IHE DELFT Institute for Water Education under the auspices of UNESCO

NEXOGENESIS
STREAMLINING WATER RELATED POLICIES

TU Delft

Introduction to the baseline results of System Dynamics Modelling in the Lielupe River Basin

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Nexus approach – Water, Energy, Food, Ecosystems

Case study – Lielupe River Basin

A business as usual pathway shows an **increase in greenhouse gases (GHG) emissions and nutrients runoff**

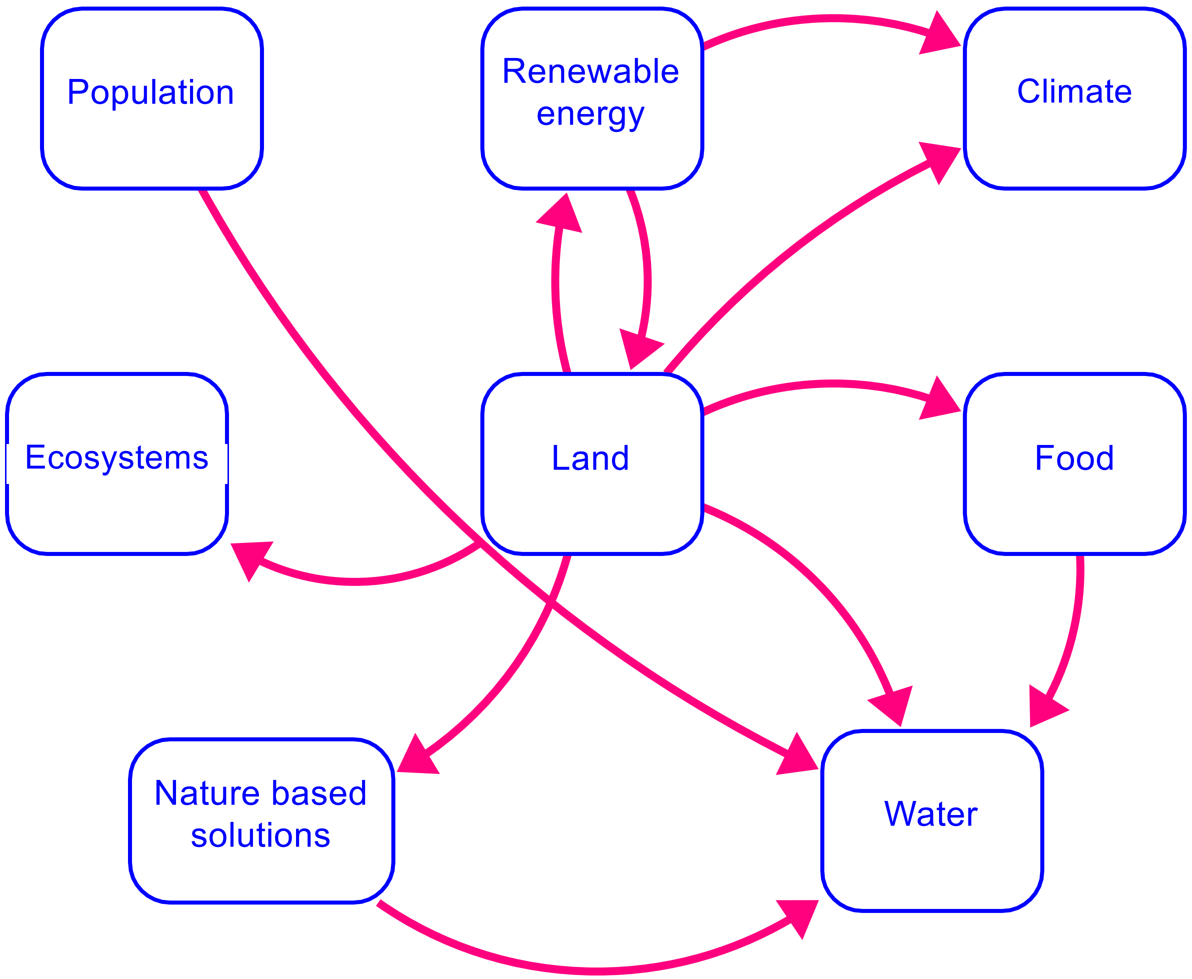
Land use trade-offs: **rainfed crops, renewable energy, preservation of meadows and pastures**

