Weight calibration in total calculation of Finnish agriculture

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Total calculation

- Average results of the economy and production process of different types of agricultural enterprises in Finland
- Aggregate economic indicators are obtained by summing up the weighted results of the bookkeeping farms
- One bookkeeping farm represents many similar farms
- 14 size classes, 10 production types, 7 support areas: in total 980 combinations
- