

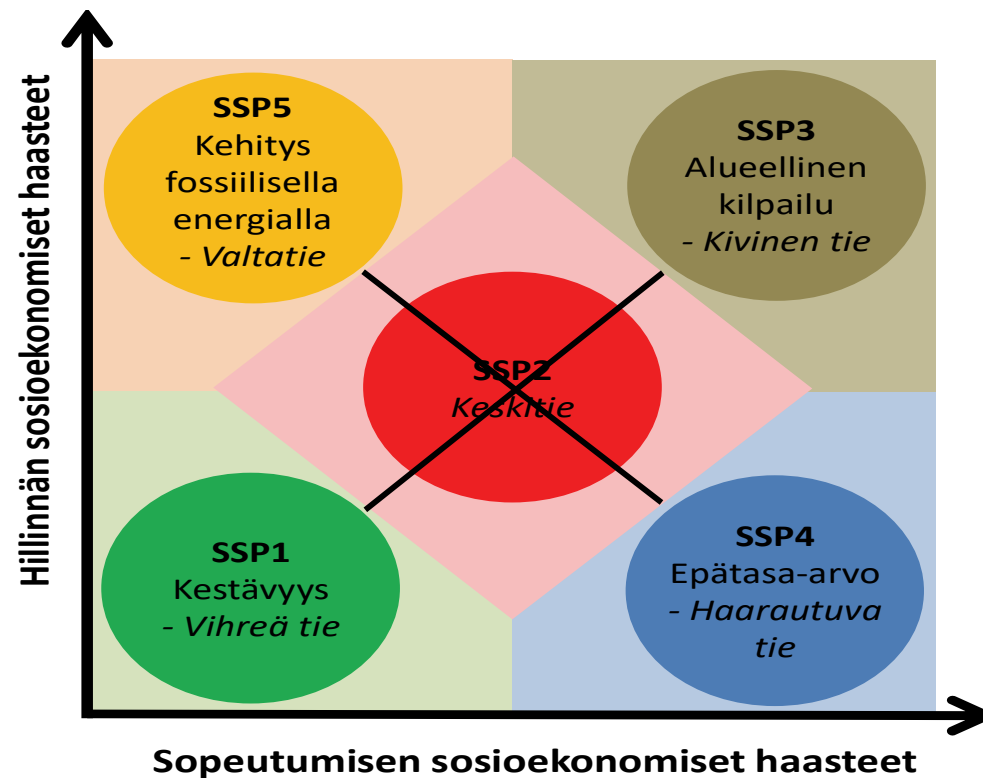
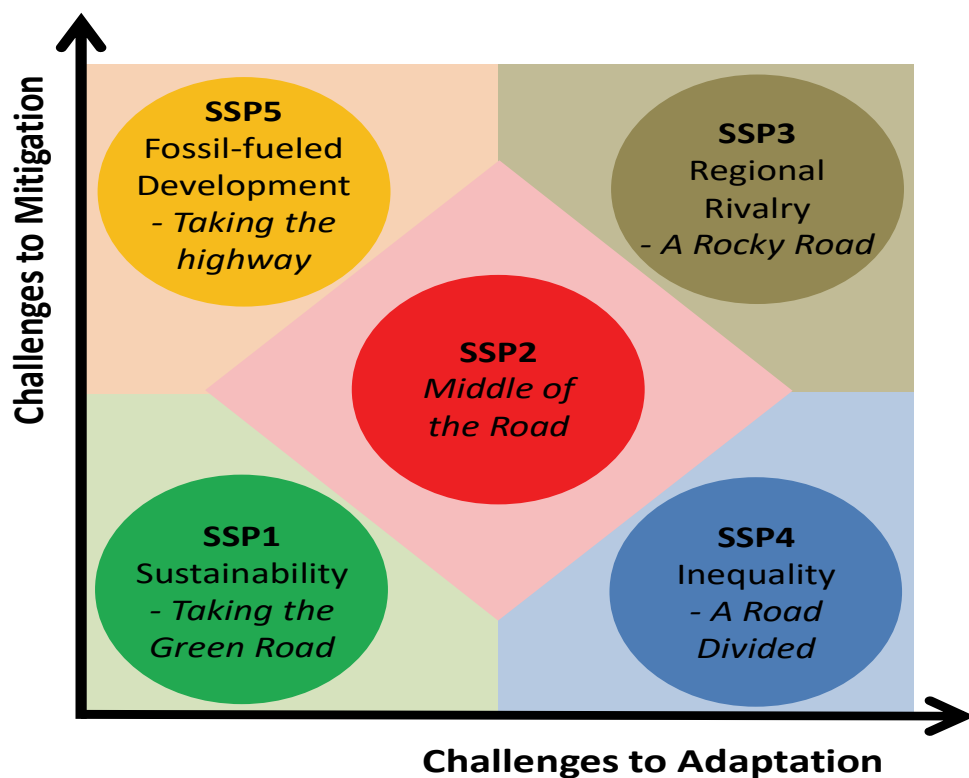
Scenario demonstration: Quantifying agri-food SSP- RCPs

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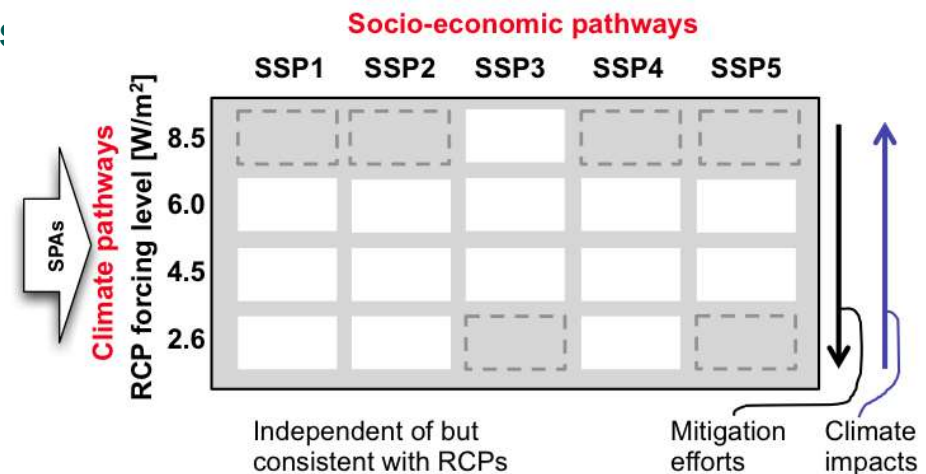
Natural Resources Institute Finland (Luke)

The five GLOBAL shared socioeconomic pathways (SSPs) representing challenges to climate change mitigation and adaptation (a) and their Finnish language equivalents (b) – out to 2050 - 2100

