Exploring adaptation strategies for climate change in the Netherlands: a bio-economic farm level analysis

Argyris Kanellopoulos, Pytrik Reidsma, Joost Wolf, Maryia Mandryk, Ben Schaap and Martin Van Ittersum

Plant Production Systems, Wageningen University, P.O. Box 430, 6700 AK Wageningen, The Netherlands

** Corresponding author : Argyris Kanellopoulos (argyris.kanellopoulos@wur.nl)*

WAGENINGEN UR
For quality of life

Introduction: study area

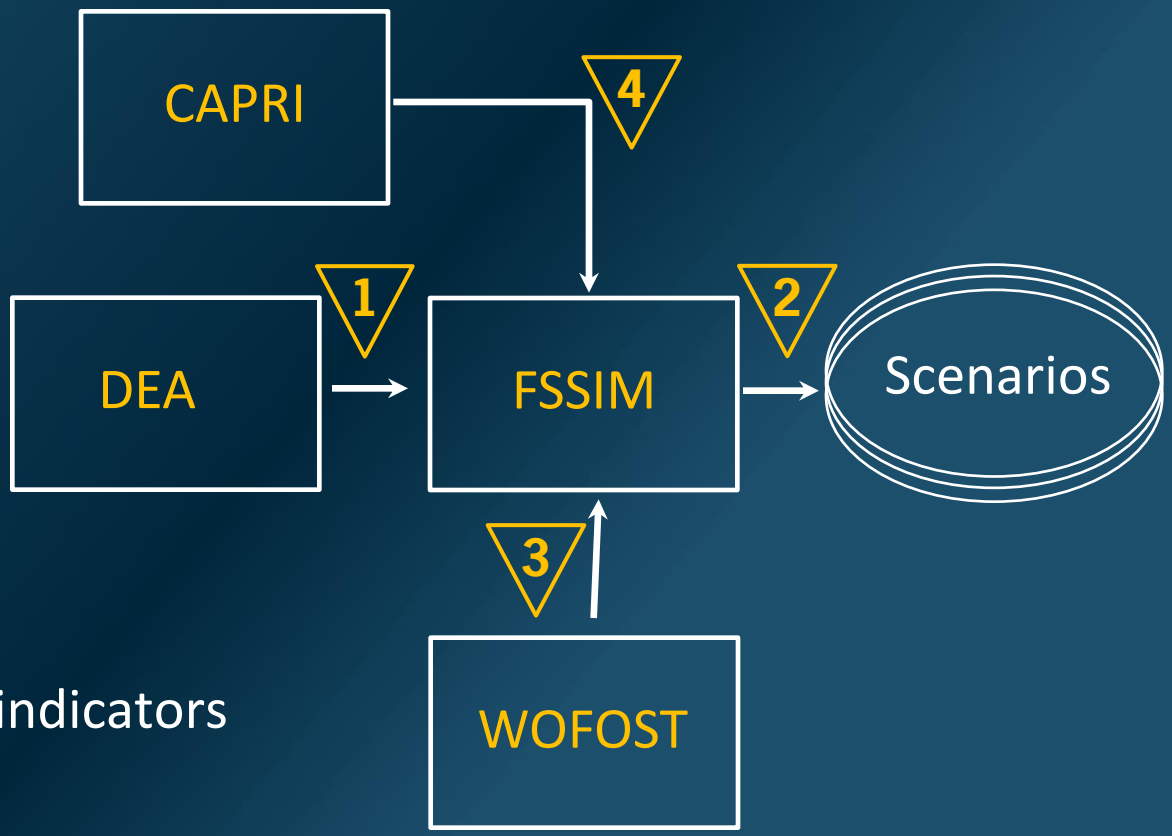
- Study area = Flevoland (the Netherlands)
- Modern arable and dairy systems
- Mainly heavy, fertile clay soils
- Assess consequences of a scenario towards 2050 assuming a strong temperature rise and a globalized economy (A1W)
- Data from 75 individual arable farms (FADN 2000-2006)

