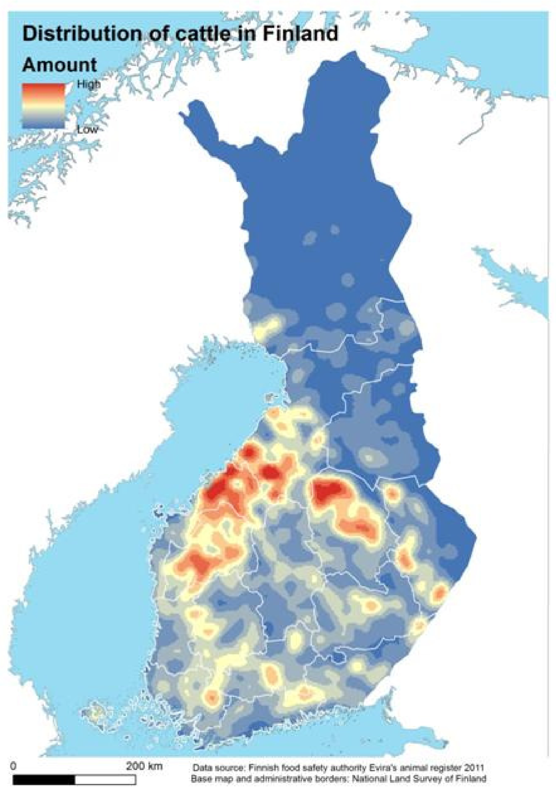
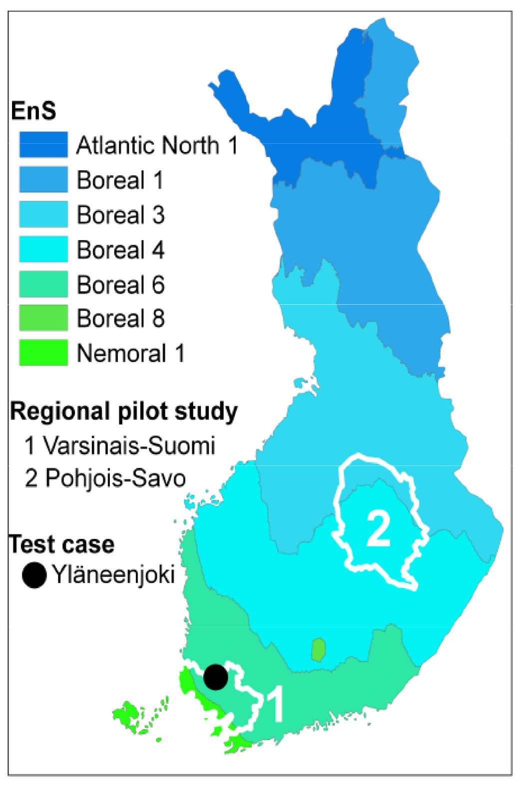
North Savo regional pilot study

- Regional agricultural development under changing climate





We evaluate climate change impacts on agricultural systems under a range of plausible future conditions. The research efforts build upon a multiple level assessment methodology for climate and other global change research (Lehtonen et. al. 2010).

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Analysis on effects of adaptation measures under future climates

Future yields are estimated based on systematic climate sensitivity analysis (crop response to T, P, CO_2) and probabilistic assessment of climate change impacts including defined future "designer" cultivars for different future time horizons (see e.g. Rötter et al 2011b) to examine what the effect of adaptation measures (such as sowing, and cultivar choice, irrigation) would be under future climates applying a probabilistic framework. Concurrently, our crop simulation models are undergoing rigorous examination on their ability to predict yield, water use and other crop indicators under a wide range of future climates and atmospheric compositions - in the framework of international research networks (www.macsur.eu; www.agmip.org) on agricultural model intercomparison and improvement. Simulated yields of alternative cereals cultivars and their nutrient requirements under different climate scenarios are checked – especially on soil types and locations of North Savo - and utilised in farm level analysis (presented below).