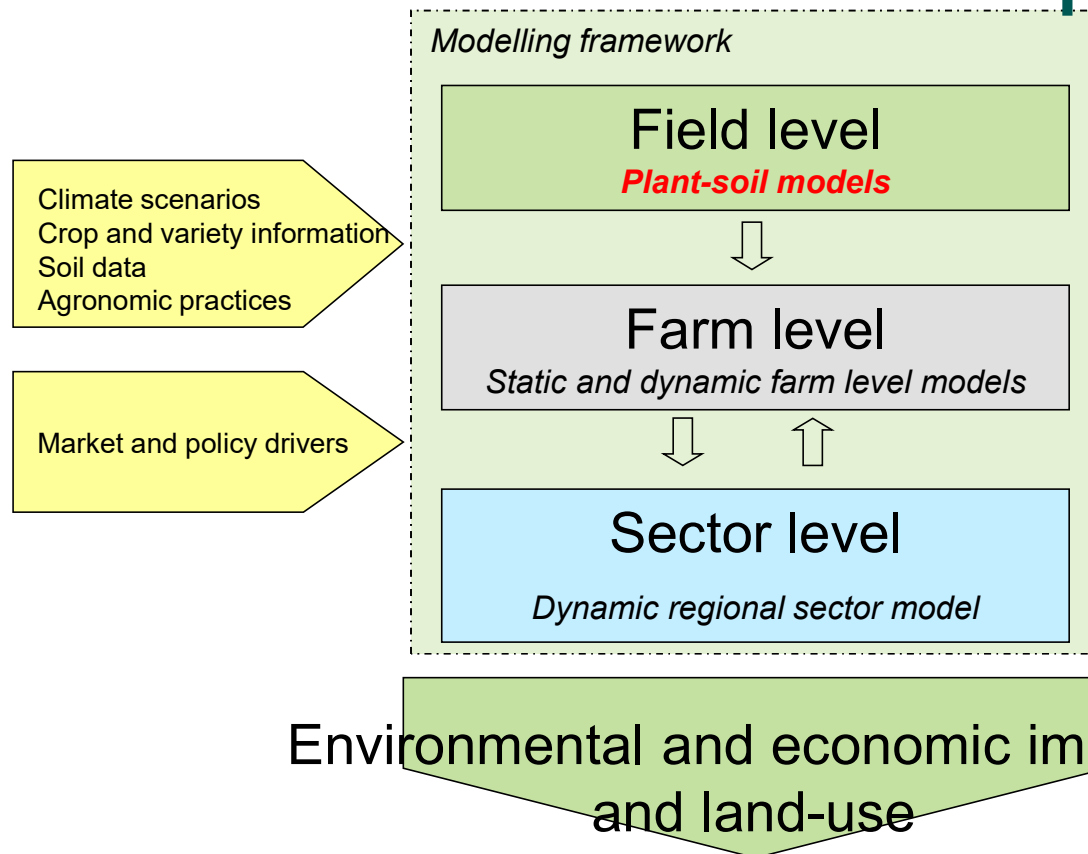


Coupling SSPs to RCPs: Issues to be made clear

- **Linking SSPs with certain RCPs, with crop yield, input use and cost effects at the farm level ?**
 - This requires some agronomic and farm economy considerations – region specific
- **Shared Policy Assumptions (SPAs) in SSPs?**
 - Regulations, subsidies, taxes...
- **Global input and output prices in agriculture, in SSPs ?**
 - Literature survey, stakeholder views
- **More exact food demand and GDP development in Finland in SSPs – check recent literature**



Luke integrated modelling capacity in quantifying agricultural development in Finland



SSP specific inputs and reasoning needed:

Population (IIASA SSP database)
 - In regions in Finland?
 GDP growth (IIASA database)
 Global / EU agricultural input and output prices
 Policy assumptions, technology, productivity...

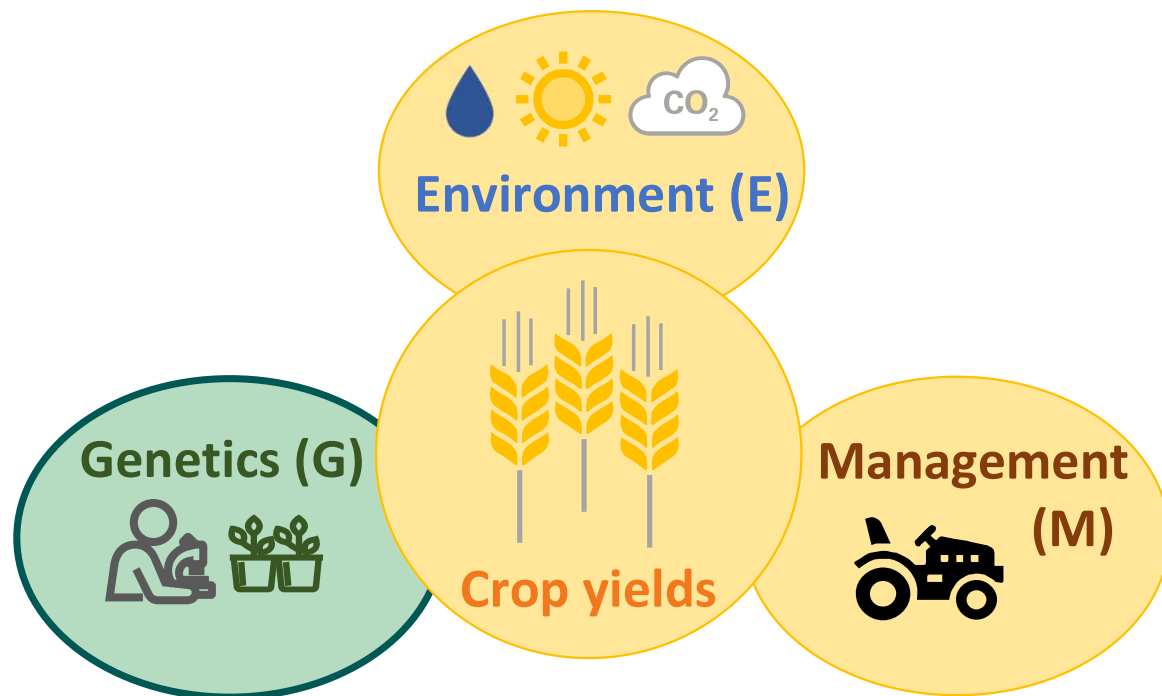
? Here for each steps: Method => results