Expected yield changes

Crop	Base year			Change in A1W2050	
	Yield (tons)	Fertilizers (€/ton)		Yield (%)	Fertilizers (%)
Winter wheat	8.7	13		16	20
Spring wheat	7.8	10		25	31
Spring barley	6.3	5.2		26	33
Potato ware	56.8	2.5		20	25
Potato seed	38.7	1.8		24	30
Sugar beet	65.5	1.3		23	29
Onion	58.4	1		42	52
Tulip	18	2.7		31	39

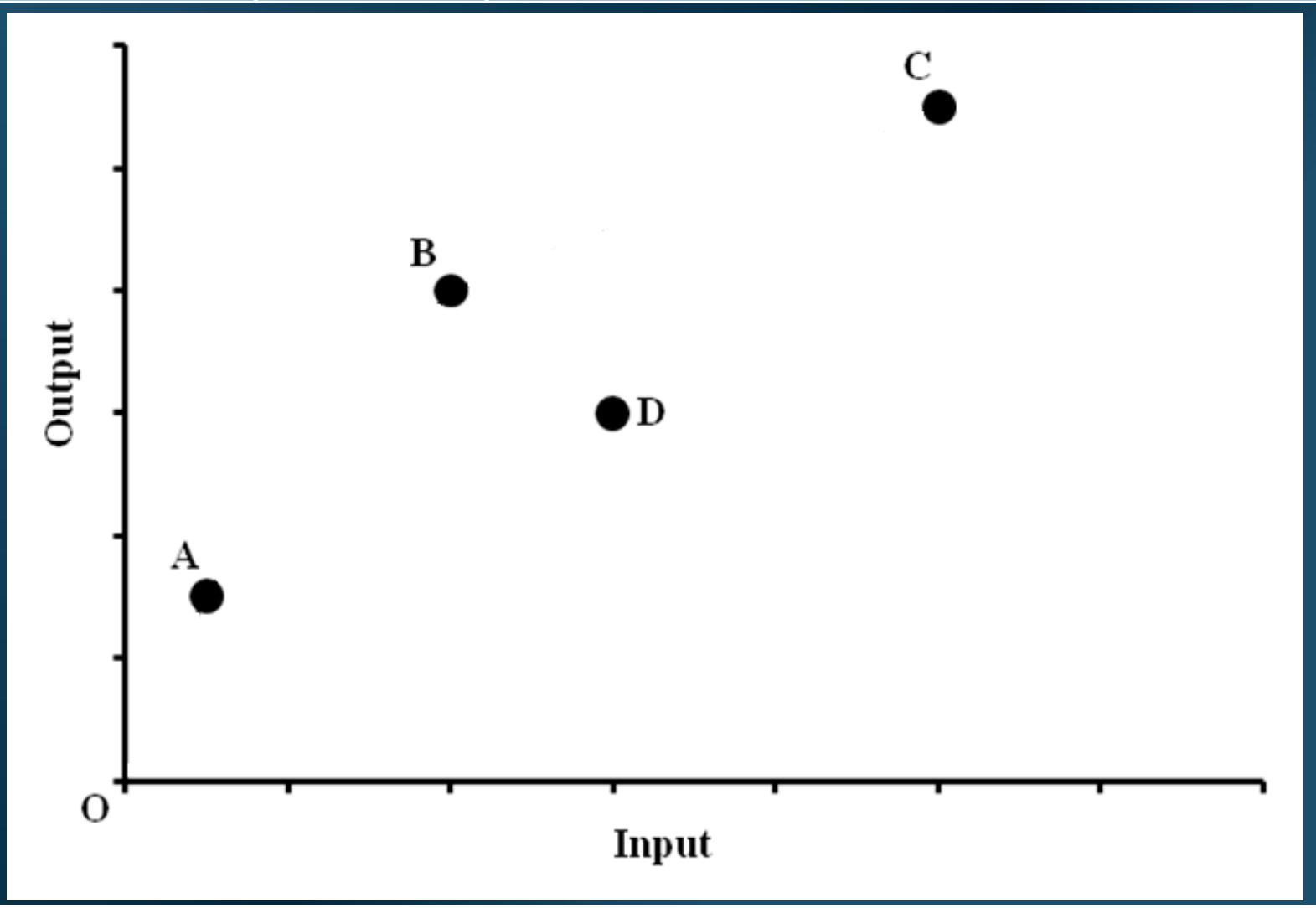
Based on WOFOST and survey

Methods: modeling framework

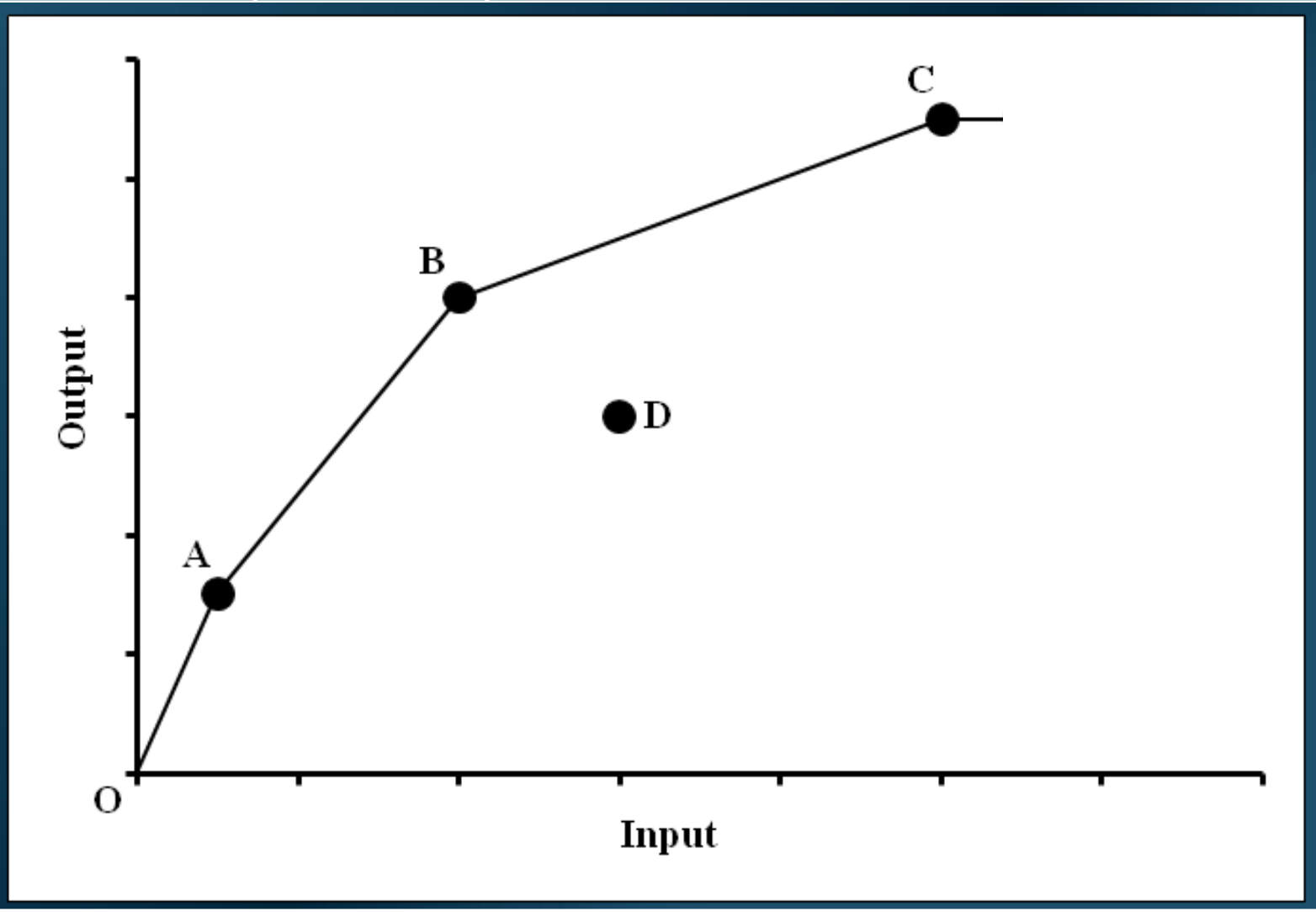


1. Outputs = f(inputs)
2. Economic , environmental indicators
3. Yield changes
4. Expected price changes

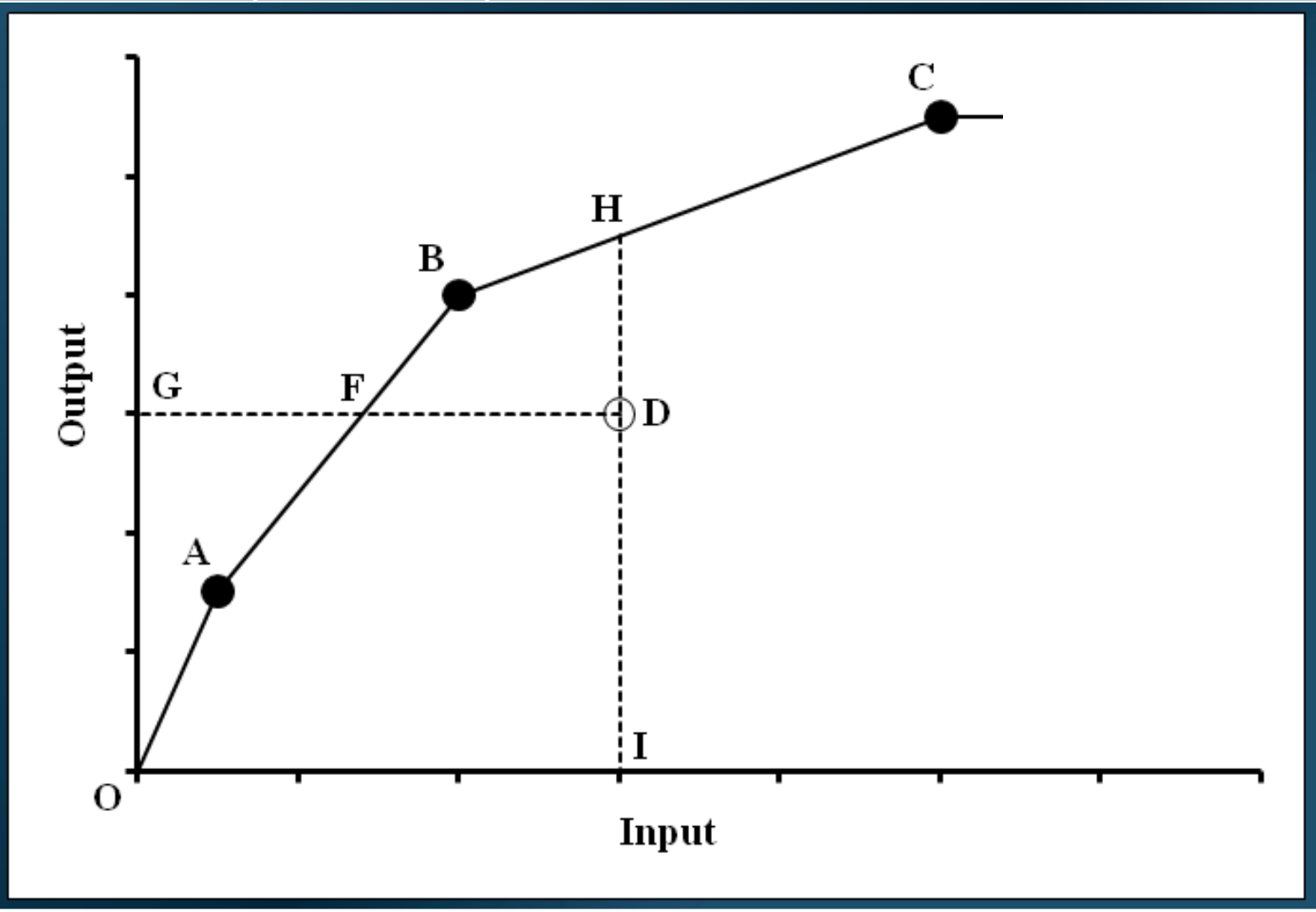
DEA with a simple example



DEA with a simple example



DEA with a simple example



Farm System SIMulator (FSSIM)

- Programming, constraint optimization model
- Optimize objective function (e.g. gross margin)
- Subject to a set of constraints:
  - Land constraint
  - Labour constraints
  - Capital constraint
  - Sugar beet quota constraint
  - ….

