Potential impacts of climate change on agricultural water management in Estonia

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Waterdrive
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Outline

- Climate and water use
- Agriculture today
- Changes in some climate indicators
- Projected changes in air temperature and precipitation
- Potential impacts of climate change on agricultural water management

Climate and water use

Proximity of the Baltic Sea; a long coastline and a high number of islets (ca 2 000)

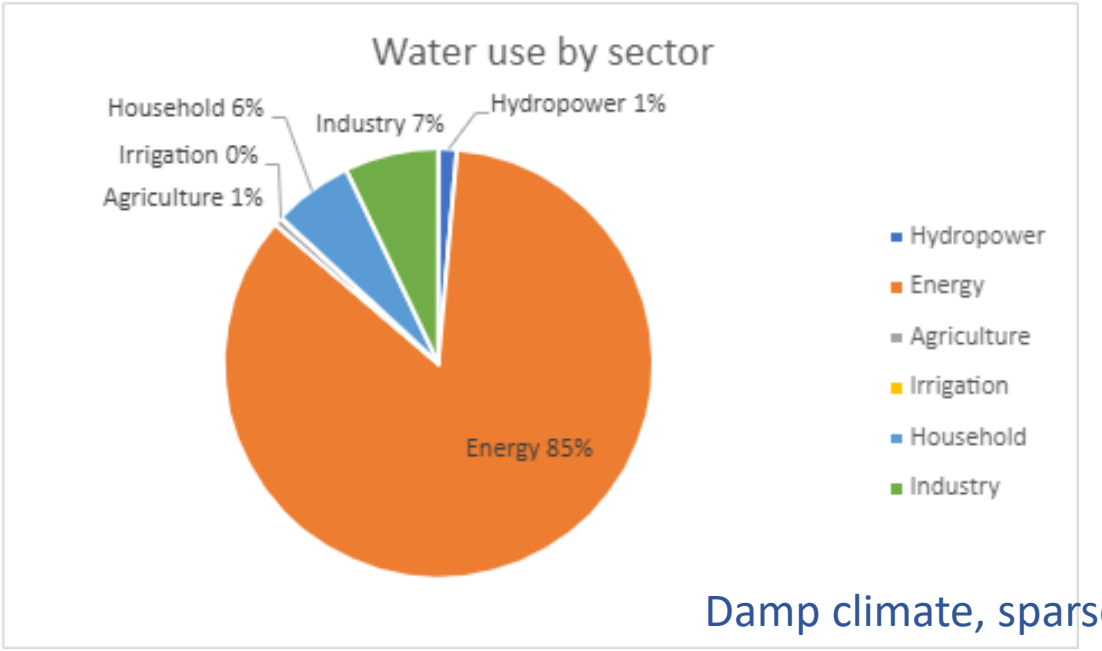
Ca 50% is covered by forest and 22% fens, forested swamps and bogs; very flat country

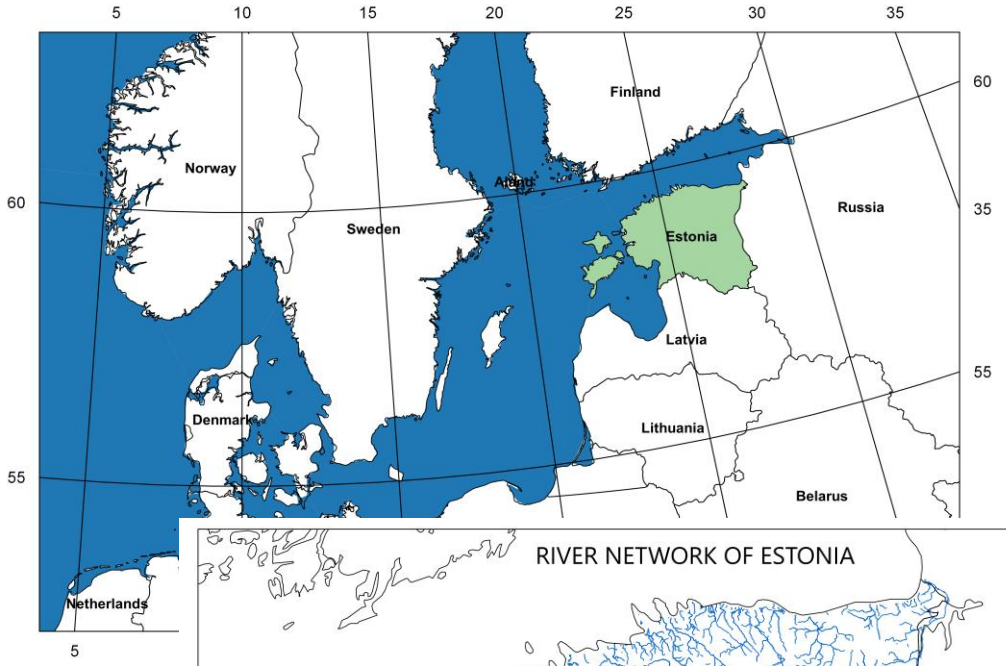
A large number of lakes (2800) and rivers (7300)