NXG 3rd Stakeholder Workshop

https://www.bef.lv/review-on-3rd-nexogenesis-workshop/

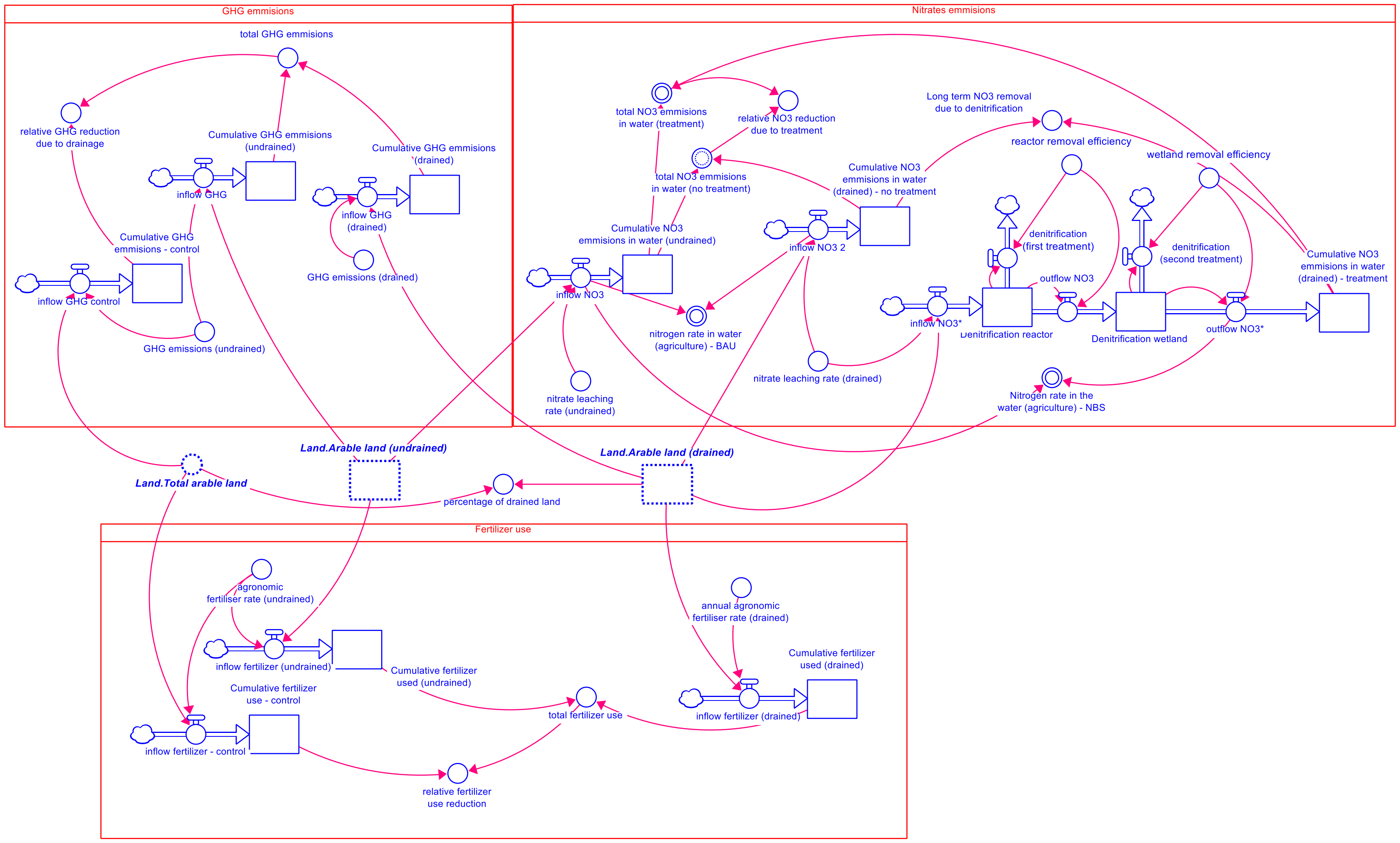
- International workshop held on the 15th June 2023 in Vilnius, Lithuania
- Identification and prioritisation of the basin's main issues and possible policies to address
  - Nutrients pollution
    - Nature-based solutions (e.g. wetlands)
  - Renewable energy transition
    - Solar and wind energy expansion
- Policy alternatives exploration