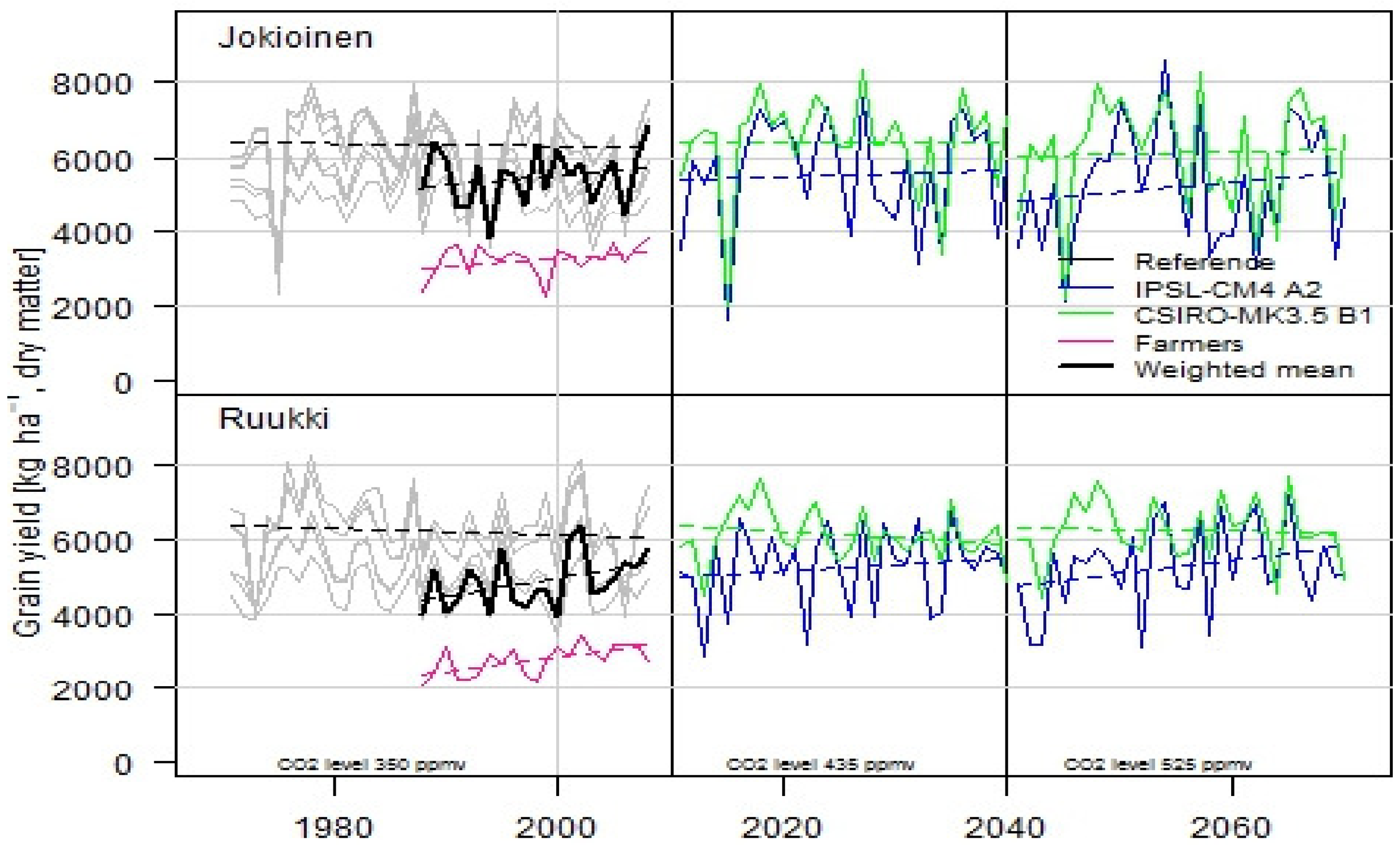
Managing grassland yield variation at the farm level – Cost of drought risk approach

Results suggest slowly increasing grassland yields.
However there are specific concerns on winter damages and feed quality losses, as well as soil compaction concerns related to heavy axle loads and wet conditions, that need further analysis.

	Baseline			Average of all GCM-scenarios		
	Jokioinen	St. Petersburg	Kuopio, North Savo	Jokioinen	St. Petersburg	**Kuopio, North Savo**
Average number of years with grass yield deficit	16	10	**6**	8.7	2.9	**3.33**
Average yield (ton of DM/ ha)	8.61	10.05	**9.74**	9.33	11.10	**12.96**
Average standard deviation of yield	0.25	0.18	**0.189**	0.24	0.19	**0.2**
Average harvest cost, €/ton dm	52.33	49,28	**49.79**	52.06	49.19	**49.28**
Average harvest and extra concentrate cost, €/ton dm	58.44	51.43	**53.96**	55.67	50.35	**52.24**