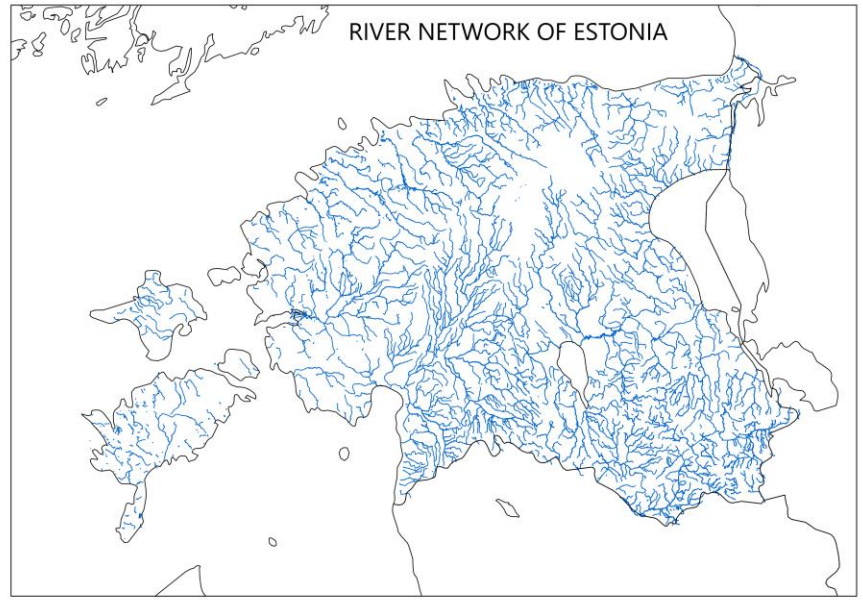
The population density 30 people per km^2

Average annual precipitation 550-700 mm

The water exploitation index (WEI+) less than 10% (2017)







Diffuse agricultural pollution has the significant pressure on water quality of surface water and groundwaters

Damp climate, sparsely populated country, a high biological diversity, plenty of water

Agriculture today

- Utilised agricultural land 22%; 22% of agricultural land is organic farming
- Large farms predominate; the share of young farmers increasing;
- Significant changes in agriculture:
  - 30 years ago animal raising predominated,

  now plant production dominates
- Significant changes in the structure of plant production:
  - Rye has remained a niche crop
  - Winter form of rapeseed dominates
  - The proportion of winter barley is increasing
  - We have become wheat growing and exporting country

- Precipitation exceeds evaporation ; irrigation role is negligible (ca 0.03 % of agricultural land is irrigated)
- Land drainage systems cover 62 % of agricultural land
- The agricultural, forestry and fisheries sector accounted for 3.3% of the gross value added (GVA) of Estonia in 2019

Changes in some climate indicators

- Annual mean air temperature has increased 0.2-0.3 ˚C dec^{-1} in the period 1951-2000 (Jaagus, 2005; Männik et al, 2014)
- Vegetation period has extended by 21 days in the period 1965-2013, mainly due to earlier spring (Saue et al, 2015)
- The annual precipitation has risen by 10% in the period 1951-2000 (Jaagus, 2005), mainly during the cold season (from November to March)
- Extreme precipitation events have become more frequent and intense in the period 1957-2009 (Tammets and Jaagus, 2013). An increase in annual maximum 1-day precipitation was detected since 1901 (Dyrrdal et al, 2021)
- Snow cover has decreased by 17-20 days on mainland and by 21-36 days on the coast in the period 1951-2000 (Jaagus, 2005)
- River ice cover duration has decreased 9 days per decade in the period 1930-2010 on mainland, due to later freeze and earlier break-up (Pedusaar et al, 2015)
- Winter river runoff has increased significantly during 1951-2015. Spring flooding on rivers has become a rare event (Jaagus et al, 2017)

Projected changes in air temperature

Period	2040-2070		2070-2100	
Scenario	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
Winter (DJF)	2.3 ˚C	3.1 ˚C	2.9 ˚C	4.9 ˚C
Spring (MAM)	2.4 ˚C	3.4 ˚C	3.1 ˚C	4.9 ˚C
Summer (JJA)	1.6 ˚C	2.2 ˚C	2.2 ˚C	3.8 ˚C
Autumn (SON)	1.7 ˚C	2.2 ˚C	2.2 ˚C	3.6 ˚C
Mean annual	2.0 ˚C	2.7 ˚C	2.6 ˚C	4.3 ˚C

(Luhamaa et al, 2015)

- The ensemble: RCA4, DIM-HIRHAM5, KNMI-RACMO22
- The resolution 12 kmx12km
- Two scenarios: RCP 4.5 = optimistic scenario and RCP 8.5 = pessimistic scenario
- The reference period 1971-2000

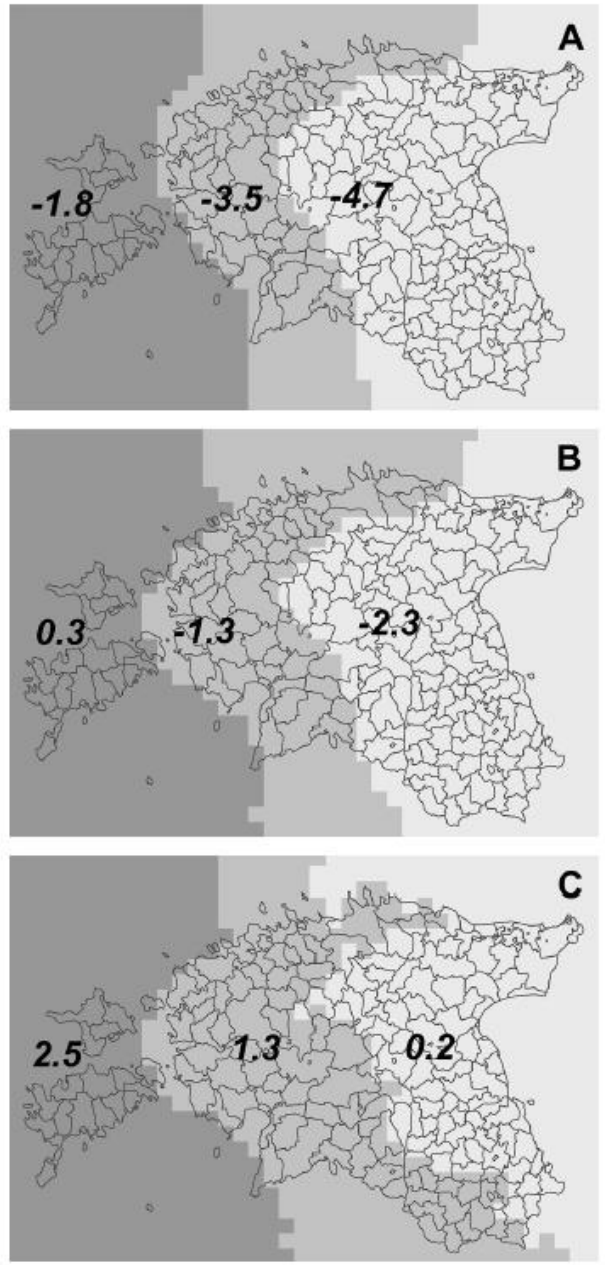


Figure: Winter mean temperature of climatic regions during reference period 1971-2000 (A), according to RCP 4.5 for the period 2070-2100 (B) and according to RCP 8.5 for the period 2070-2100 (C)

Projected changes in precipitation

Change in mean precipitation (%)

Period	2040-2070		2070-2100	
Scenario	RCP 4.5	RCP 8.5	RCP 4.5	RCP 8.5
Winter (DJF)	9%	16%	15%	22%
Spring (MAM)	10%	21%	16%	24%
Summer (JJA)	11%	15%	18%	19%
Autumn (SON)	10%	11%	8%	12%
Mean annual	10%	16%	14%	19%

(Luhamaa et al, 2015)

