

14. June 2016 Poland

## **ENVIRONMENTAL MEASURES IN THE ZONE BETWEEN THE EDGE OF FIELDS AND STREAMS.**

- WOODCHIP BIOREACTORS, INTELLIGENT/SATURATED BUFFERZONES  
& PALUDICULTURES.

*AF SENIOR KONSULENT FRANK BONDGAARD, SEGES*



# Constructed wetland nr. 1 in Denmark 2006

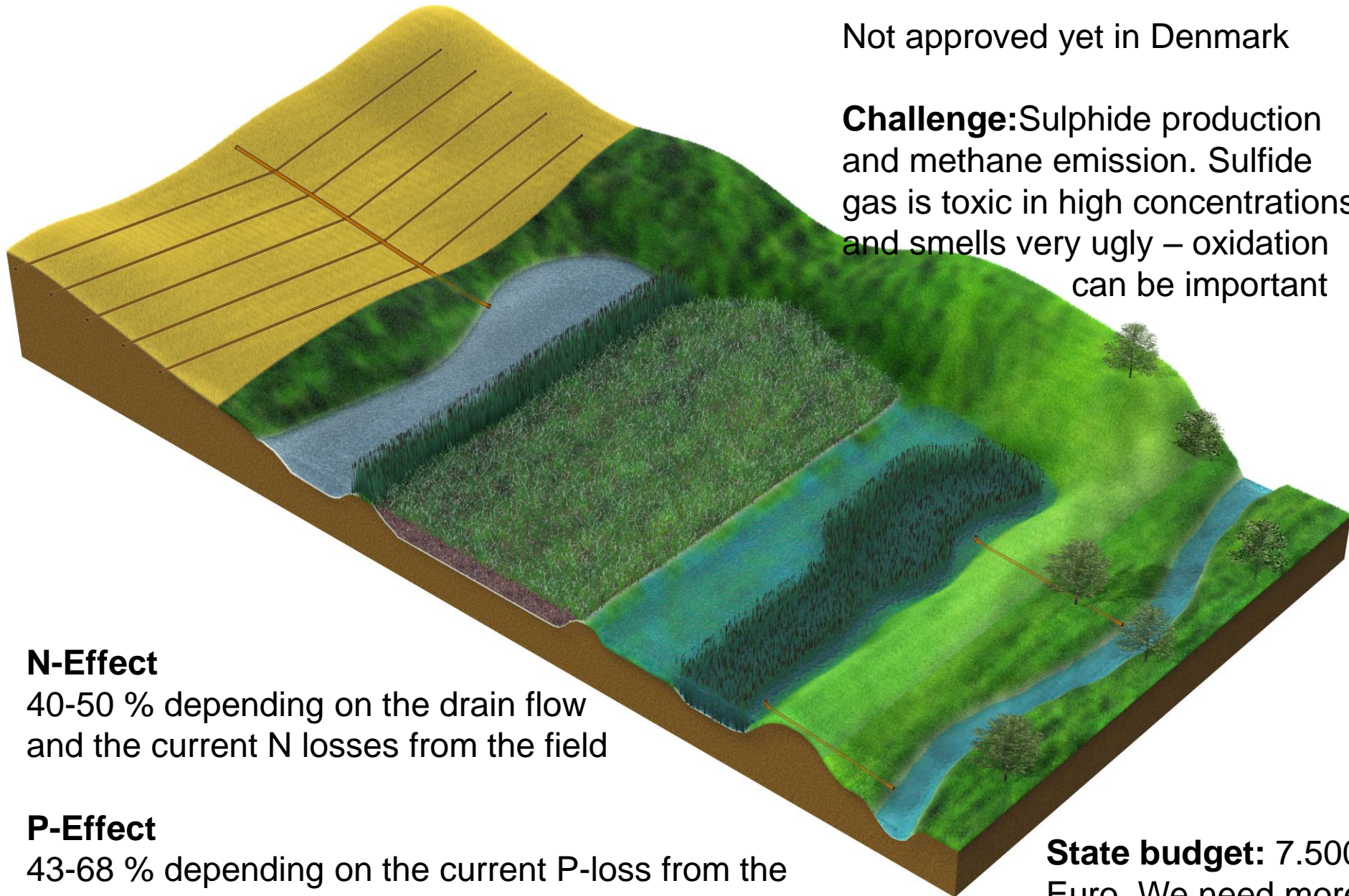




# Constructed wetland with woodchips/filter matrix

Not approved yet in Denmark

**Challenge:** Sulphide production and methane emission. Sulfide gas is toxic in high concentrations and smells very ugly – oxidation can be important