Our approach – System Dynamics Models



Feature	Count
Modules	8
Equations	160
Variables	220
Months	420
Simulations	1000

Example of submodules – Nature Based Solutions



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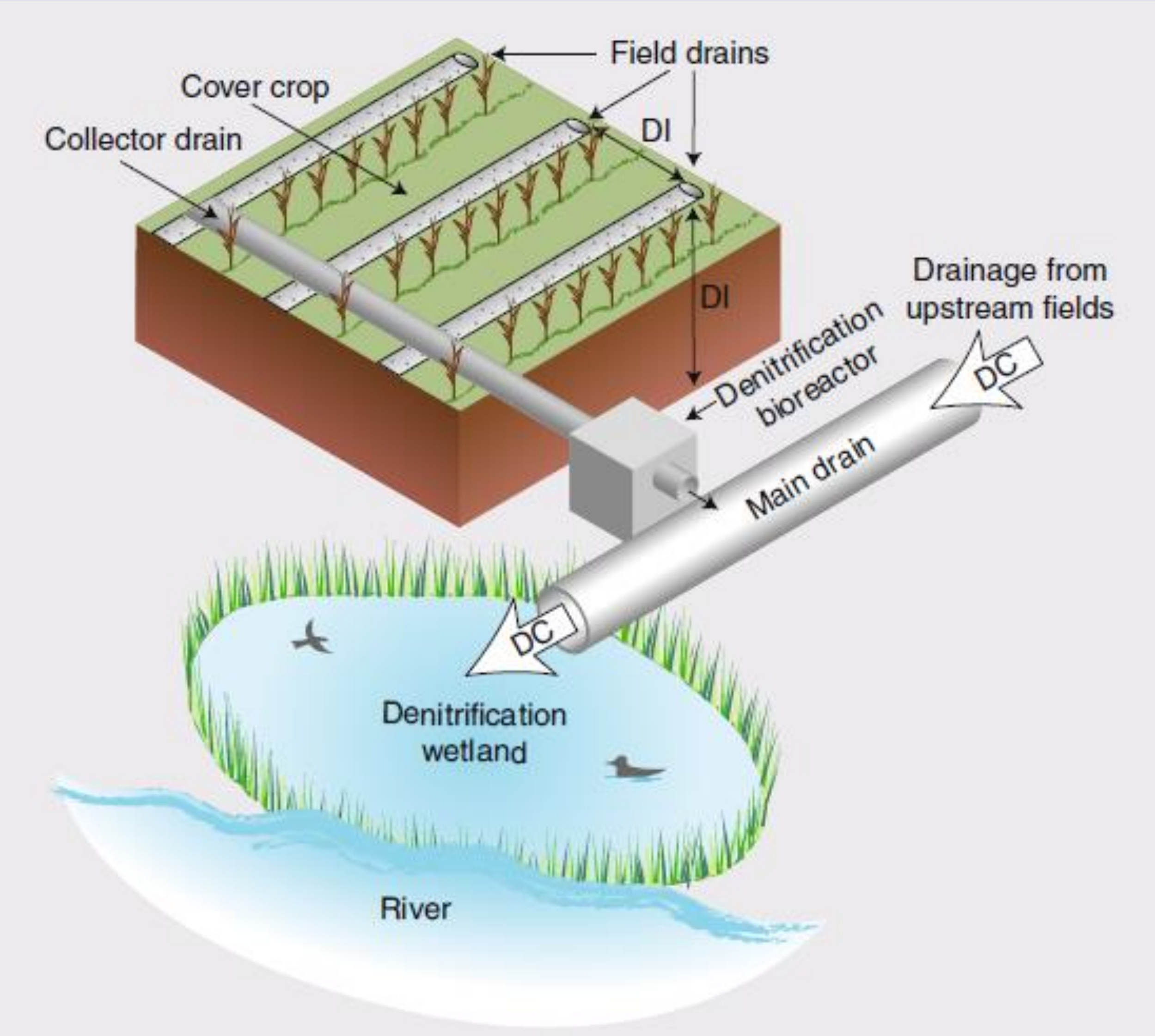
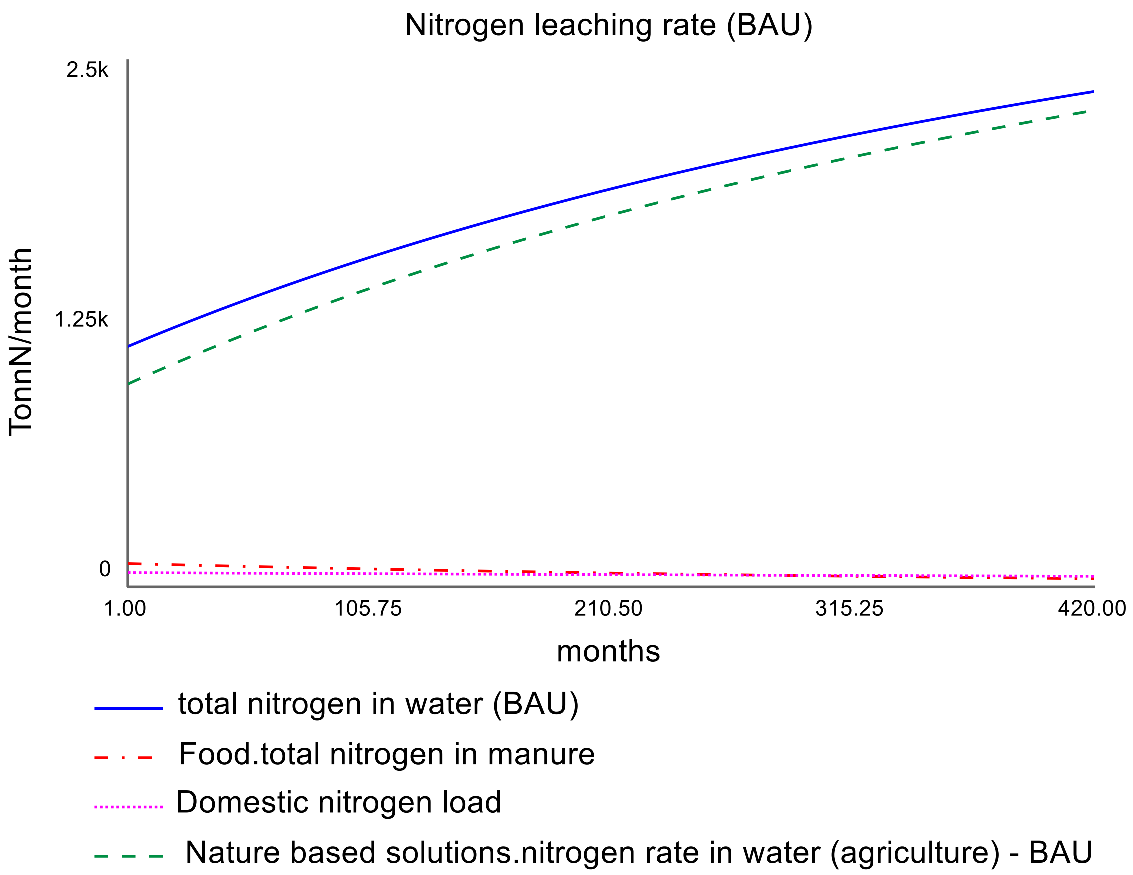
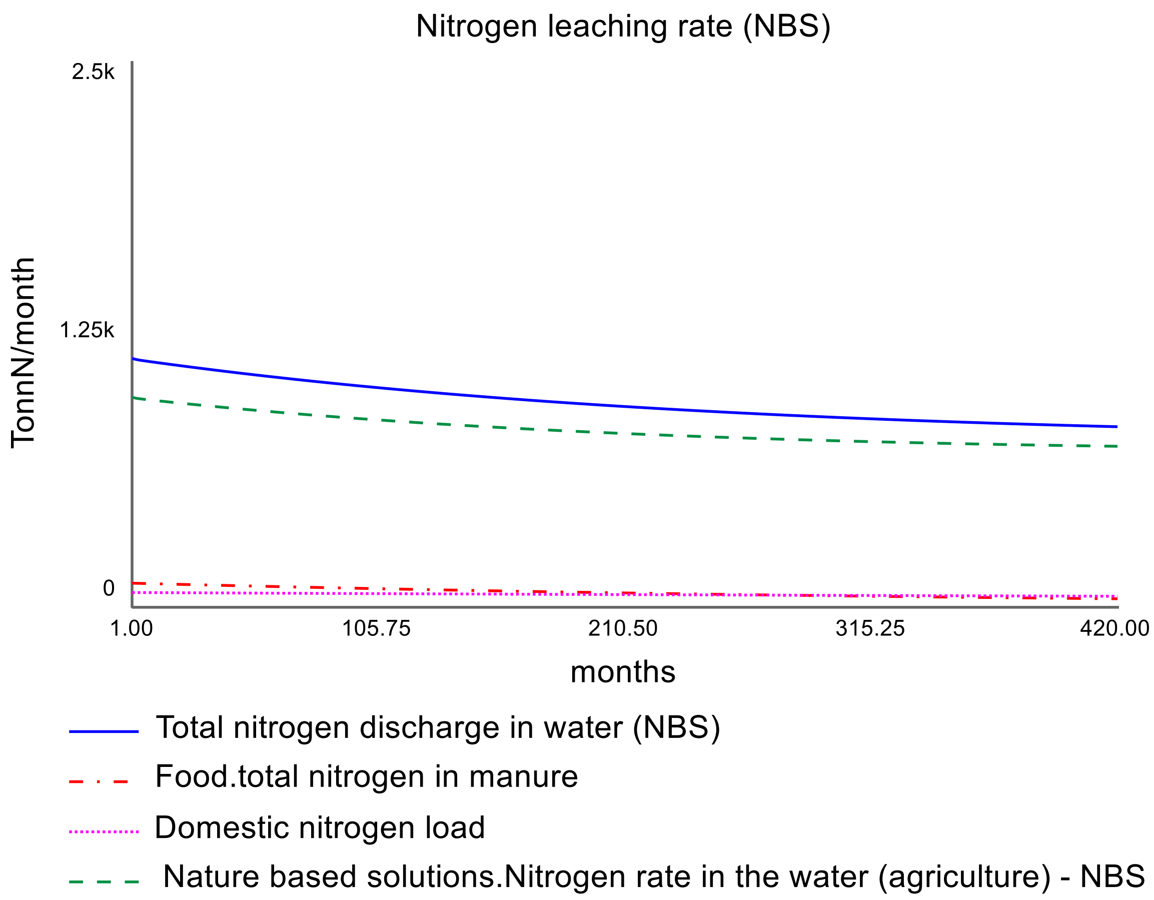
Nutrients pollution

- **Policies to consider**
  - Implementing NBS to control nitrogen pollution
    - **Treatment 1** – Woodchip Bioreactor (in-site)
    - **Treatment 2** – Constructed wetlands (regional – 3% of drained crop land)
    - **Rapid expansion of nutrient control** - 5% annual rate of implementation of NBS to control nitrogen pollution

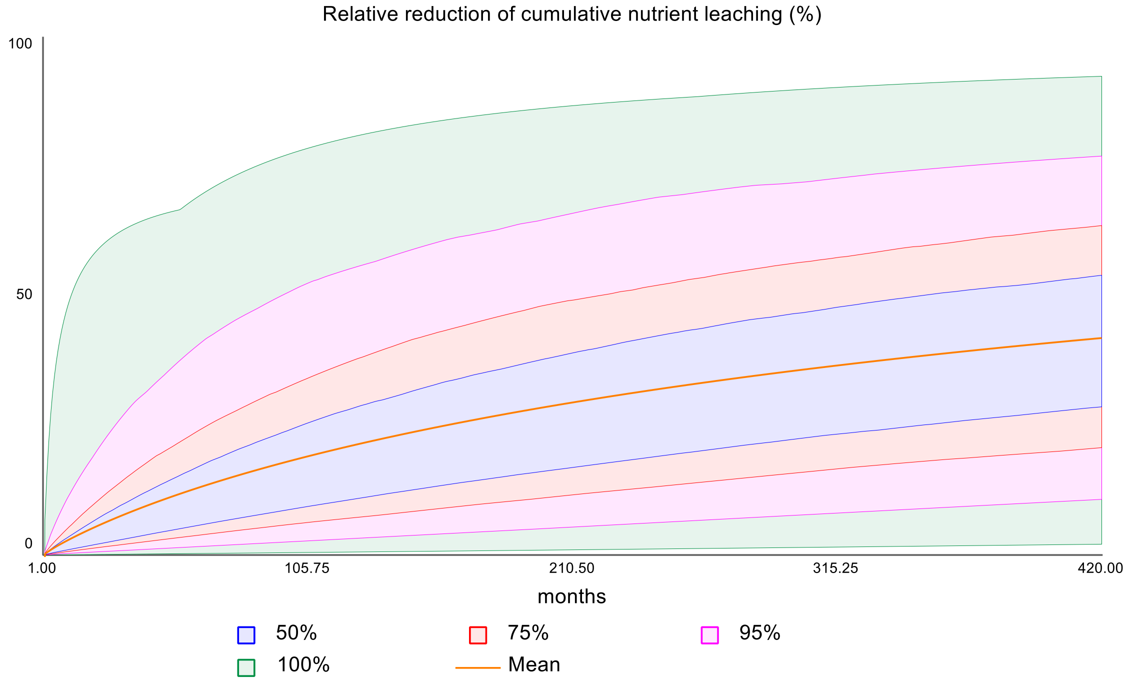


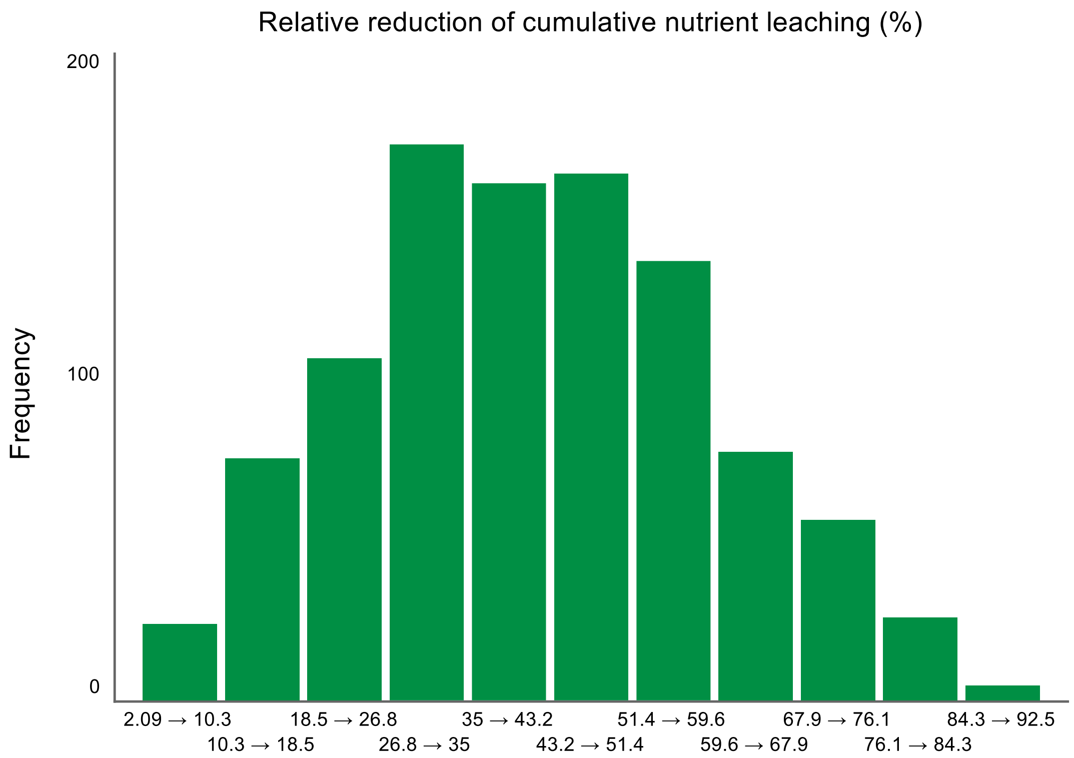


Nitrogen leaching rate (BAU)
2.5k
1.25k
0
TonnN/month
1.00
105.75
210.50
315.25
420.00
months
total nitrogen in water (BAU)
Food.total nitrogen in manure
Domestic nitrogen load
Nature based solutions.nitrogen rate in water (agriculture) - BAU



Nitrogen leaching rate (NBS)
2.5k
1.25k
0
TonnN/month
1.00
105.75
210.50
315.25
420.00
months
Total nitrogen discharge in water (NBS)
Food.total nitrogen in manure
Domestic nitrogen load
Nature based solutions.Nitrogen rate in the water (agriculture) - NBS