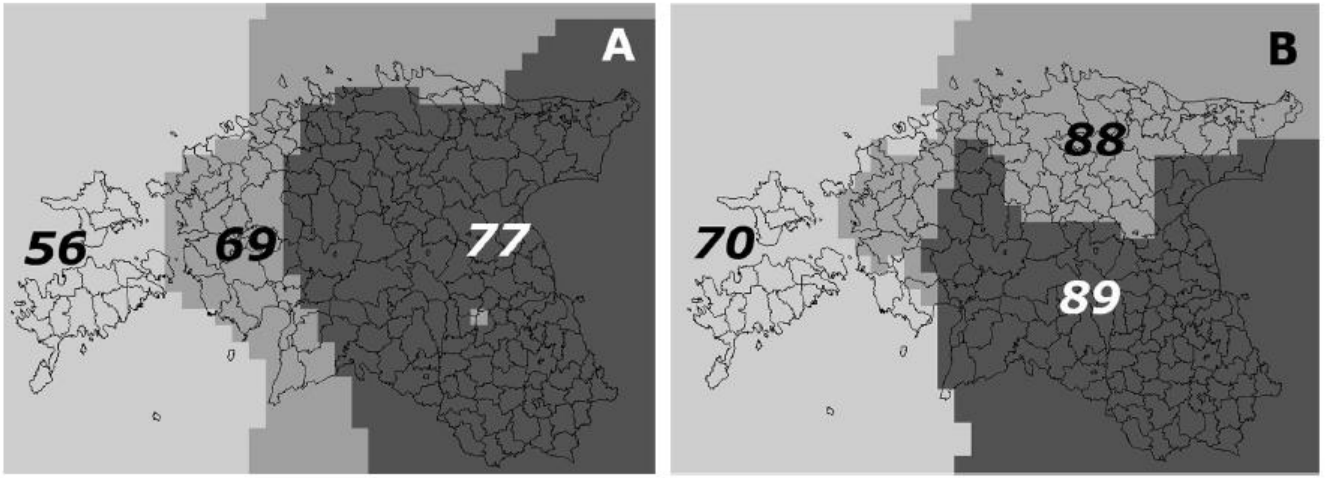


Figure: Summer precipitation sum of climatic regions during reference period 1971-2000 (A) and according to RCP 8.5 for the period 2070-2100 (B)

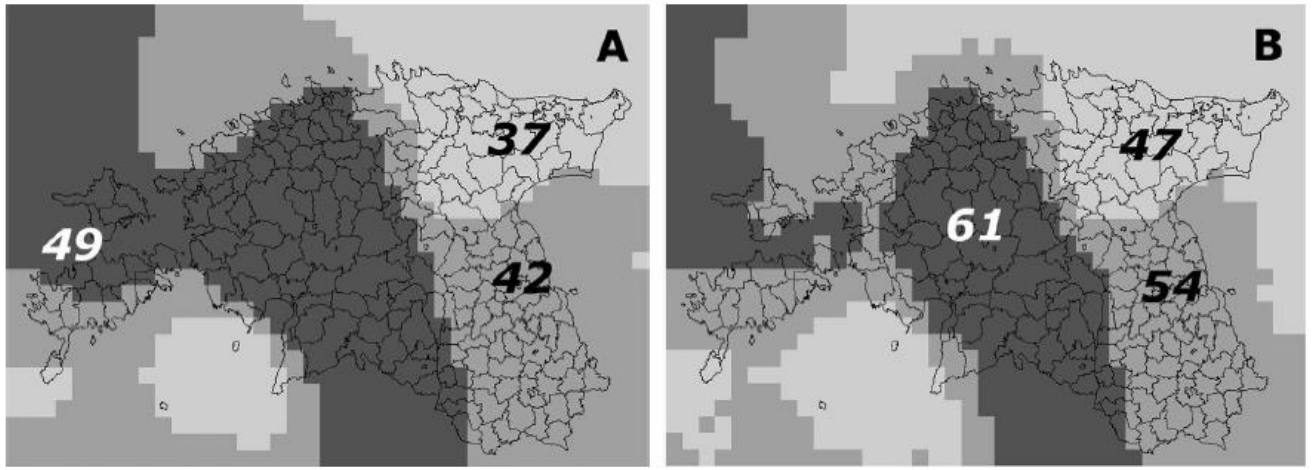


Figure: Winter precipitation sum of climatic regions during reference period 1971-2000 (A) and according to RCP 8.5 for the period 2070-2100 (B)

Potential impacts of climate change on agricultural water management

The air temperature (the length of the vegetation period) is increasing and the amount of precipitation is increasing

- Need for construct and reconstruct drainage systems, need for better maintenance
- Need for (more) active water regulation, possibility to save and allocate the water (water reservoirs, pumping stations, channels etc)
- Need for irrigation systems may rise
- Need for restoration of waterbodies may rise
- Water use for agricultural purposes may increase

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Thank You!

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