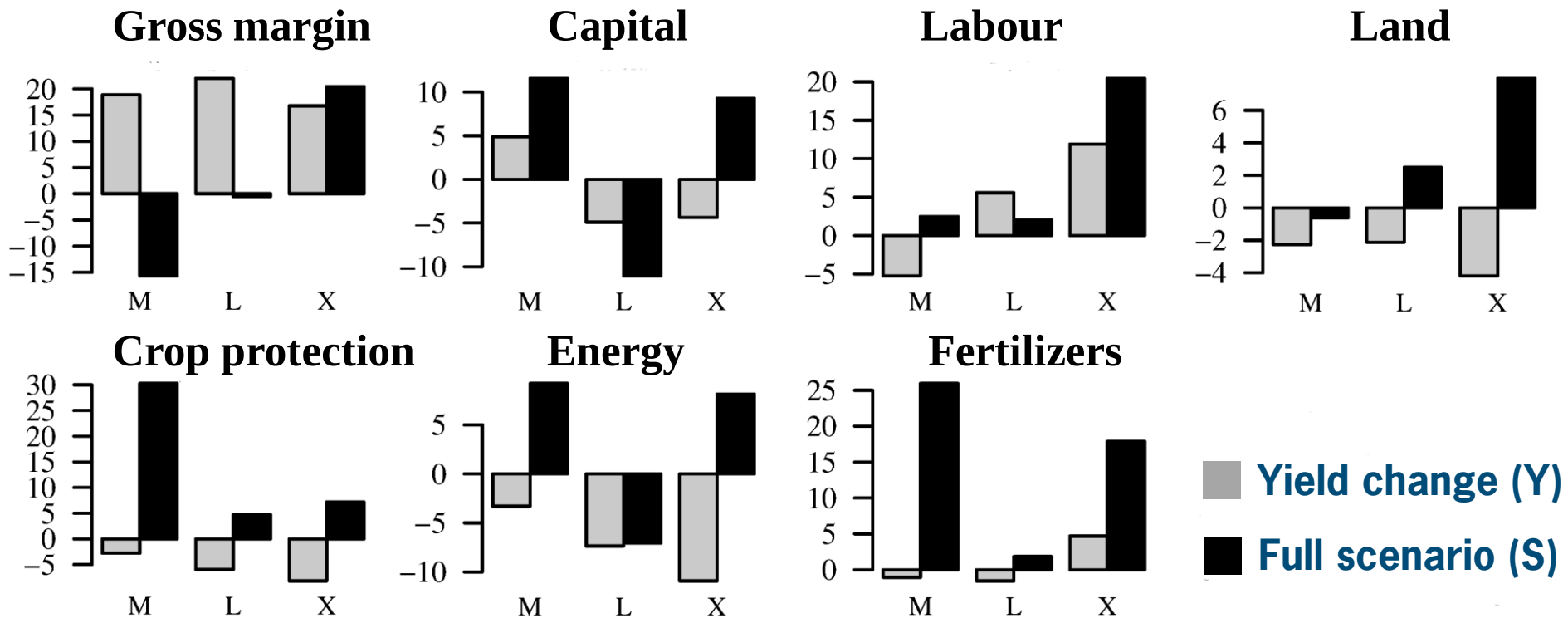
Setup of simulations

- DEA: to calculate technical efficiency and identify best farm practices
- FSSIM: to calculate economic-environmental indicators
- Results of FSSIM for future scenarios are presented as relative changes from base year simulations.