- What all is taken into account*

3 main steps in the SSP quantification for agriculture

- **Step 1: Climate impact studies with crop modelling => changes in attainable yields of different crops:**
 - climate impact, breeding effort, risks, (agro-)technological development, technology update
- **Step 2: Farm level modelling:** dynamic optimisation model with pre-crop effects in crop rotation, input use responses in crop yields, over 30 year time-span => **farm level yields**
 - **First**, yield shifters from current yields to SSP specific yield levels are adopted based on step 1
 - **Takes** prices of inputs and outputs, and some policy variables, per SSP, from the literature
 - => **produces** economically rational (optimal) use of inputs and resulting yields + rational land use + farm incomes
- **Step 3: Sector level modelling of SSP-RCPs:**
 - **Takes** the input use and yield effects from the farm model, + EU prices and policy variables in SSPs
 - **Takes** diet changes, population and but sector level development with supply (domestic production+imports), demand (domestic demand+exports), are affected by e.g. diet changes
 - **Produces:** The outcomes show production, trade, land use, farm incomes in Finland and in 4 main regions

Changes in crop cultivars

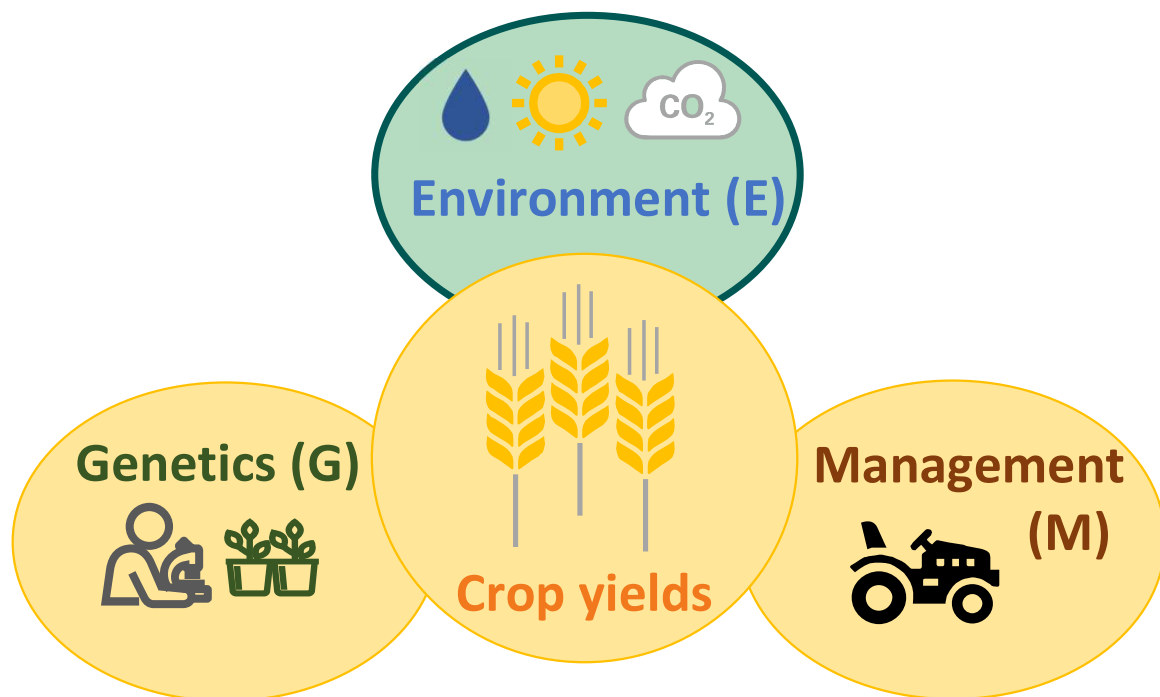


Breeding effort (G)

*Describing genetic potential of crops
Reflecting how food production is valued
in society*

SSP1-RCP2.6 “Taking the green road”	+ / ++
SSP3-RCP8.5 “A rocky road”	0

Changes in climate and environment



Climate impact on yields

Direct impacts of warming, heat, droughts, floods, etc.

SSP1-RCP2.6
"Taking the green road"

-/+

SSP3-RCP8.5
"A rocky road"

-/+

Pest and disease pressure impact

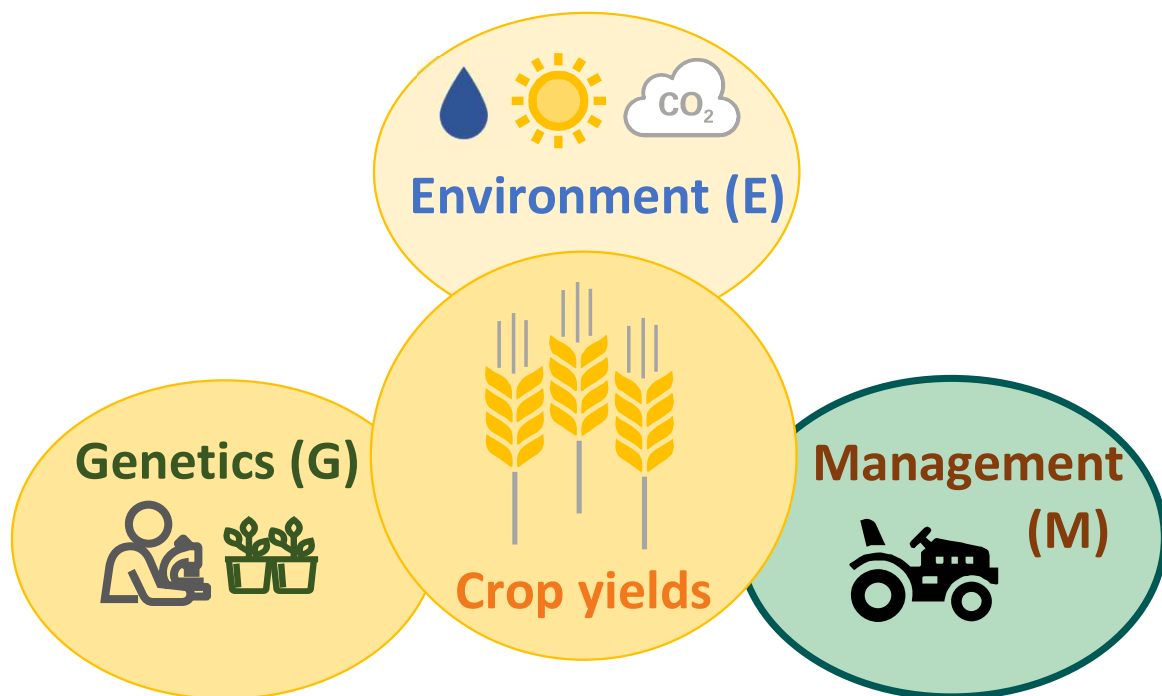
SSP1-RCP2.6
"Taking the green road"

0/-

SSP3-RCP8.5
"A rocky road"

--

Changes in agro-management



Overall (agro-) technological development

SSP1-RCP2.6 “Taking the green road”	++
SSP3-RCP8.5 “A rocky road”	0

Technology uptake at farms

SSP1-RCP2.6 “Taking the green road”	++
SSP3-RCP8.5 “A rocky road”	+

Overall yield impacts in SSPs 2050

	A	B	C	D	E	F	G
	Climate impact	Breeding effort	Yield potential (A x B)	Other risks	Tech. development	Tech. uptake	Attainable yields (C x D x E x F)
SSP1 – RCP2.6 “Taking the green road”	-/+	++	++	0	++	++	++
SSP3 – RCP8.5 “A rocky road”	-/++	0	-/+	--	0	+	--

DEMCROP farm level dynamic optimisation model

Maximizes the present value of 30 years' returns by planning the use of farm field blocks, fertilization and fungicides with yield response per plant + liming with yield response per block, taking into account the benefits of crop rotation