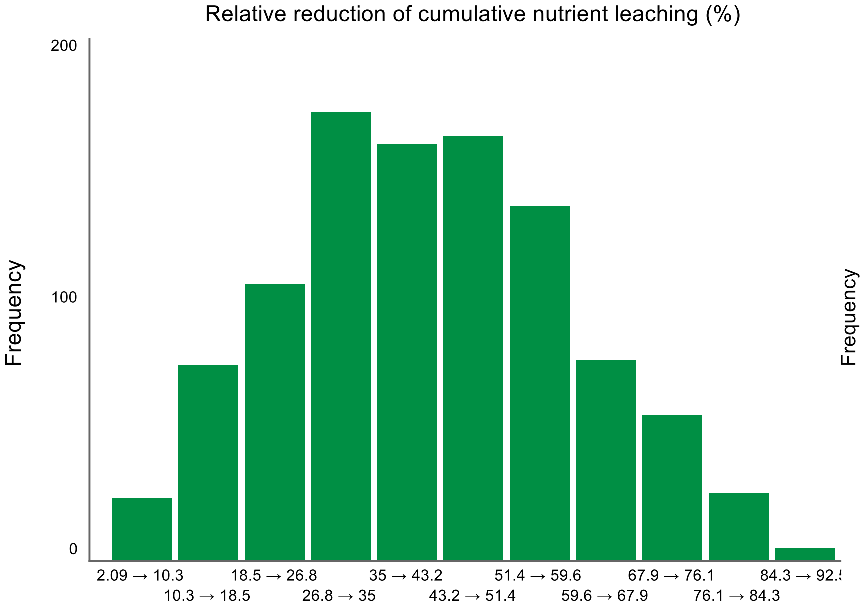




Mean - 41.9
Min - 2.09
Median - 41.2
Max - 92.5

Std. Dev. - 17.6
25% Percentile - 28.6
75% Percentile - 54.1
Interquartile Range - 25.4

Both treatments

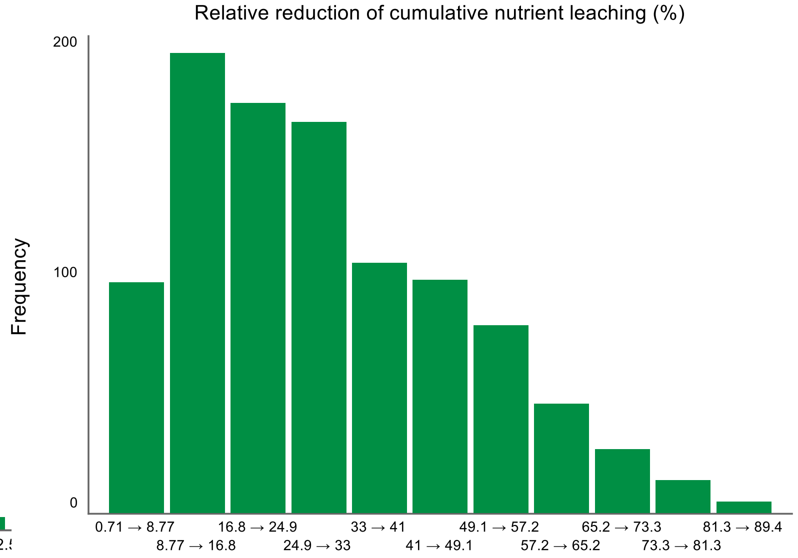


Mean - 41.9
Min - 2.09
Median - 41.2
Max - 92.5

Std. Dev. - 17.6
25% Percentile - 28.6
75% Percentile - 54.1
Interquartile Range - 25.4

Average reduction – **42%**
50% of cases – (29%-54%)

Only treatment 1 - bioreactor

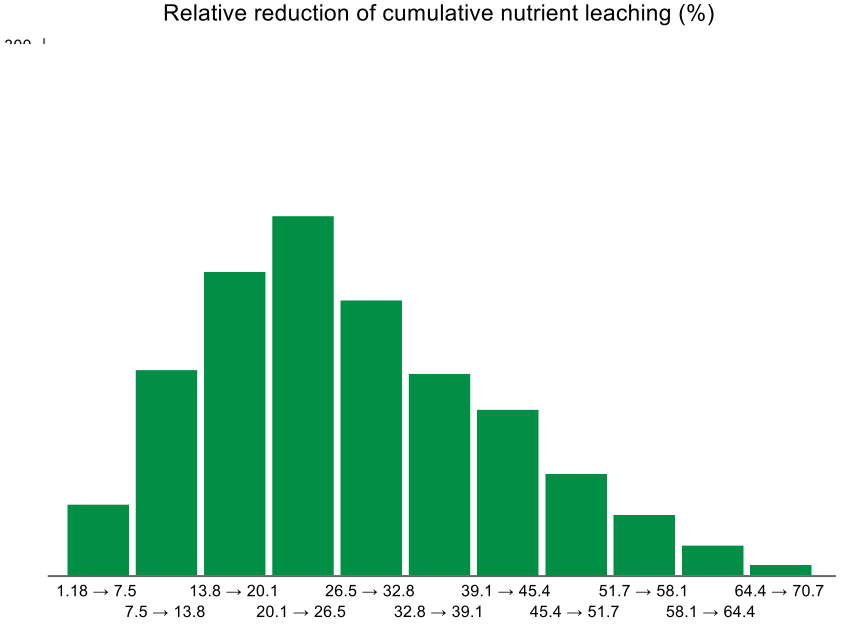


Mean - 30
Min - 0.71
Median - 26.4
Max - 89.4

Std. Dev. - 18.2
25% Percentile - 15.3
75% Percentile - 42.7
Interquartile Range - 27.4