## N-Effect

40-50 % depending on the drain flow and the current N losses from the field

## P-Effect

43-68 % depending on the current P-loss from the field

**State budget:** 7.500 Euro. We need more research.

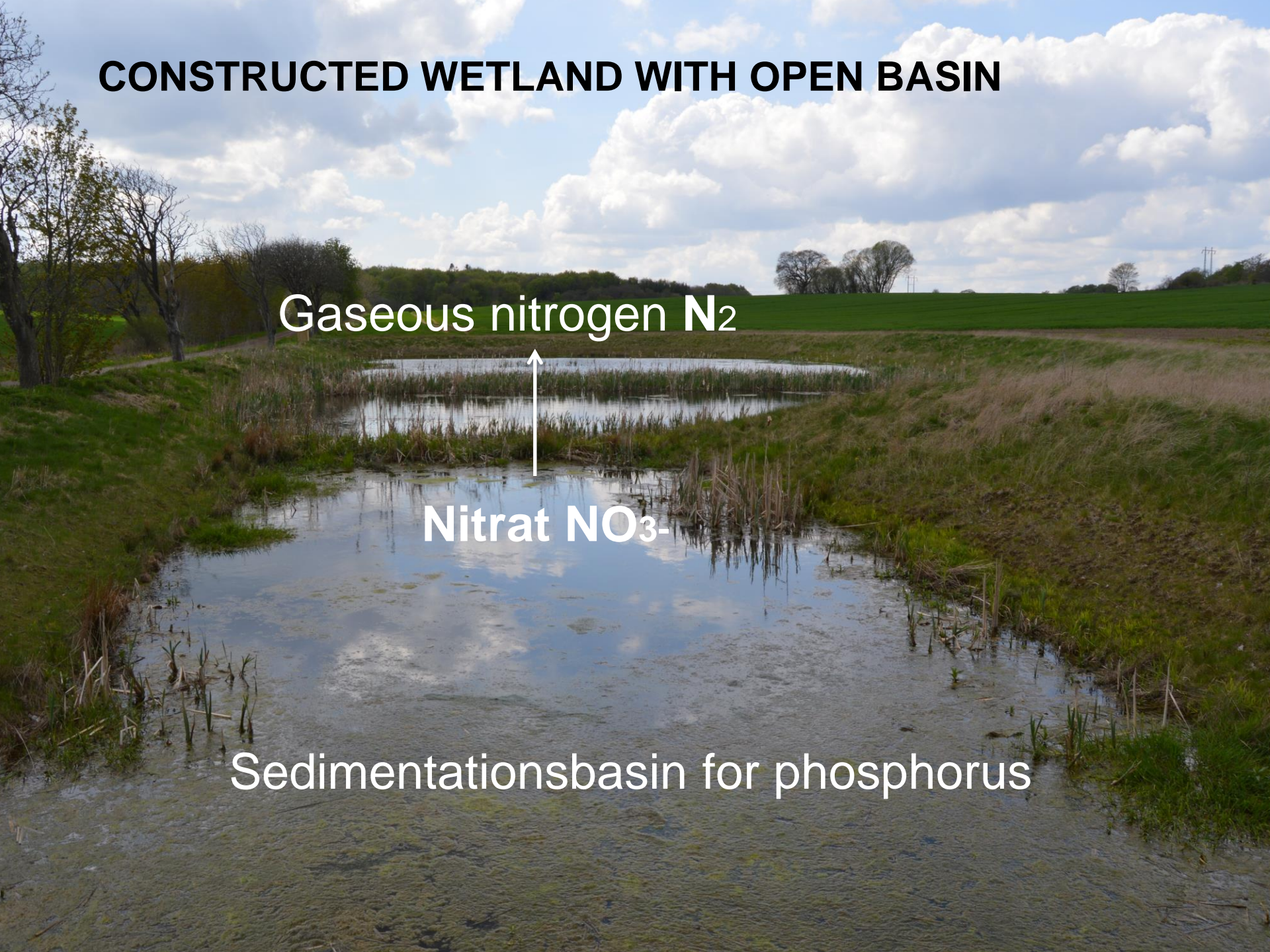


# CONSTRUCTED WETLAND WITH OPEN BASIN

Gaseous nitrogen  $N_2$

Nitrat  $NO_3^-$

Sedimentationsbasin for phosphorus



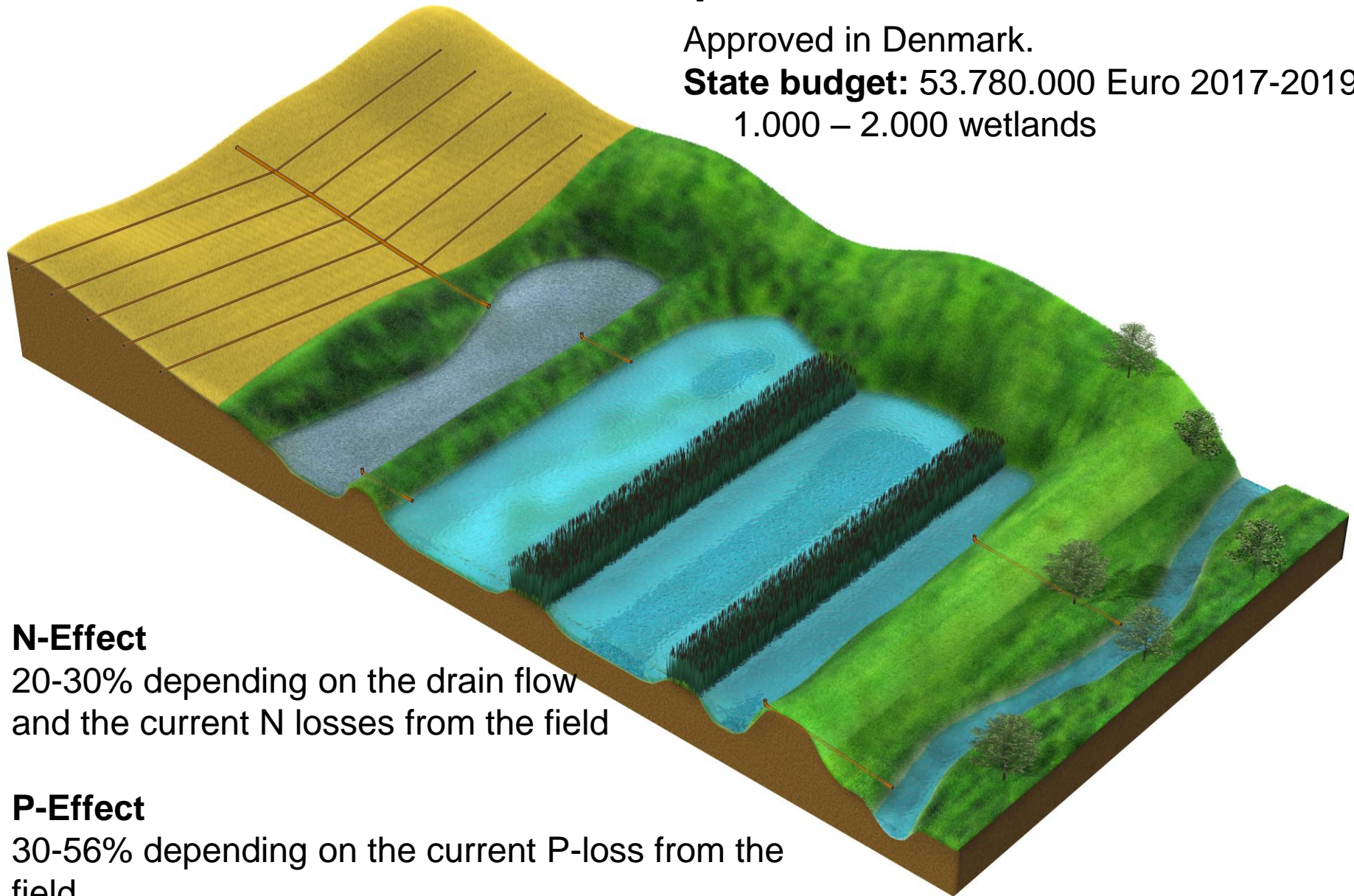


# Constructed wetland with open basin

Approved in Denmark.

**State budget:** 53.780.000 Euro 2017-2019

1.000 – 2.000 wetlands



## **N-Effect**

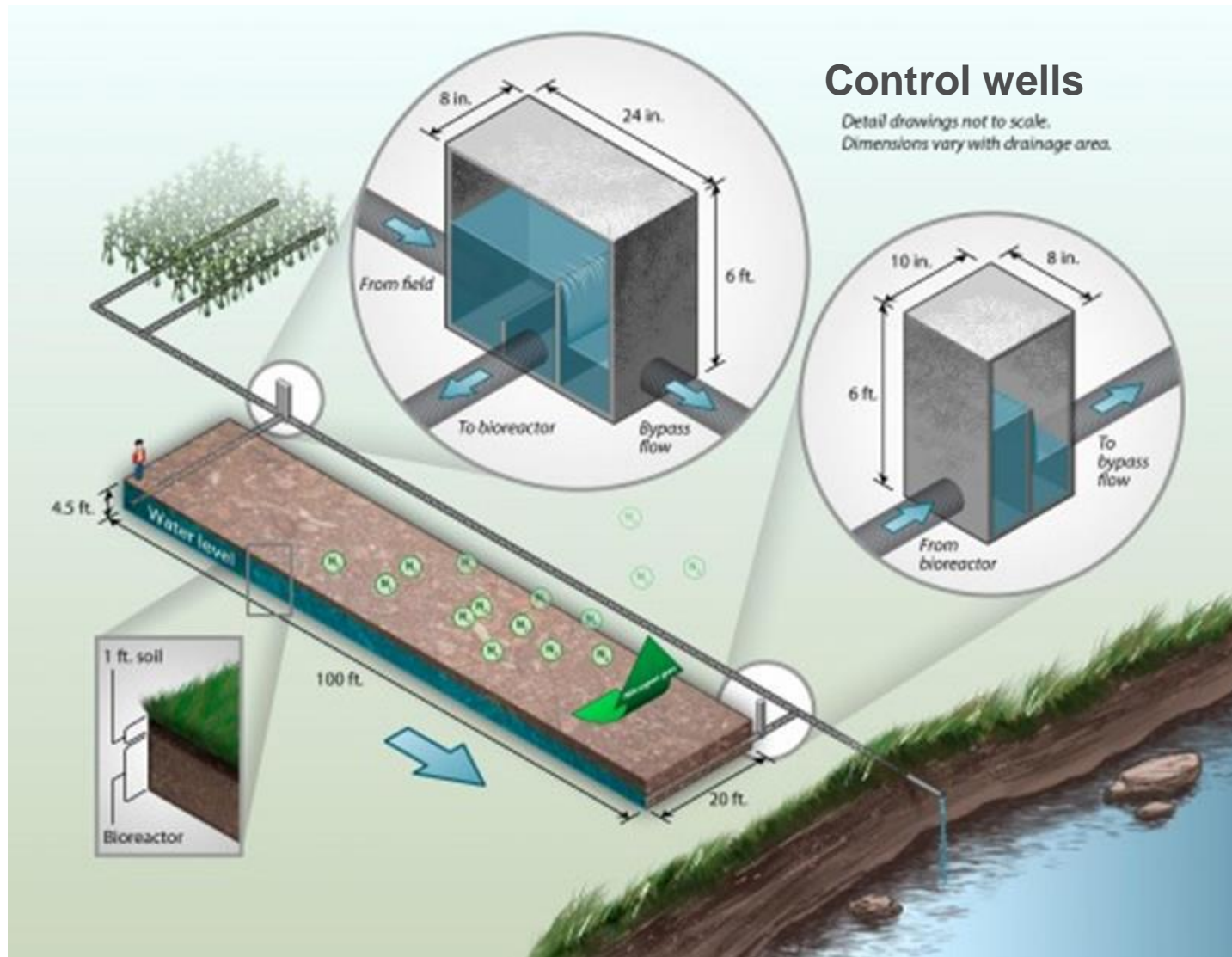
20-30% depending on the drain flow  
and the current N losses from the field