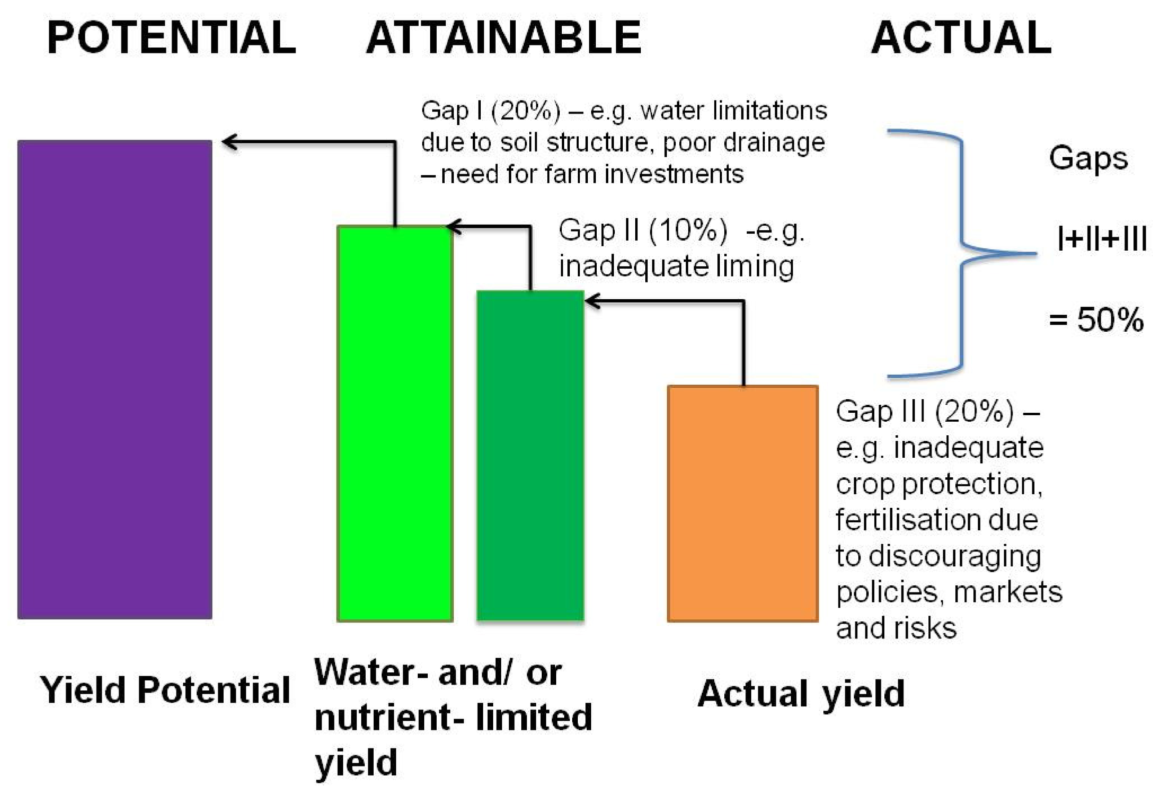
Source: Kässi, P. Känkänen, H. & Niskanen, O. 2014.Farm level approach to manage grass yield variation in changing climate in Jokioinen, Kuopio and St. Petersburg. Manuscript, MTT / Economics 2014.
Based on GCM Ensemble data derived by Höglind et. al. 2013.

Fig. 1 Simulated water-limited annual yields of spring barley for the Jokioinen and Ruukki study sites for historical weather 1970 – 2008 and projections for periods 2011-2040 and 2041-2070 (solid lines) with trends calculated for each period (dashed line) and mean regional yields of the farmers at surrounding rural centre areas (pink solid line) with trend (pink dashed line). Grey lines show the simulated yields for different cultivar types and dashed black like the trend for the cultivar type used in future projections. Bold solid black line shows simulated average yields weighted according to cultivar use By farmers and dashed bold black line the trend of the weighted means. (from Palosuo et al., in prep.)



<u>Economic analysis through dynamic optimisation</u> over 30-40 years. The yield gap (Fig. 3) can be endogenised in : Adjusting land use and crop rotation (monoculture implies disease pressure), N-fertilisation, soil improvements (liming, soil pH value), fungicide use . => Changing yields and marginal costs => optimal adaptation. Hence different price expectations and policies trigger different management and yields.