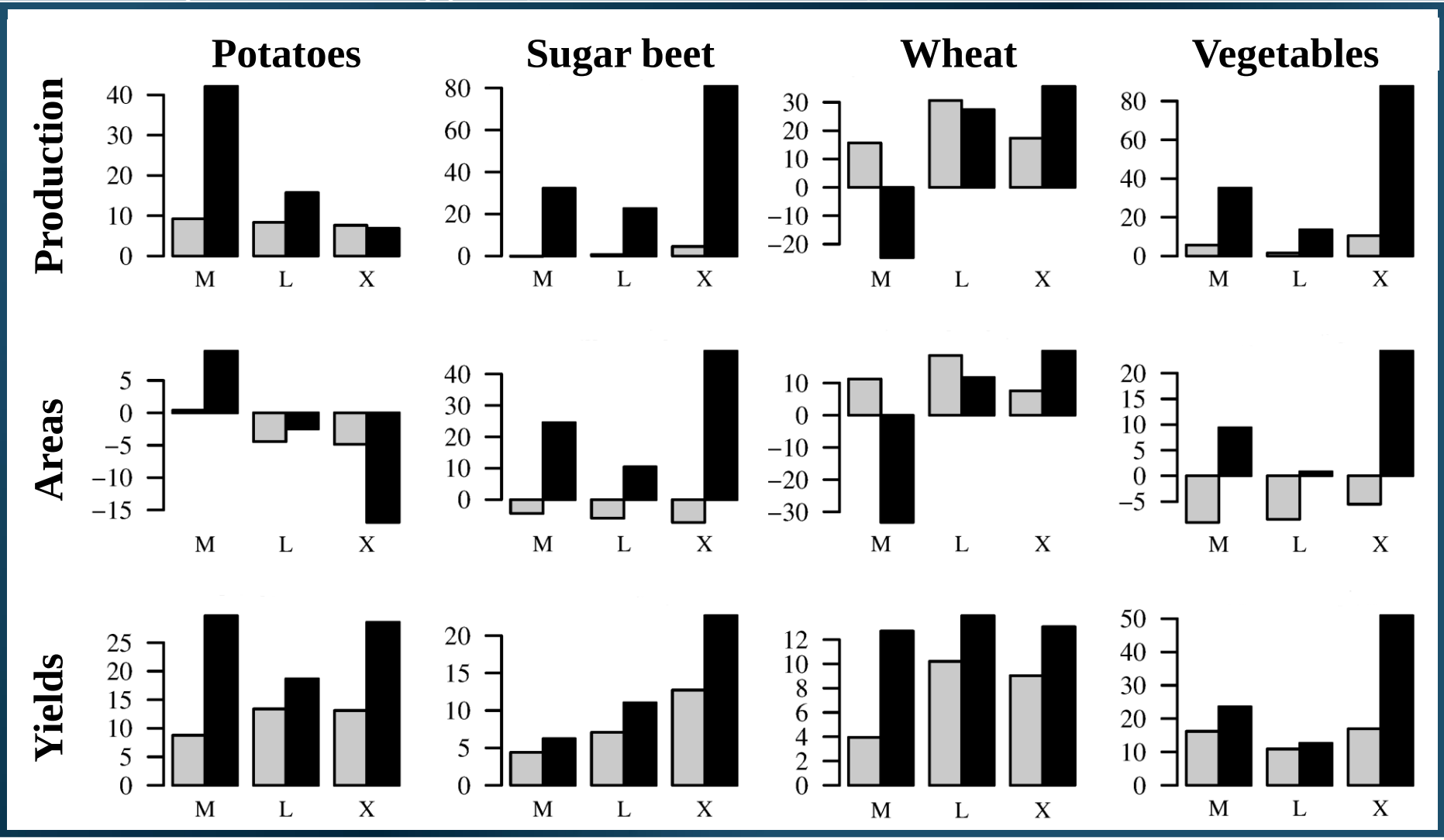
Results: DEA and FSSIM (base year)

- 64 out of 75 farms are currently technically efficient
- Average efficiency score ≈ 98%
- Model run P shows that 40% of the farmers are currently profit maximizers

Results: per farm type (economic size)



Results: per farm type (economic size)



WAGENINGEN UR
For quality of life

Yield change (Y)

Full scenario (S)

Discussion and Conclusions

- Arable farms in Flevoland are in general technical efficient
- In A1W 2050 scenario extra large farms tend to expand while smaller farms will shrink or stop
- Production of vegetables and tulips increase!
- Fertilizer application increases substantially in the A1W 2050 scenario

- The effect of extreme events was not taken into account
- Technological change (new genotypes, precision agriculture?)
- FSSIM as a gross margin maximizing tool. Why not calibration?