## **P-Effect**

30-56% depending on the current P-loss from the  
field



# Woodchip bioreactor in US



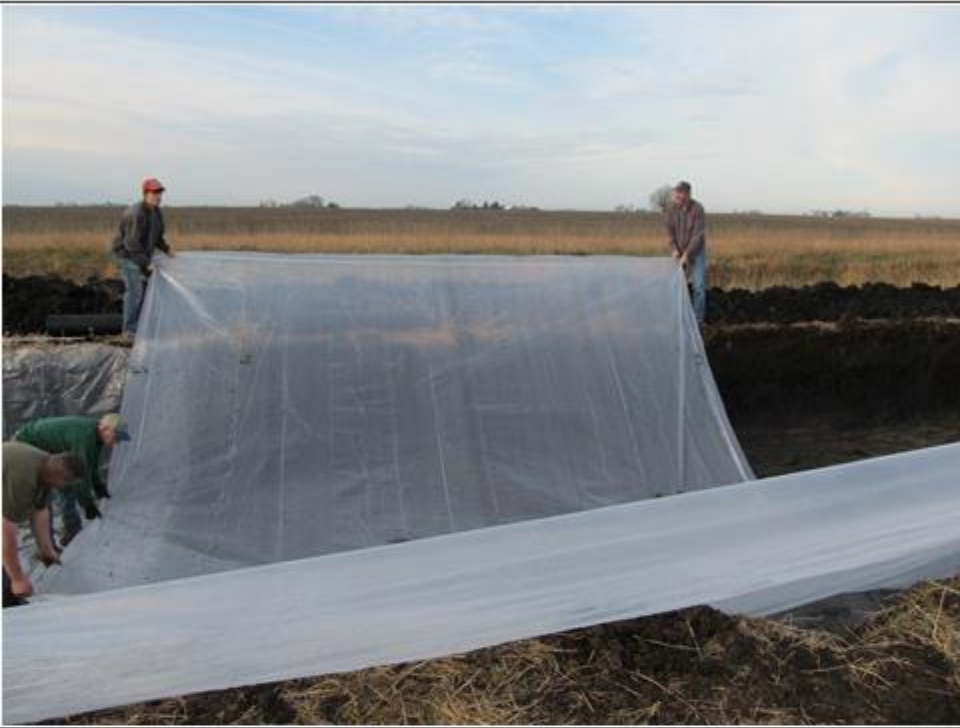
From: Woodchip Bioreactors for Nitrate in Agricultural Drainage. Laura Christianson



