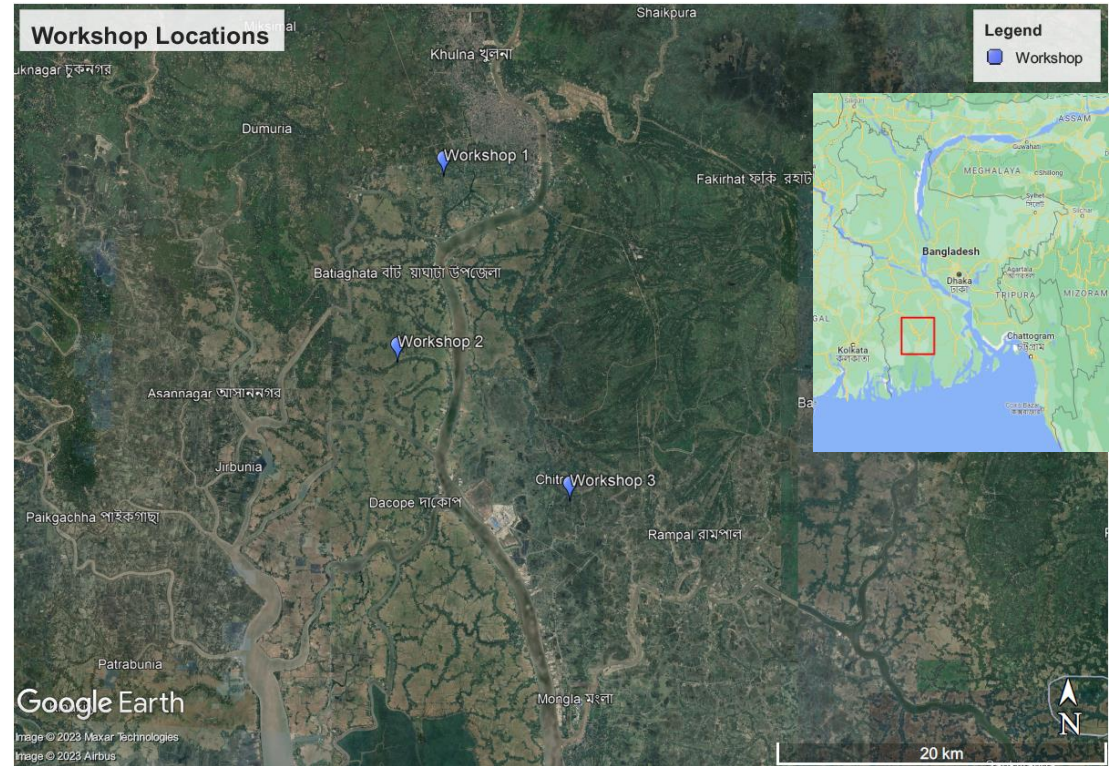


# Salinity in water and food systems

- Lack of drinking water
- Lack of water for cattle
- Lack of irrigation water for crops because of their salt intolerance

# Transition Pathways (Consultation at Field Scale, Bangladesh)

- The objective: To gather knowledge about the farmers perception on salinity, now and in the future and their transition pathways for salinity-water-food







# Transition Pathways (Consultation at Field Scale, Bangladesh)

- Salinity has seasonal and spatial variation
- Salinity is increasing
- Local people are experiencing impact higher salinity and are aware of possibility of increased salinity in the future
- Willing to adapt to new agricultural practices and strategies but wants to continue farming
- Consultation with Regional stakeholders  
October 2023

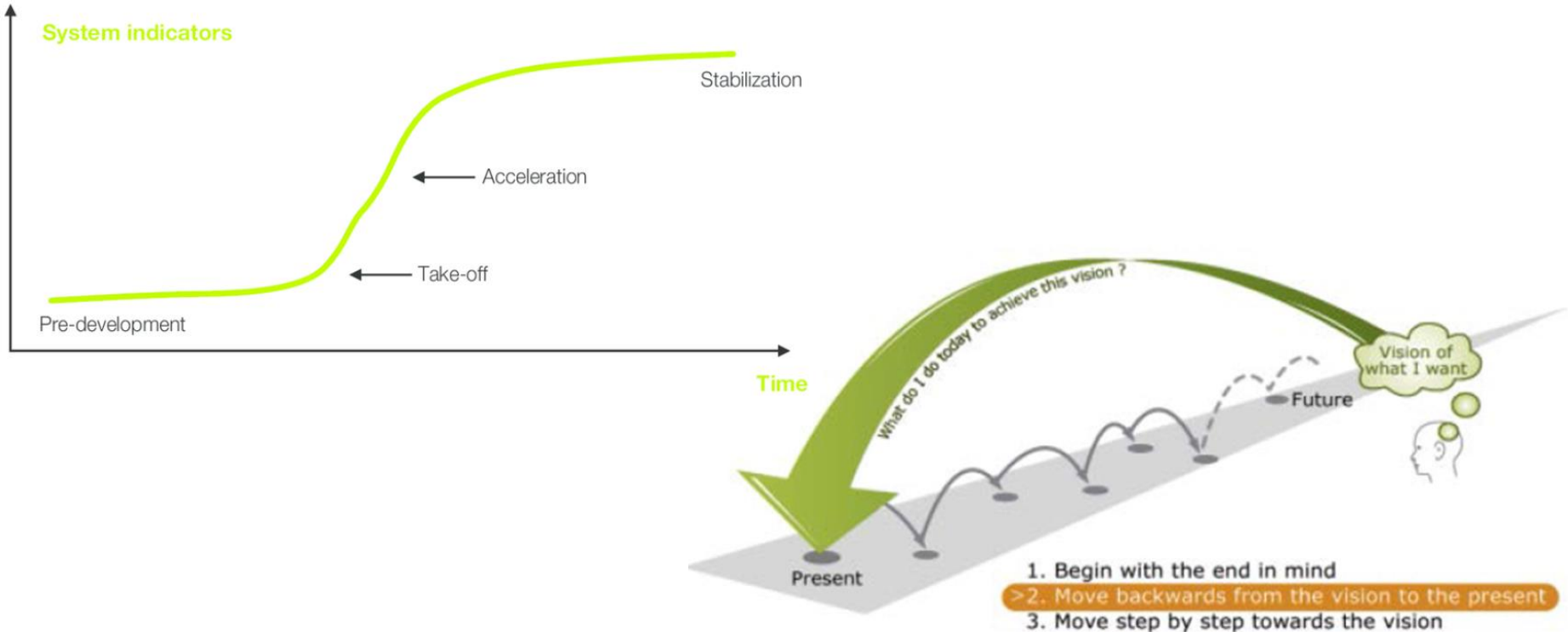


# Transition Pathways (Consultation at Field Scale, Bangladesh)

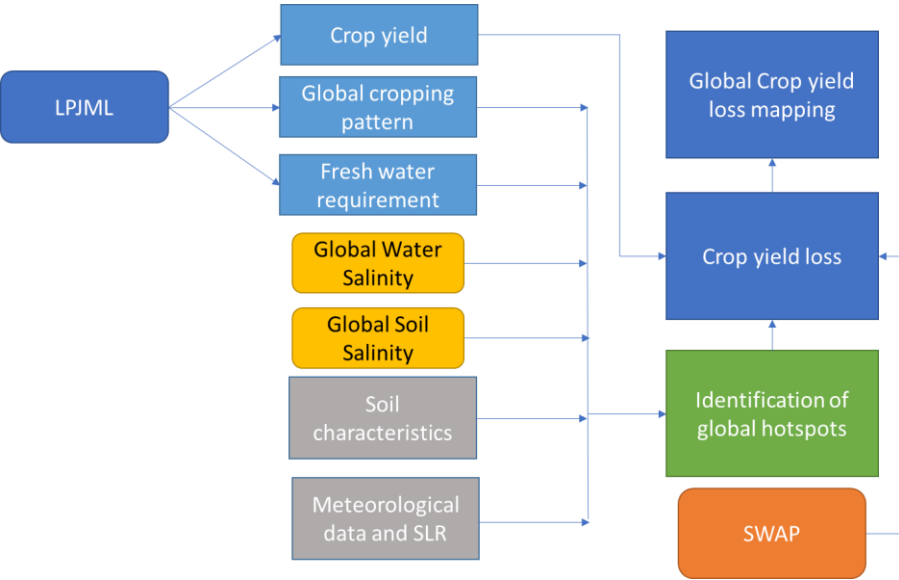


Experience in south west Bangladesh	Current		Future		Transition Pathway towards perceived sustainable future
<b>General information</b> <ul style="list-style-type: none"> <li>• Salinity level</li> <li>• When highest</li> <li>• where highest</li> </ul>					
<b>Agriculture</b> 					
<b>Livestock</b> 					
<b>Shrimp</b> 					
<b>Drinking Water</b> 					

# Transition Pathways (Back casting)



# Salinity Hotspot Identification – global perspective



## Dealing with the global challenge of salinization

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### Drivers

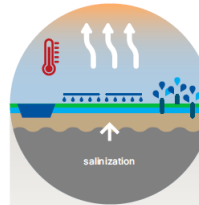
- Global drivers**
- Natural soil salinization
  - Population growth
  - Sea level rise
  - Temperature increase

- Regional drivers**
- Irrigation systems inland water diversion
  - Land subsidence
  - Land use change
  - Melting glaciers
  - Overextraction groundwater

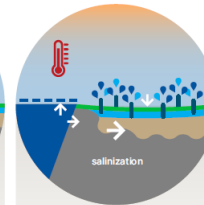
### Challenges

- Salinization on (food) system**
- Lower food production with conventional agriculture
  - Biodiversity decrease
  - Pressure on freshwater resources due to competition with other sectors

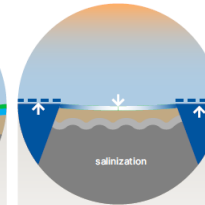
### Landscapes



- (Semi) arid areas**
- Irrigation systems: higher salinization
  - Temperature increase: more evaporation
  - Overextraction groundwater: XX



- Delta landscapes**
- Land subsidence: XX
  - Overextraction groundwater: XX
  - Sea level rise: pushing salt land inwards
  - Temperature increase: XX



- Small Islands Development states**
- Land subsidence: XX
  - Sea level rise: increasing salinity coastal aquifers

## Facts and figures

**FUTURE**

Avails land impacted by salinity **50% by 2050**

Estimates predict that 50% of all arable land will become impacted by salinity by 2050.

Below land flood levels for 2100 **630 million ppl**

Below land flood levels mid-century **340 million ppl**

Up to 630M people live on land below projected annual flood levels for 2100. Up to 340 million people for mid-century, versus roughly 250M people at present. Estimates show 18M people currently occupy land less than 10meters above current high tide levels, including 230M below 1 meter.

Dinking water **[XX]**

Migration **[XX]**

**CURRENT**

Estimated global annual costs **€21.3 billion** (US\$ 27.3 billion)

Degradation of salt-affected lands in irrigated areas related to lost crop production. The Dutch have an income of agriculture of €3078 million per year.

Salt-affected topsoil (0-10 cm) **424 million ha**

Salt-affected subsoil (10-100 cm) **838 million ha**

More than 424 million hectares of topsoil and 833 million hectares of subsoil are salt-affected (information from 118 countries covering 85% global land).

Most salt-affected regions **Australia, Eurasia, Middle East, North Africa**

Salts per annum added in Europe **1 million MT**

Salts per annum added in USA **10 million MT**

Europe adds 1 million metric tons (100 kg) of salts per annum to the environment, while USA applies about 10 times more than this annually to paved surfaces, causing secondary salinization.

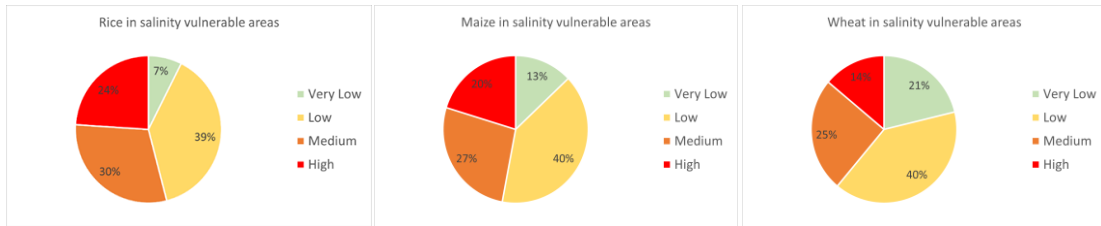
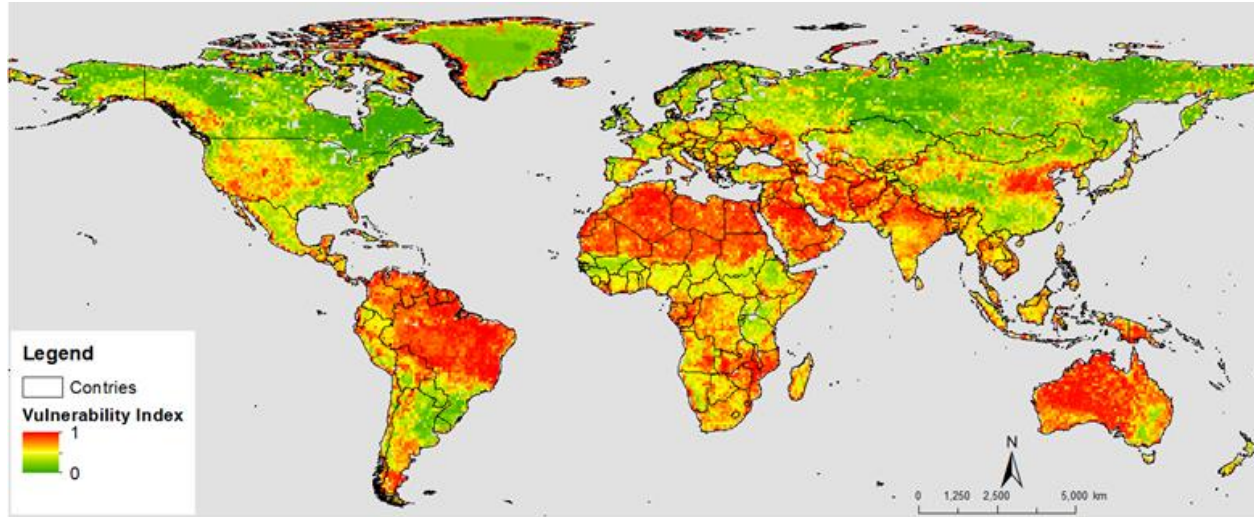
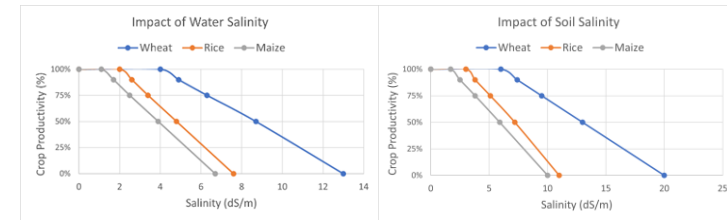
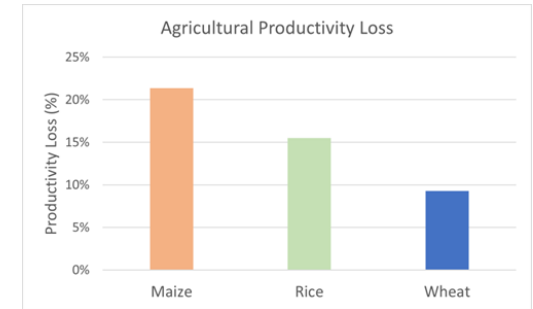
Biodiversity **[XX]**

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Link to Global Salinity Campaign: NFP/NWP, FAO, ICBA, WUR, VU, Salt Doctors and others

# Salinity Hotspot Identification – global perspective

- Salinity sensitive crops are cultivated in salinity vulnerable areas
- Production loss is higher for crops with lower salinity tolerance



# Salinity – longer term – pieces of the puzzle

- International level: hot spot analyses, global trends, co-creation between hotspots
- National level: raising awareness, supporting the salinity regions with technological options and stakeholder interaction, creating pathways
- Local level: raising awareness of salinity issues and solutions, listen to the local stakeholder knowledge, include them in constructing pathways



Thank you

ধন্যবাদ



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