Average reduction – **30%**
50% of cases – (15%-43%)

Only treatment 2 - wetland



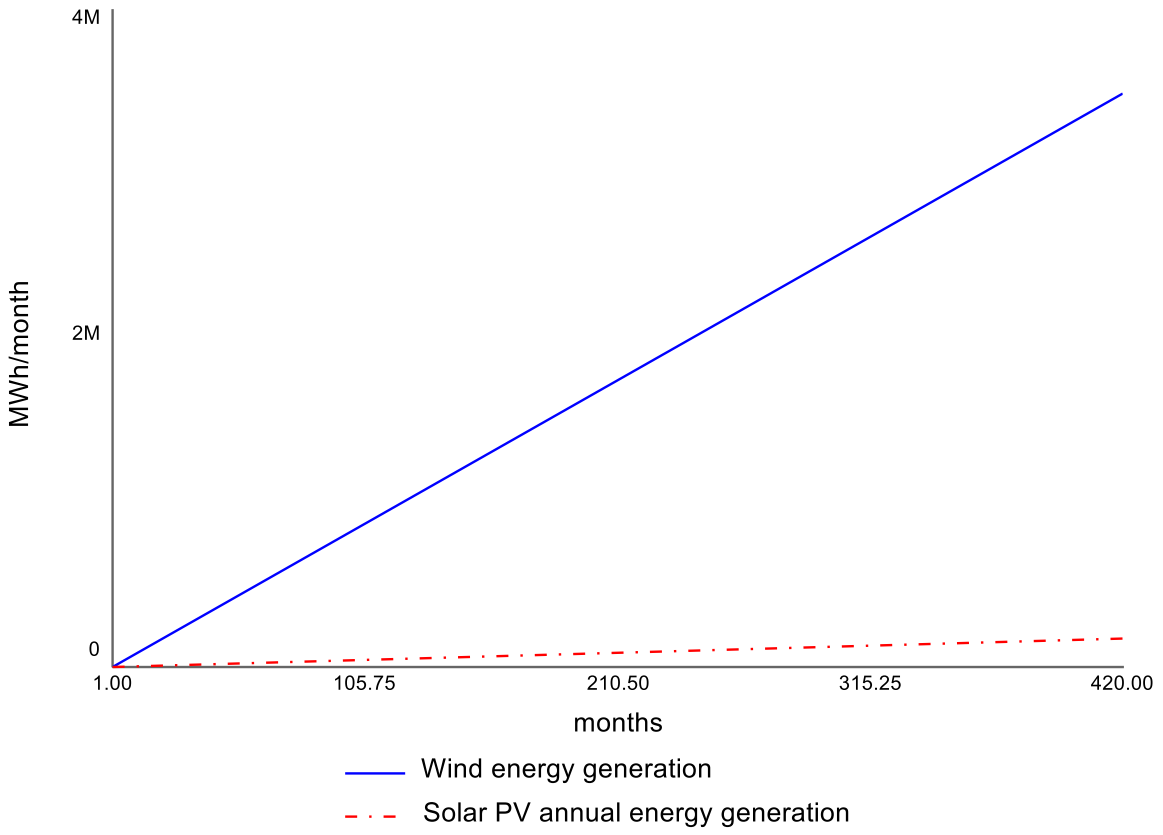
Mean - 27.6
Min - 1.18
Median - 25.6
Max - 70.7

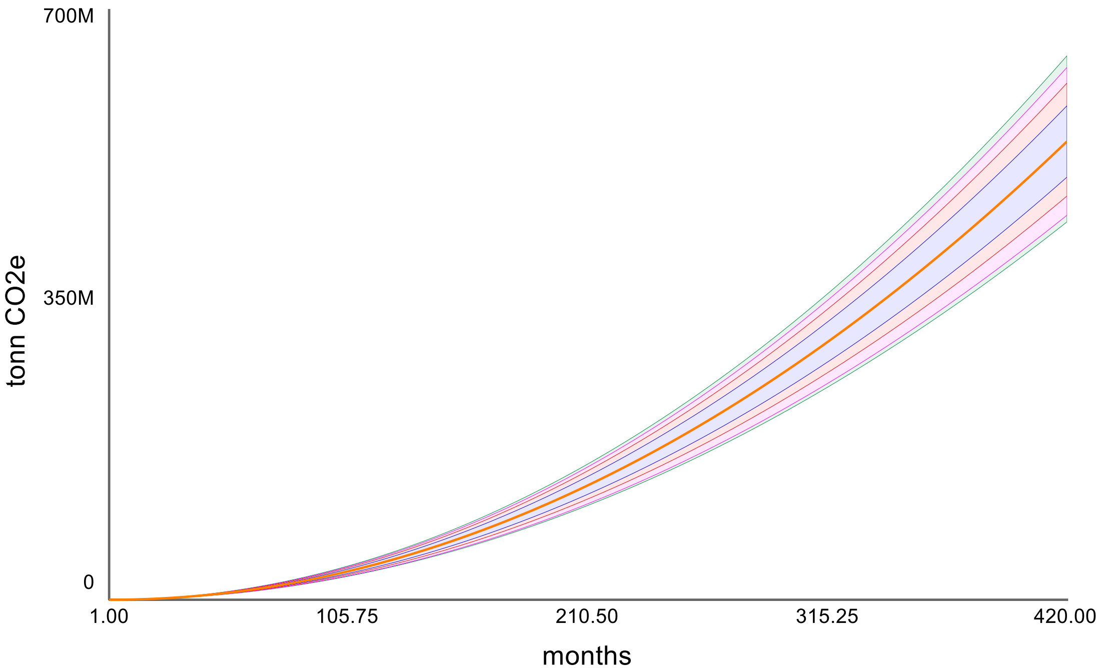
Std. Dev. - 13.4
25% Percentile - 17.3
75% Percentile - 36.7
Interquartile Range - 19.3

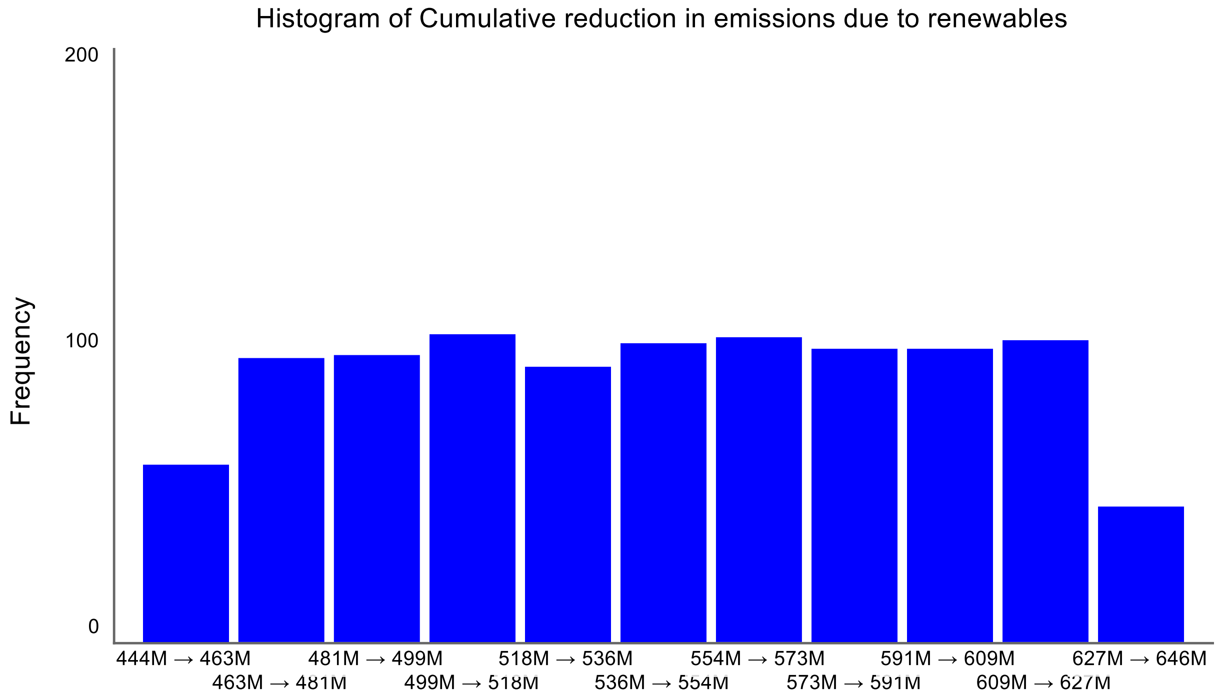
Average reduction – **28%**
50% of cases – (17%-37%)

Renewable energy and climate

- **Policies to consider**
  - Expanding renewable energy (solar and wind)
    - 1% annual expansion following current trends
    - Wind energy potential dominates solar energy potential







Mean - 544M
Min - 444M
Median - 545M
Max - 646M

Std. Dev. - 53.4M
25% Percentile - 499M
75% Percentile - 590M
Interquartile Range - 91.2M

Average reduction – 544M Tonn CO2
50% of cases – (500-590 Tonn CO2)

Discussion points

- Using combined NBS to control nutrient pollution shows promising results
  - It shows an expected 40% long-term reduction in nutrient loads for 2050. This is in the range of recently reported results of 30 years of nutrients control policy in Denmark (30-52%)
  - Using a single treatment shows positive results but lowers the efficiency of reduction and increases uncertainty.
  - How feasible is it to implement these alternatives? How can they be combined with other options to control nutrient pollution in the river basin?

Discussion points

- Renewable expansion represents an opportunity to reduce CO2 emissions in the long term
  - Increasing renewables by 1% a year would be equivalent to reducing 550 tonnes of CO2 in 2050.
  - In our model wind energy dominates solar energy. From your experience, can you evidence such a trend in the river basin?

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Thanks for your attention!

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