Fig. 3. Production situations and yield gaps – explaining current yield gaps and their evolution



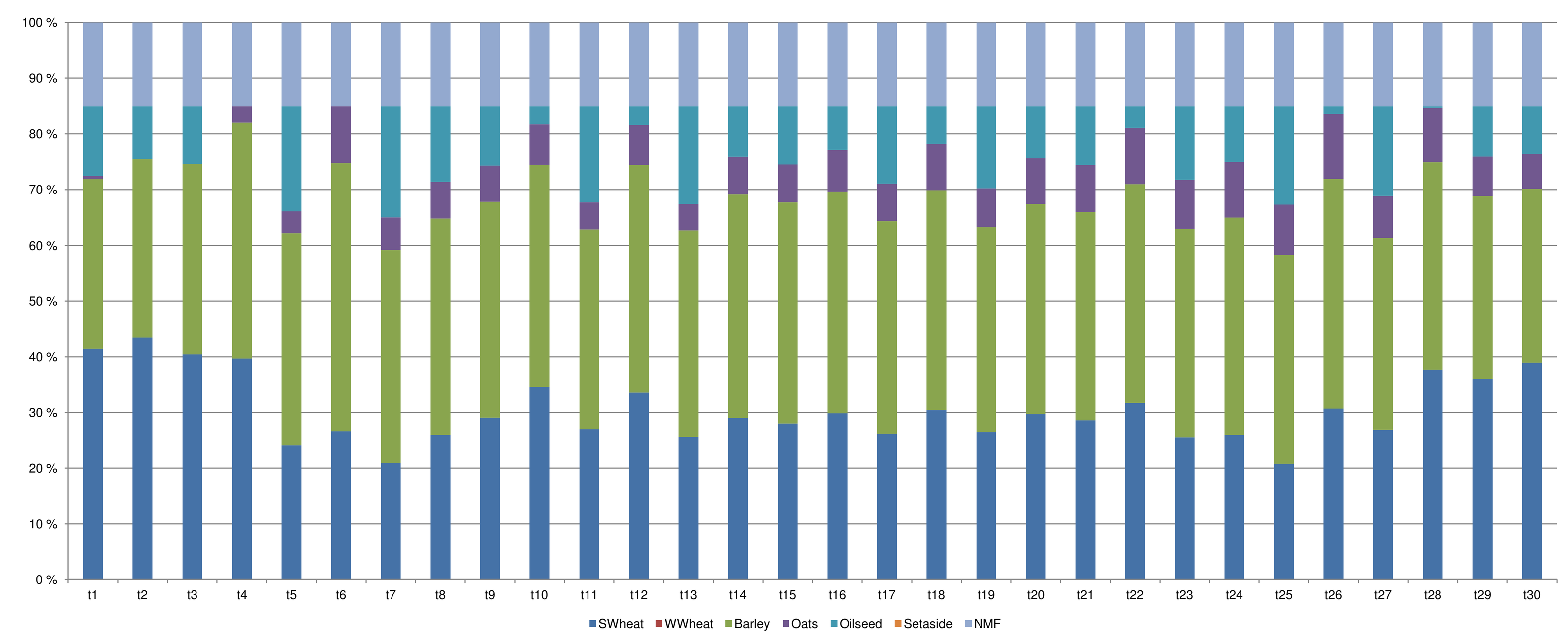


Fig. 2a. Land allocation (%) under high- disease-pressure vs. high-price (+30 %) over 30 years