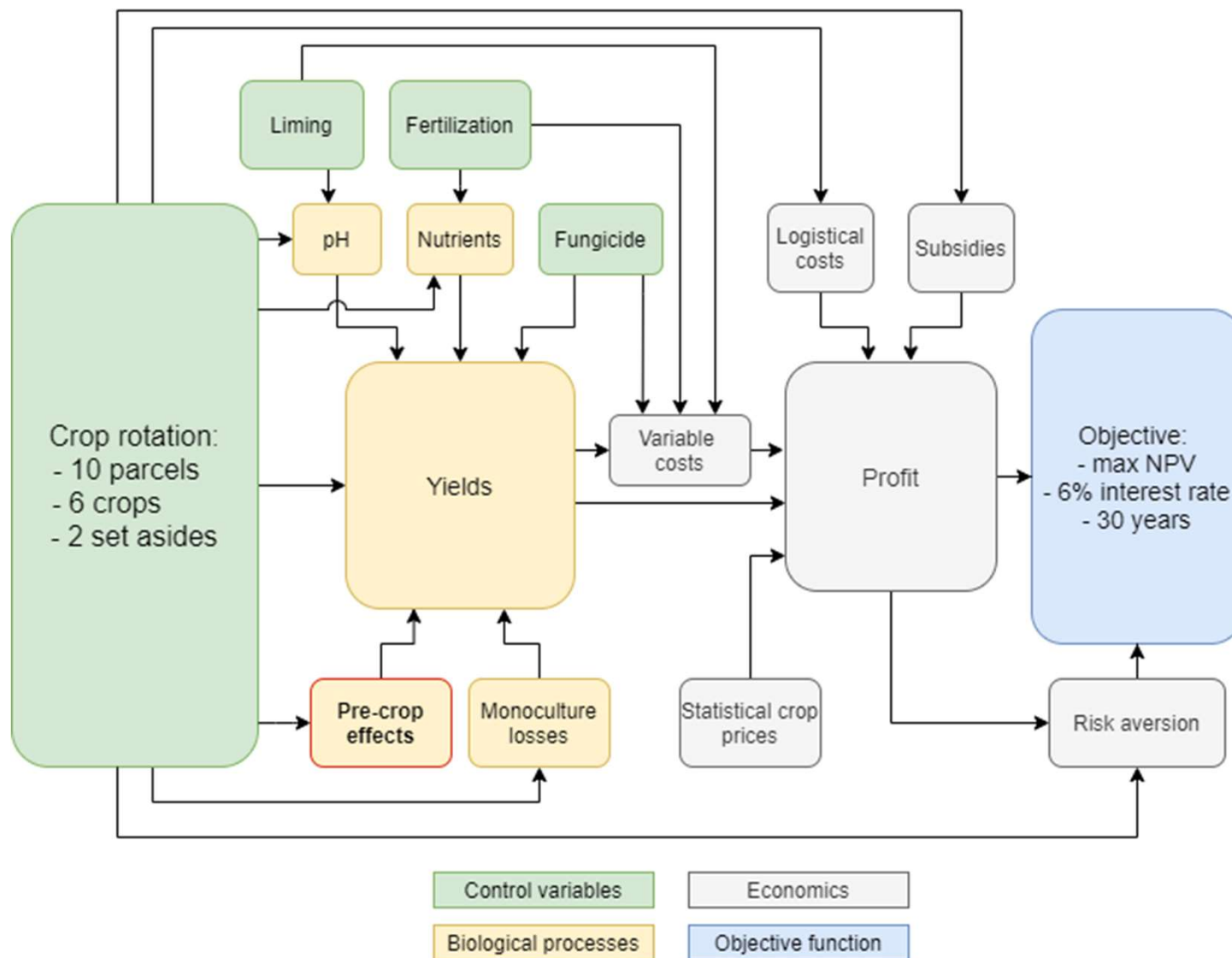


Figure: Janne Rämö, Luke

Farm level assumptions

[1] Dumortier et al., 2021

[2] Lehtonen et al., 2020

	Change in yields	Change in fertiliser price	Change in labor costs	Change in subsidies	Change in crop prices
SSP1-RCP2.6 “Taking the green road”					
Cereals	+10%	+5%	-10% ²	-10%	+11% ¹
Rapeseed	+10%	+5%	-10%	-10%	+11
Grain legumes	+10%	+5%	-10%	-10%	+11
SSP3-RCP8.5 “A rocky road”					
Cereals	-5%	+10% ²	+10% ²	-10%	+5.4% ¹
Rapeseed	-5%	+10%	+10%	-10%	+5.4% ¹
Grain legumes	-5%	+10%	+10%	-10%	+5.4% ¹

Farm level results/Yields kg/ha

	Wwheat	Fbarley	MBarley	Oats	Oilseed	Fababean
Baseline	6025	4898	4737	4937	1600	1569
SSP1-RCP2.6						
“Taking the green road”	6526	5623	5178	5463	1814	1760
SSP3-RCP8.5						
“A rocky road”	5731	4655	4303	4614	1494	1435

Farm level results

Scenarios	NPV (1000 euro per 100 ha) for 30 years	NPV (1000 euro per 100 ha) per year
Baseline	394.2	13.14
SSP1-RCP2.6 “Taking the green road”	429.2	14.30
SSP3-RCP8.5 “A rocky road”	232.6	7.75

? Table?