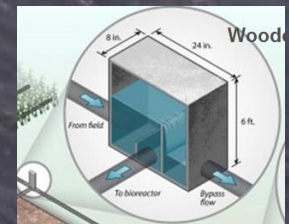


<http://biogeochemistry.nres.illinois.edu/Embarras/bioreactor.html>





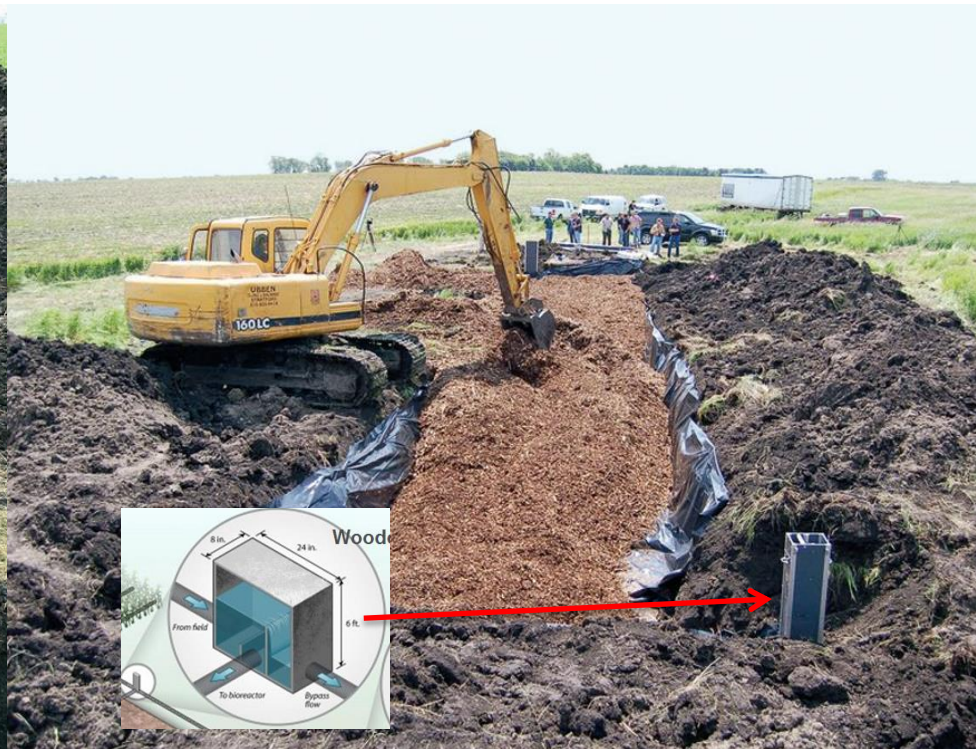




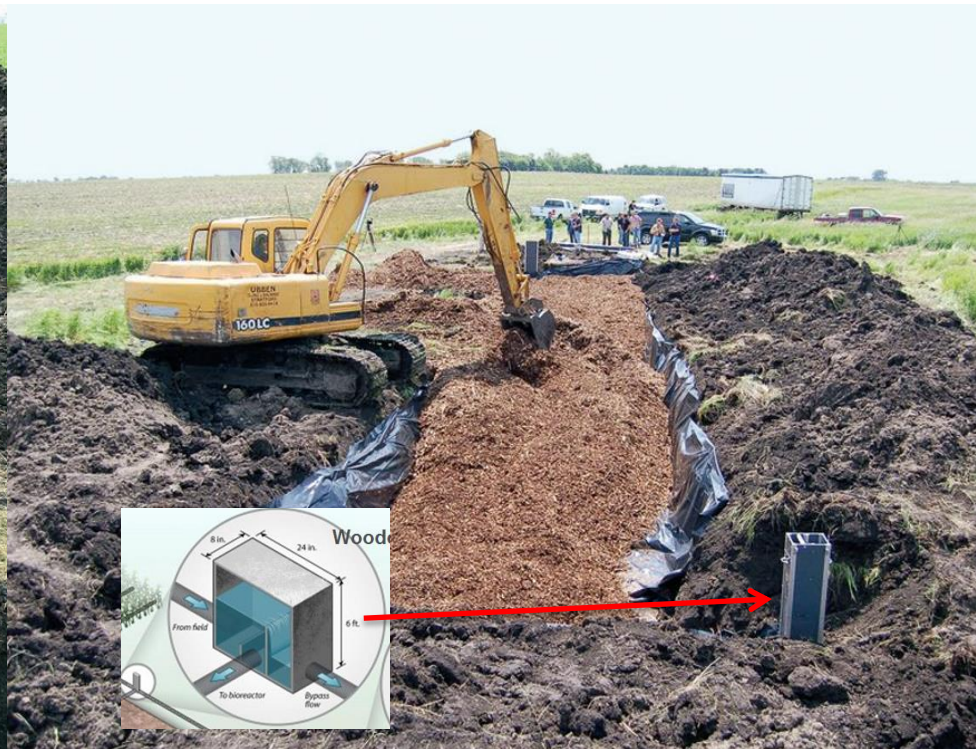














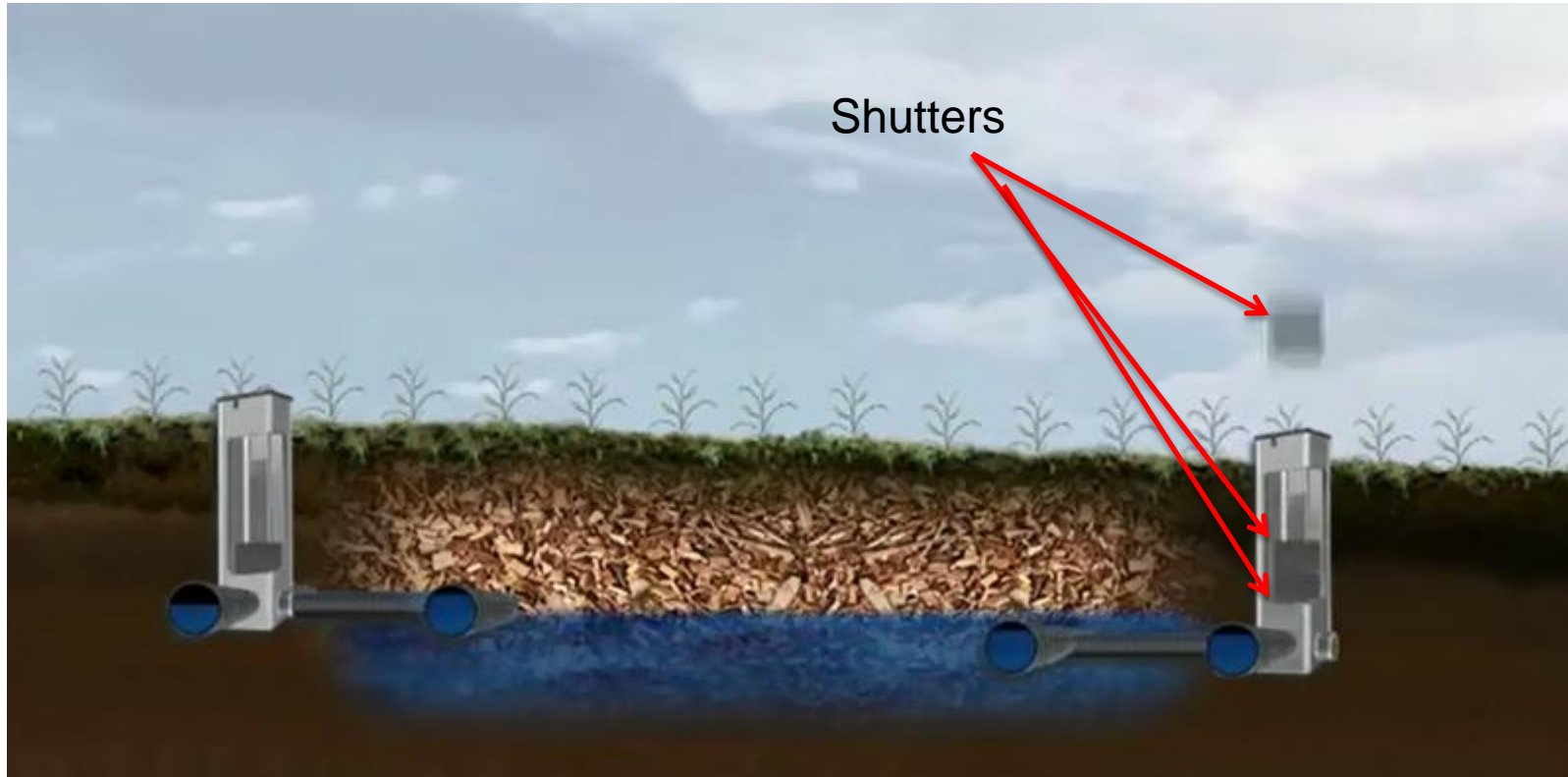
# Woodchip bioreactor

Inlet of water





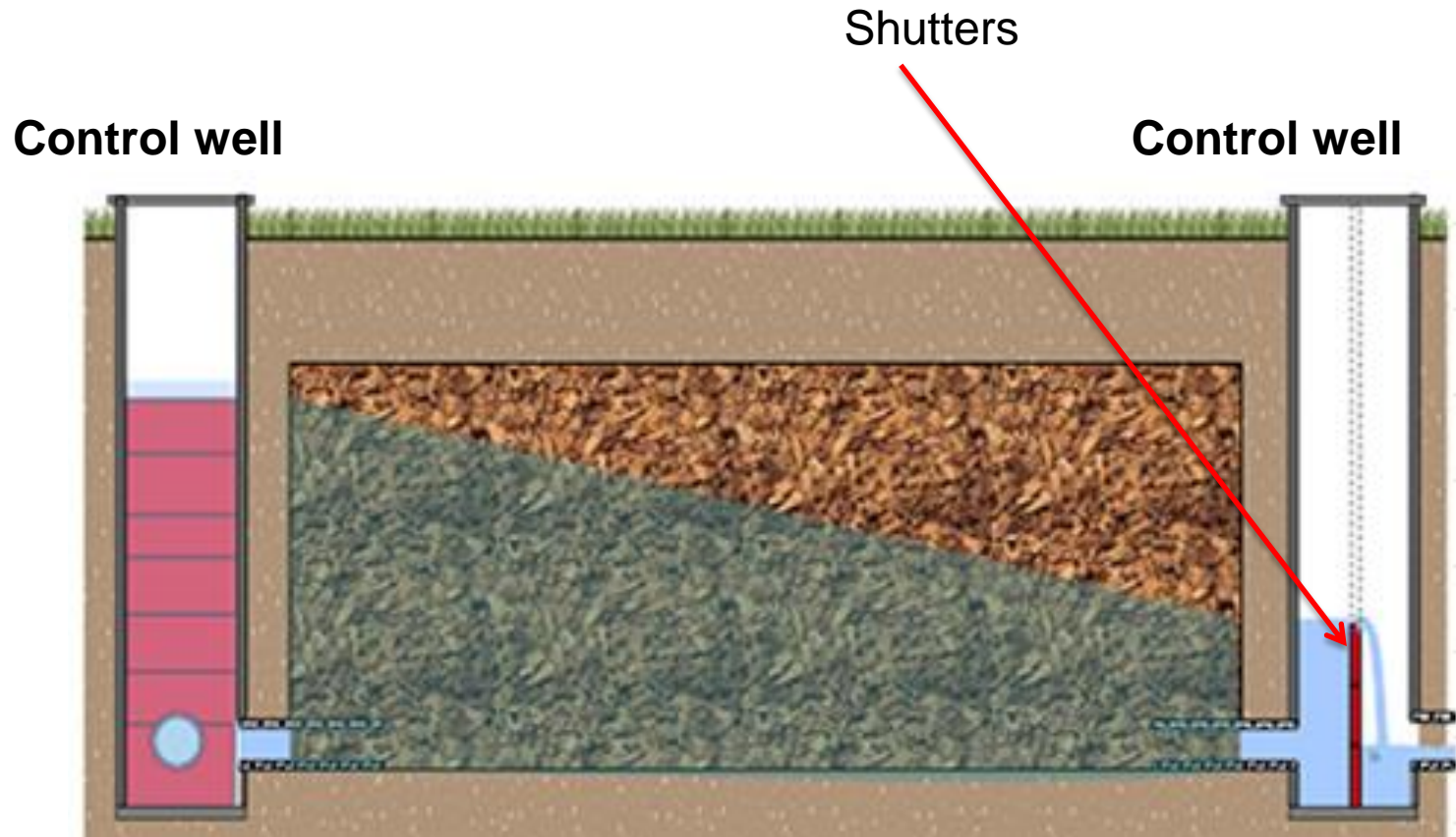
# Woodchip bioreactor in US



[See Youtube: Nabbing Nitrates Before Water Leaves the Farm: Bioreactors](#)