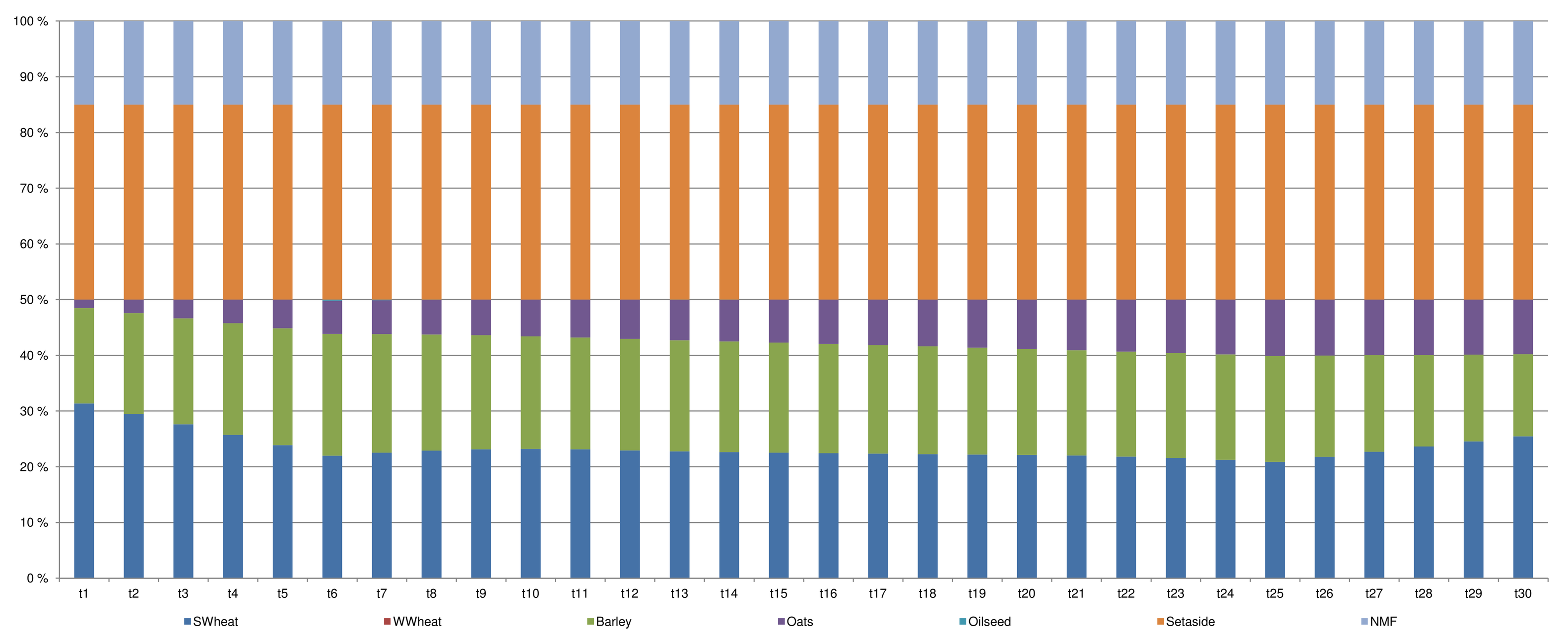


Fig. 2b. Land allocation (%) under low-disease-pressure vs. low-price (-30%) over 30 years

		S1	S2	S3	S4	S5	S6
Average Yields Kg/ha	Spring wheat 3068	2941	2732	2623	3151	3119	2741
	Winter wheat 3031	-	-	-	-	-	-
	Barley 2923	2639	2377	2261	3058	2749	2365
	Oats 2786	2745	2549	2436	2970	2930	2553
	Oilseed 1305	1349	1252	1188	1365	1358	1261
Gross margin €/ha/year		298	194	148	323	238	153
Fungicide, nr of application		48	0	0	300	0	0
Average pH		6.57	5.86	5.52	6.59	6.49	5.52

S1: high- disease-pressure + high-price
S2: high-disease-pressure + current-price
S3: high-disease-pressure + low-price
S4: low-disease-pressure + high-price
S5: low-disease-pressure + current-price
S6: low-disease-pressure + low-price

The farm level production re-organisations - from cereals and livestock farm analysis- can be included in the sector level economic model DREMFIA (Lehtonen 2001) which simulates supply and demand decisions. Specific representative farms as well as alternative production options (including joint production activities representing synergies due to crop rotations) are used in modelling adaptations and changes in marginal costs. The agricultural policy system with various national measures and their budget ceilings are included.

Evaluate regional agricultural development under chosen socio-economic drivers timescales 20-30-40 years

Changes in regional allocation of agricultural production, taking into account current trends, policies and market prospects, will be studied using MTT's DREMFIA agricultural sector model, consistently linked to farm models

Analysed socio-economic drivers include domestic demand, EU prices of agricultural products, relative prices of inputs and outputs, and specific policies influencing production and land use

The model outputs to be jointly evaluated in a transdisciplinary team are fertilisation and crop yield levels, as well as the intensity of animal production, regional land use and its intensity. The sector model outcomes include regional nutrient balances and surpluses which imply changed nutrient leaching in changed climate conditions

These variables are driven by changing multi-regional production structure, i.e. the volume and specialisation of production on competitive regions. They may be driven primarily by markets and policies, including structural aids designed to improve competitiveness of Nordic agriculture, currently suffering from high input prices and production costs. The sector model is run over SSP1, 2 and 3 global scenarios, with cooperation with PIK Potsdam MagPie modelling group.

References

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