Farm and sector level analysis: Assumptions

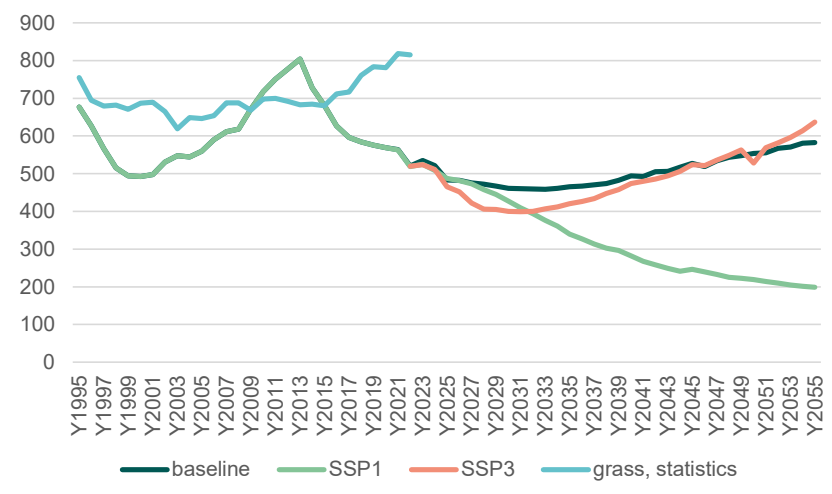
- **Baseline:** A point of comparison for SSP1, SSP3
 - Prices: OECD-FAO Agricultural outlook 2024; subsidies as CAP 2023-2027
- SSP1&3:
- **Prices of crops** adopted from the review of Dumortier et al. 2021
 - Prices of livestock products must be consistent to crop prices, due to feed use
- **Input prices** increase esp. in SSP3: fertilisers (10-20%), crop protection (20-30%), fuels (+20-30%)
- **Agri-environmental payments** up (down) by 30% in SSP1 (SSP3)
- **Decoupled area payments** down in SSP1&SSP3; coupled payments down in SSP1, but some are kept as in CAP2023-2027, some increased in SSP3
- **Population:** Increases to 6.1 million in SSP1, decreases to 5 million in SSP3, 2025-2050
- **Dietary changes:** Beef -35%, pork&poultry -65%, dairy products -50% in SSP1 (unchanged from 2023 levels in SSP3). A rapid increase in the consumption grain legumes (400-500%) and cereals (10-70%) in SSP1.

Sector level assumptions

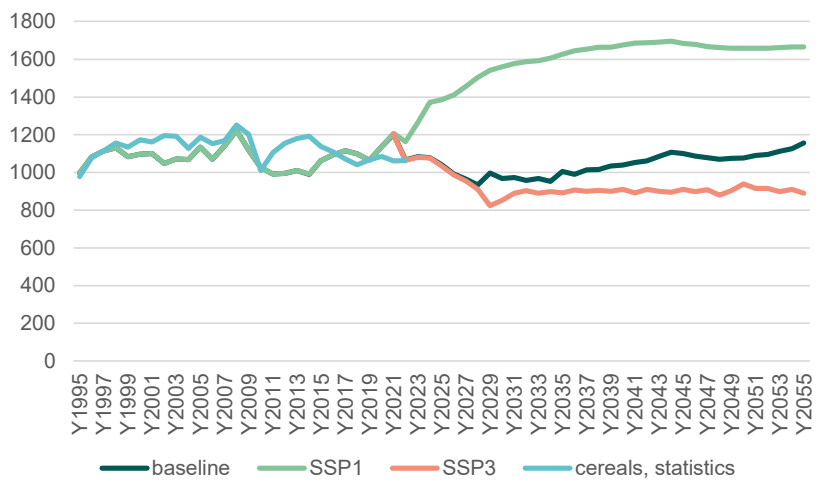
	Change in crop prices	Change in input prices	AEPs	Decoupled/ coupled area payments	Populati on	Dietary changes		
						<i>Meat</i>	<i>Dairy</i>	<i>Legumes /cereals</i>
SSP1-RCP2.6 “Taking the green road”	+	+	++	-/-	+	--	--	++/+
SSP3-RCP8.5 “A rocky road”	+	++	--	-/+	-	0	0	0