# Woodchip bioreactor





# Effect of Woodchip bioreactor

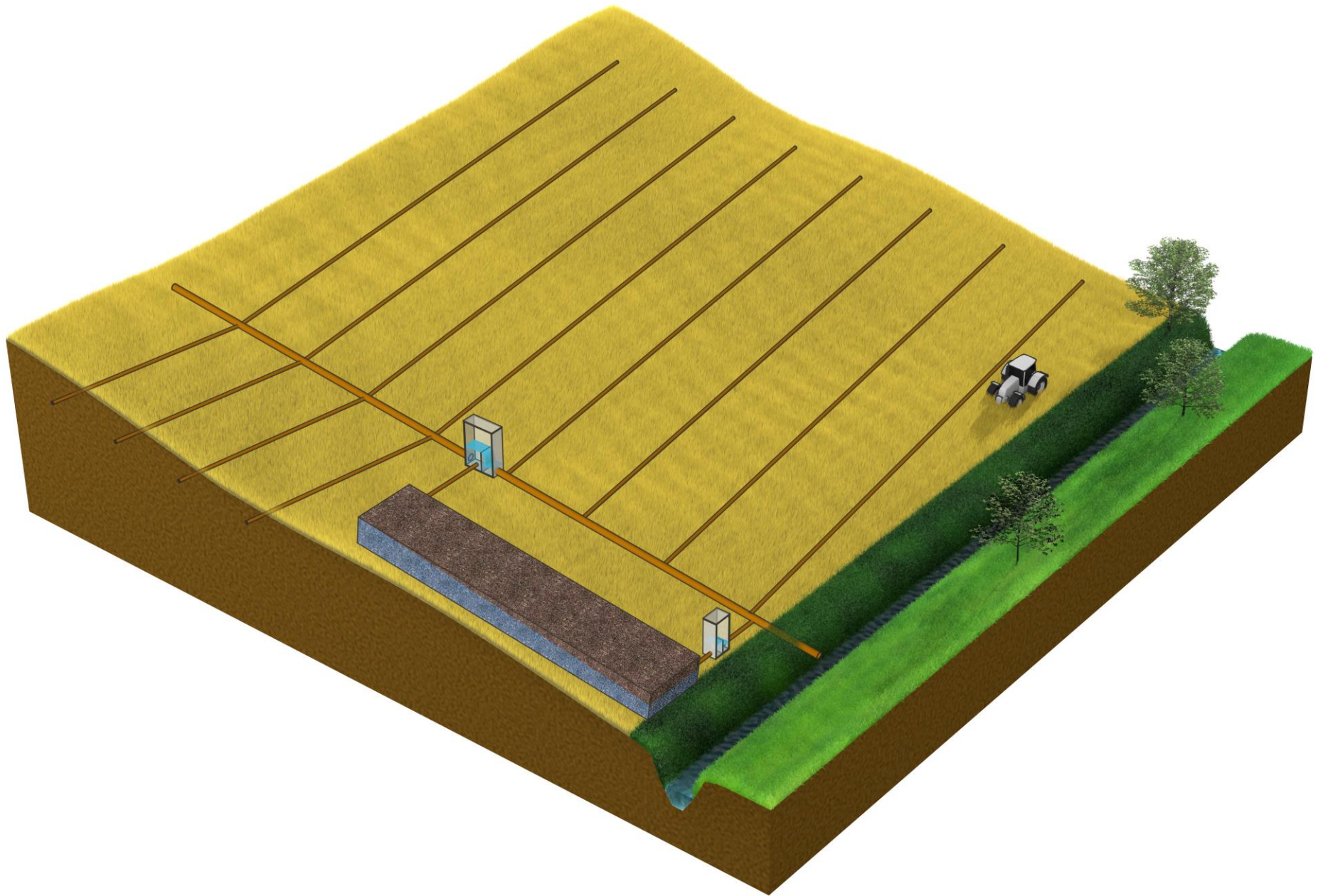
	Practice	Comments	% Nitrate-N Reduction <sup>+</sup>	% Corn Yield Change <sup>++</sup>
			Average (SD*)	Average (SD*)
Edge-of-Field	Drainage Water Mgmt.	No impact on concentration	33 (32)	
	Shallow Drainage	No impact on concentration	32 (15)	
	Wetlands	Targeted water quality	52	
	Bioreactors		43 (21)	
	Buffers	Only for water that interacts with the active zone below the buffer. This would only be a fraction of all water that makes it to a stream.	91 (20)	
	Saturated Buffers	Divert fraction of tile drainage into riparian buffer to remove Nitrate-N by denitrification.	50 (13)	

\* SD = standard deviation. Large SD relative to the average indicates highly variable results.

From: Reducing Nutrient Loss: Science Shows What Works



# Woodchip bioreactor





# Intelligent bufferzone - hilly

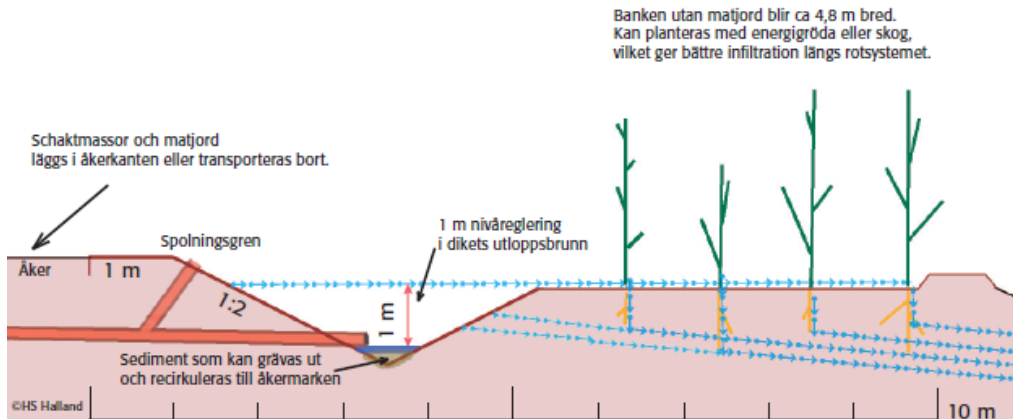




# Intelligent bufferzone - flat



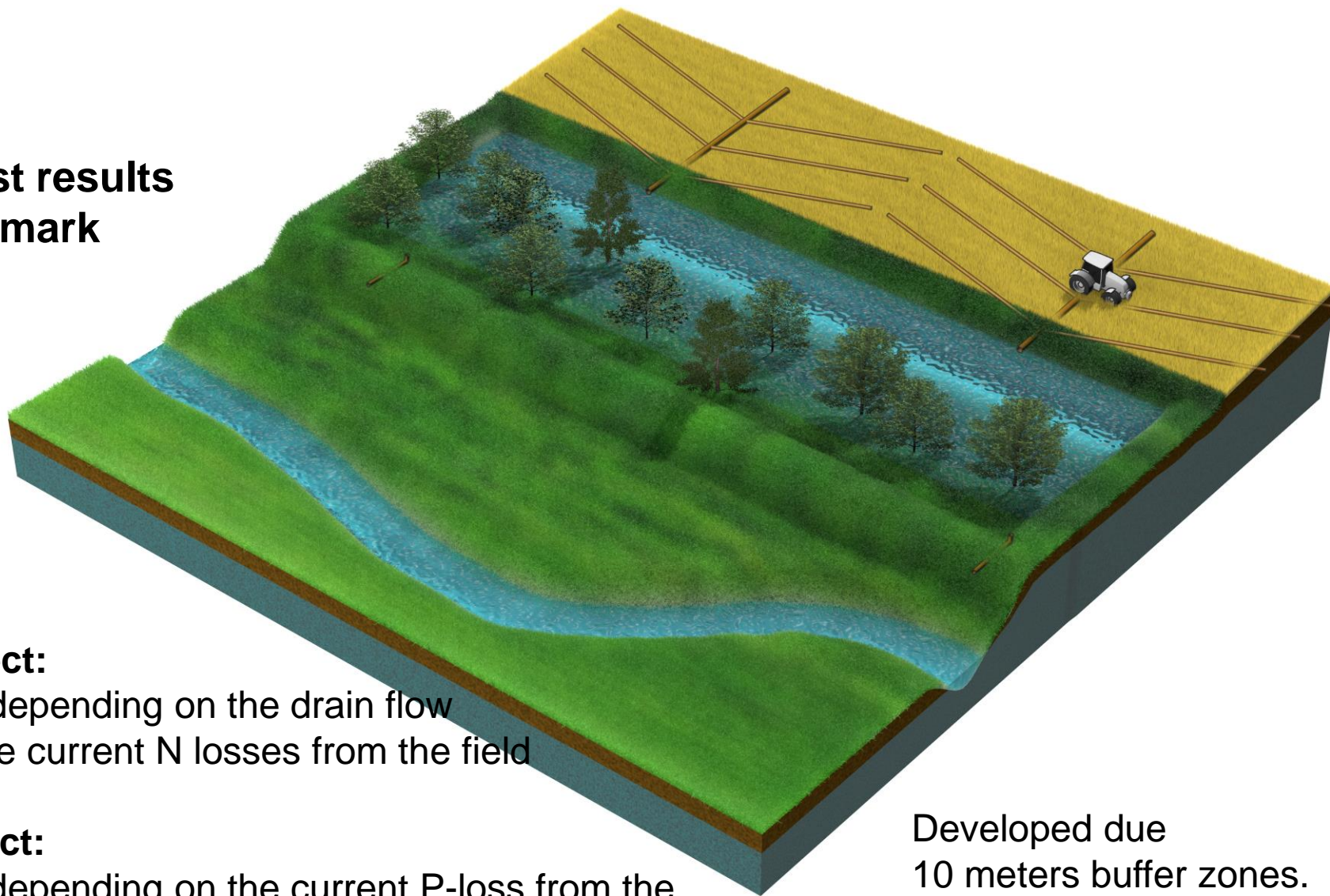
## Intelligent skyddszon med detaljer





# Intelligent bufferzone

## The first results in Denmark



### **N-Effect:**

24 % depending on the drain flow  
and the current N losses from the field

### **P-Effect:**

45 % depending on the current P-loss from the  
field

Developed due  
10 meters buffer zones.

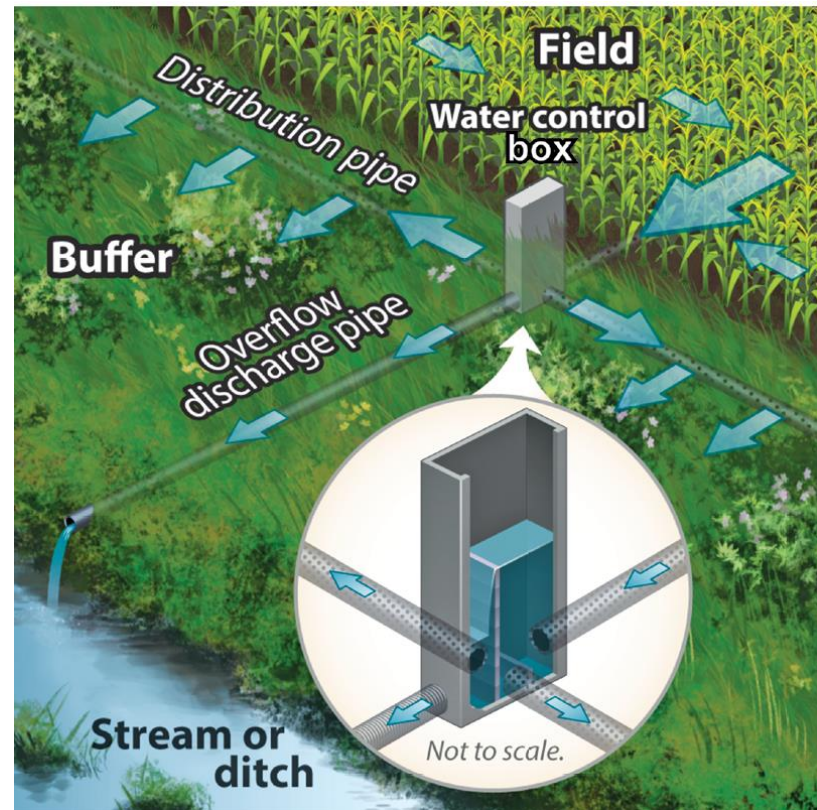
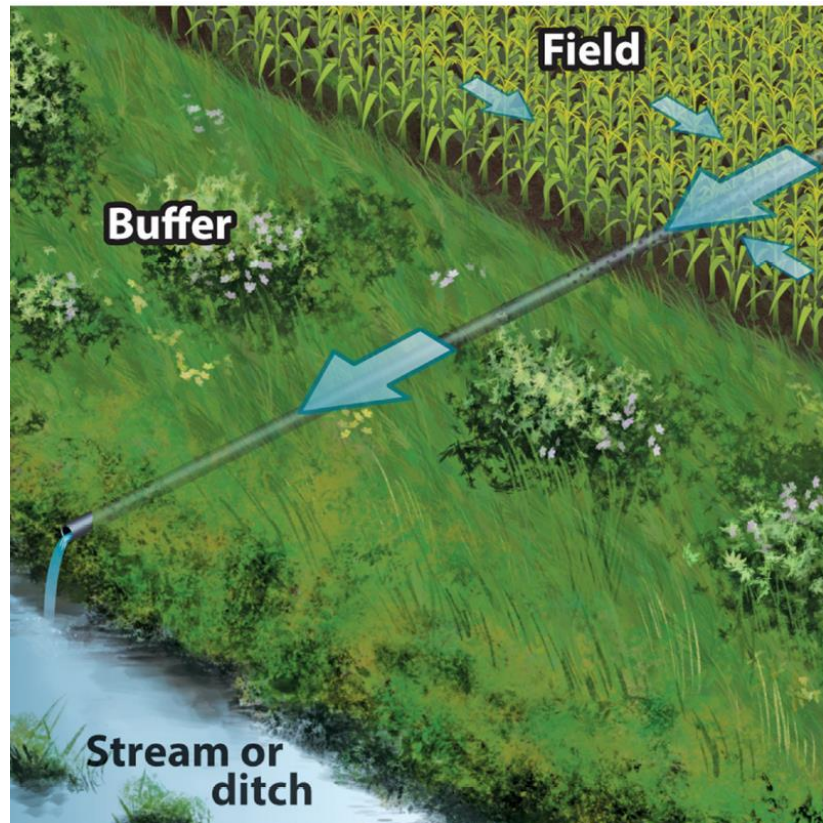


# Intelligent bufferzone





# Cleaning Iowa's Waters with Saturated Buffers



Tom Isenhardt , Dan Jaynes

<https://store.extension.iastate.edu/Product/Cleaning-Iowa's-Waters-with-Saturated-Buffers-in-Iowa-Watersheds>

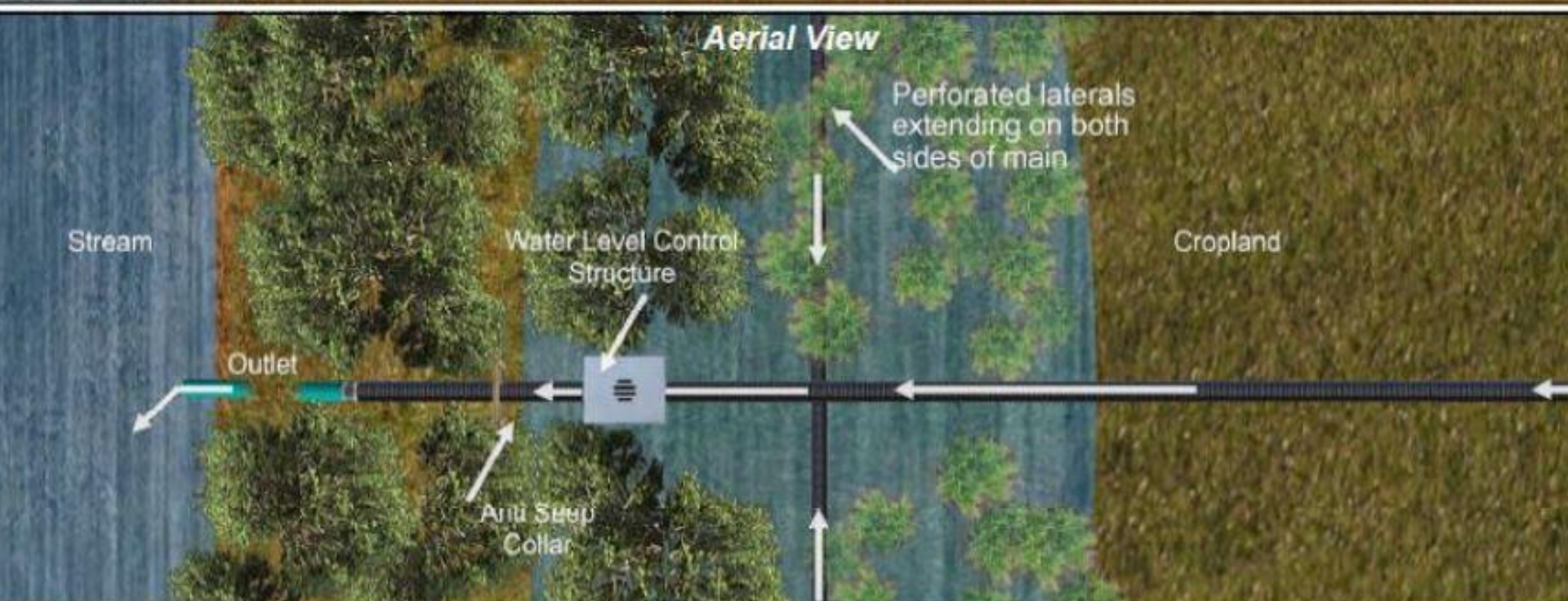


# Saturated Buffer

## Side View



## Aerial View

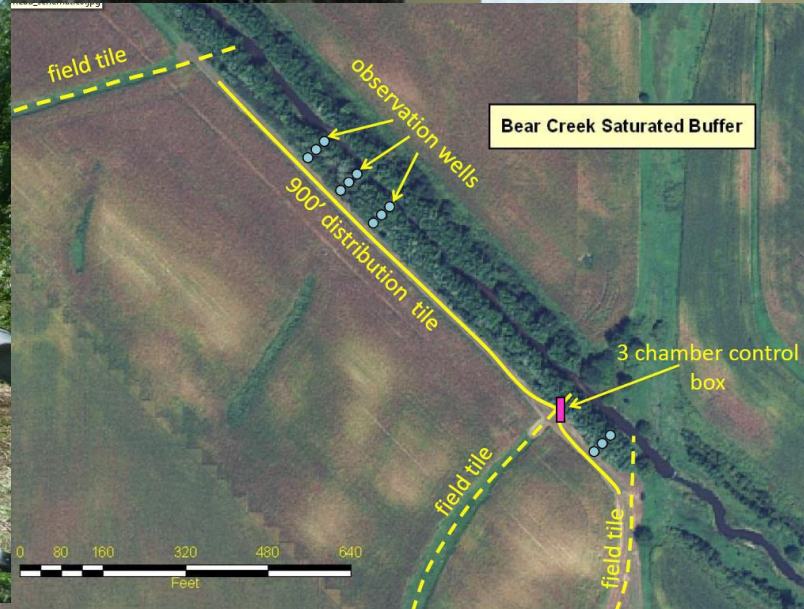
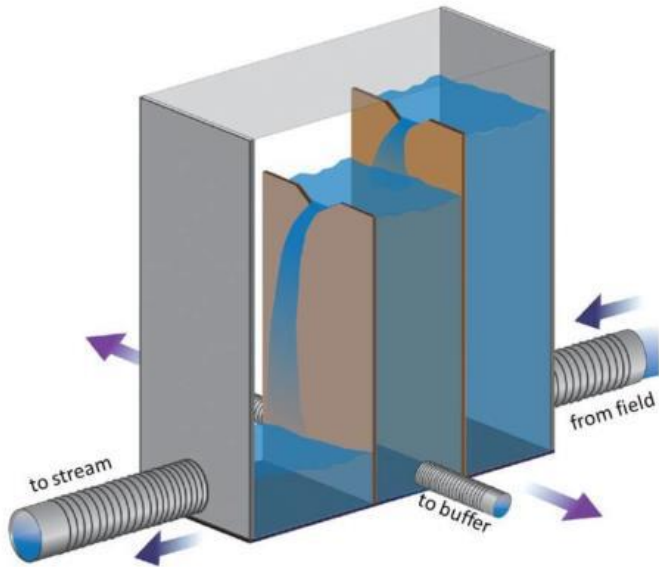






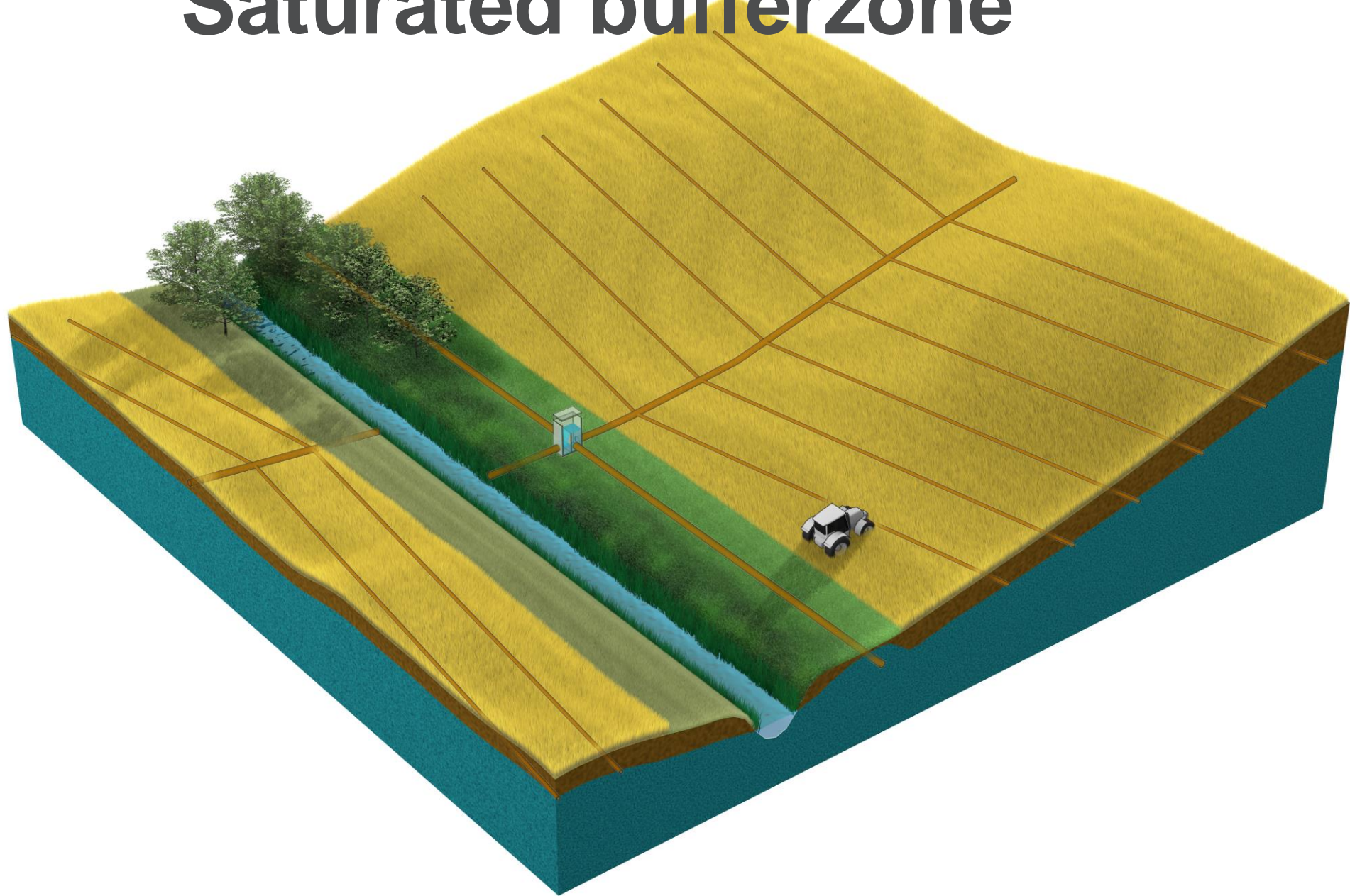
SGAARD'S  
SKINSTATION  
55 03 64







# Saturated bufferzone





# Effect of saturated bufferzone



	Practice	Comments	% Nitrate-N Reduction <sup>+</sup>	% Corn Yield Change <sup>++</sup>
			Average (SD*)	Average (SD*)
	Saturated Buffers	Divert fraction of tile drainage into riparian buffer to remove Nitrate-N by denitrification.	50 (13)	

From: Reducing Nutrient Loss: Science Shows What Works



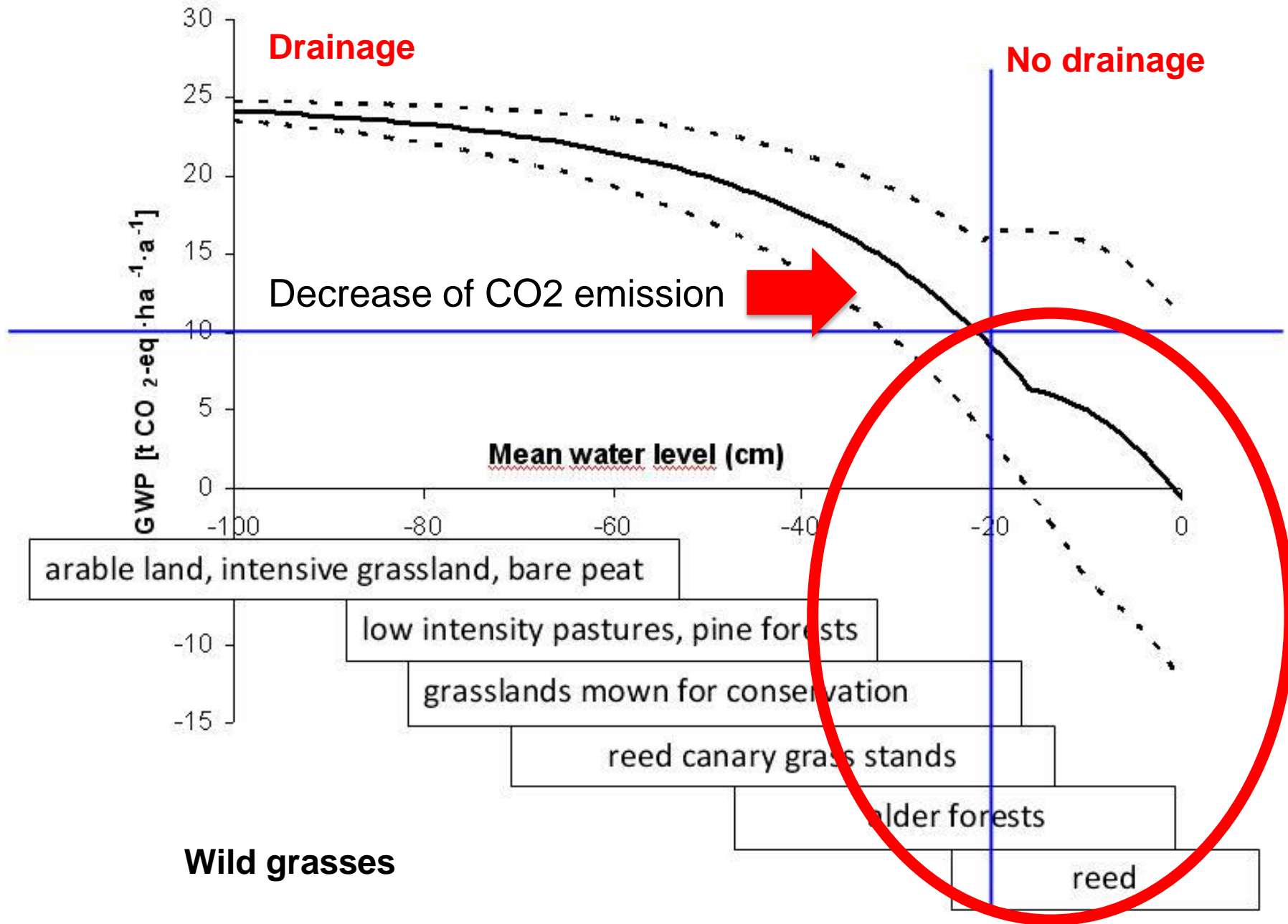
# Paludiculture



**70,000 ha in Denmark (Greve et al 2014).  
~ 20% of the entire agricultural sector's greenhouse gas  
emissions are coming from peatlands.  
(Nielsen et al. 2012).**



# Paludiculture – raising the waterlevel





# Paludiculture - Cinderella project

*Phragmites australis* - Reed



*Arundo donax*  
*Kæmperør* eller  
*Italy* – 10 meter  
*Denmark* – 5 meter



*Typha latifolia*  
*Bulrush*

*Typha angustifolia*  
*Bulrush*



[https://www.youtube.com/watch?v=\\_a9AkU1Qev0](https://www.youtube.com/watch?v=_a9AkU1Qev0)



# Paludiculture



Harvesting of reeds for thatching

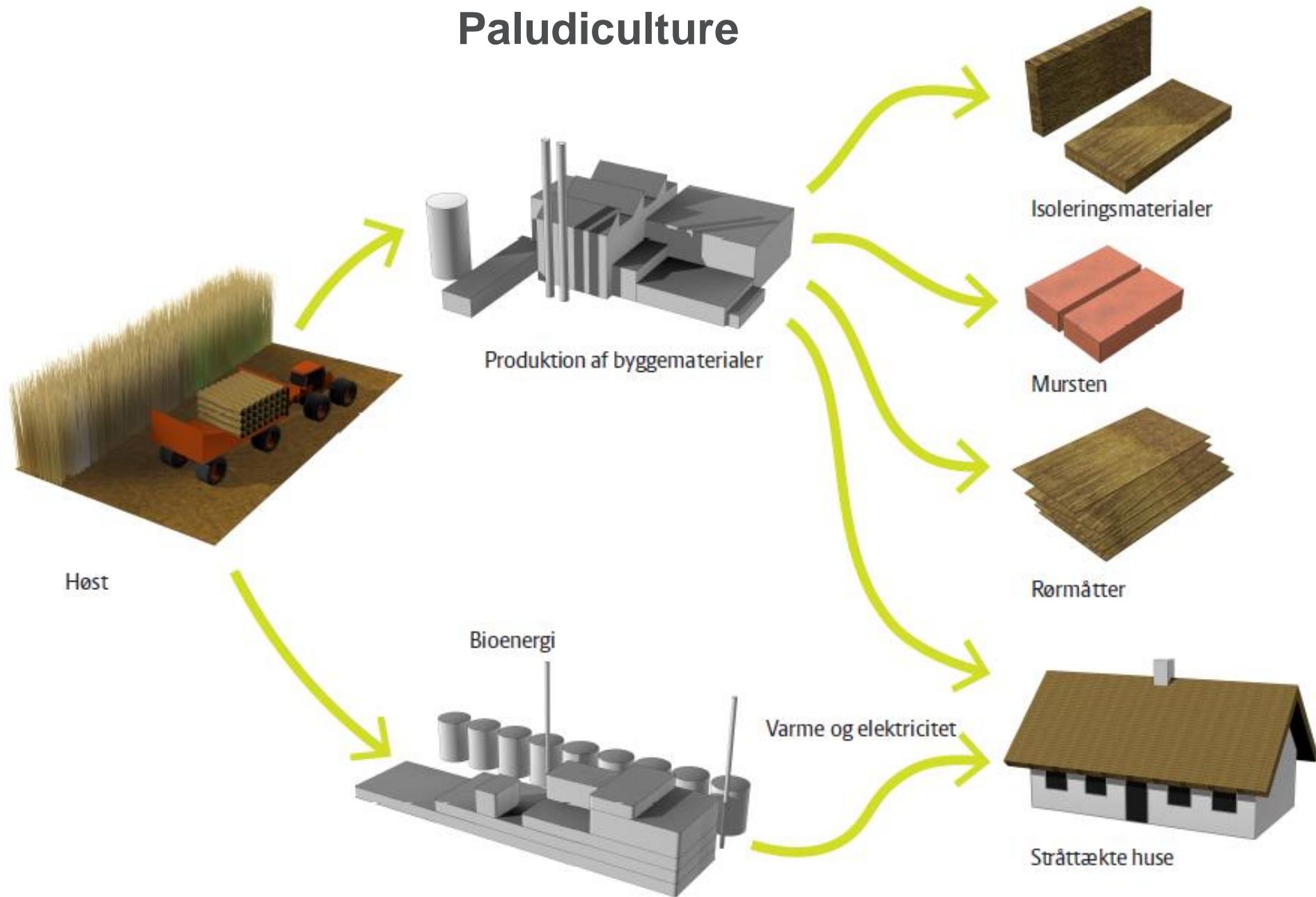


Harvest of biomass





# Paludiculture





# Paludiculture