Preliminary Sector level results (to be revised): Agricultural land use

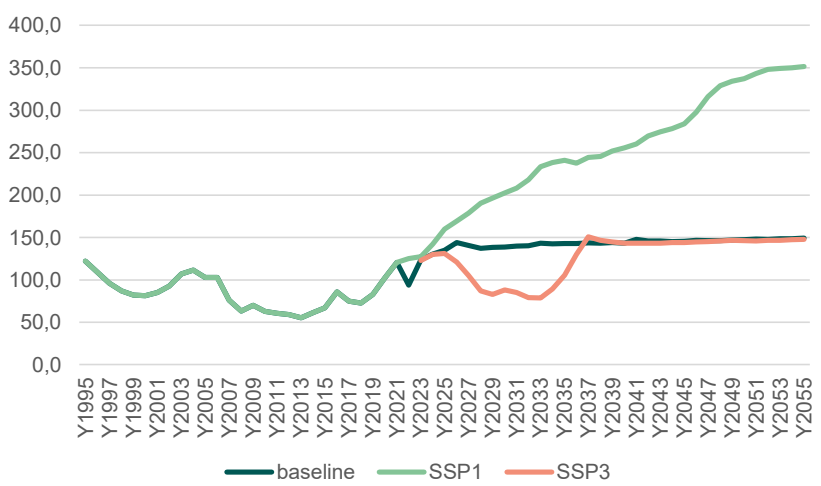
Forage grasslands, 1000 ha



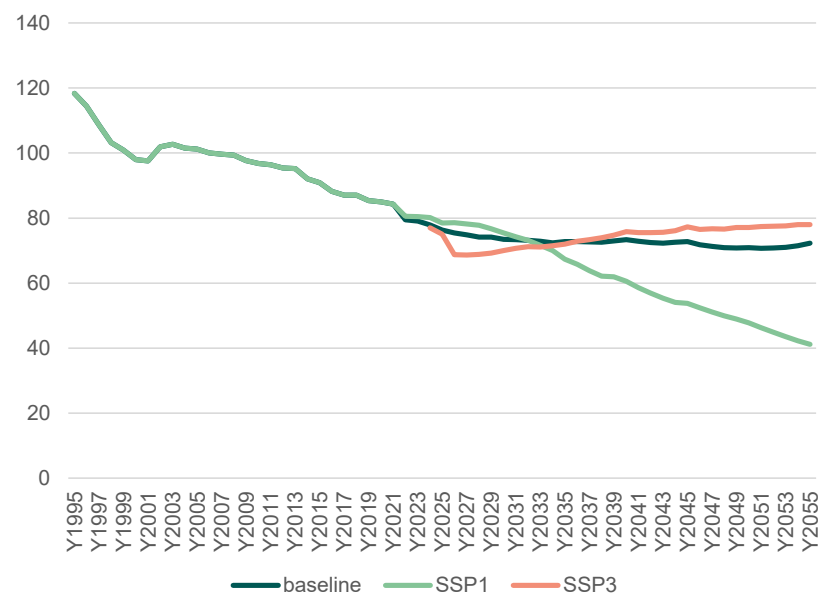
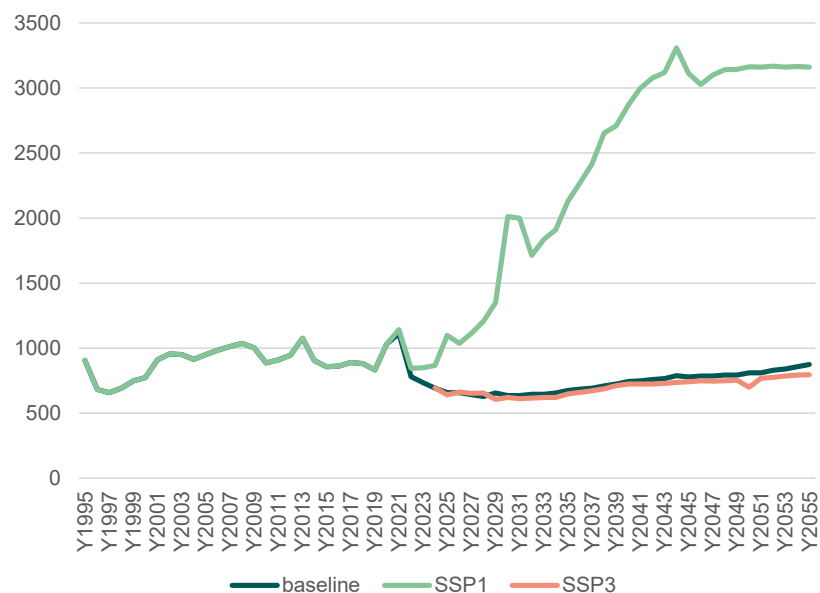
Cereals area, 1000 ha



Other crops, 1000 ha



Preliminary Sector level results (to be revised) Farm income (M€), left Labour hours (1000 person year equivalent, right)



Conclusions and further research

- Many things needs to be assumed at different levels
 - Global storylines needs to be interpreted for Finland – have been interpreted for agri-food sector
 - Climate scenarios as part of SSPs, e.g. how policy in SSPs influence breeding, technology
- Consistency across scales requires interaction between disciplines → important to understand what is assumed and why
- Agronomy matters: from field to farm to sector levels
- Prices matter: contains large uncertainty, how they develop in global SSPs
- Topics for further research: resilience to shocks, how farmers and food industry adapt to global changes in the regions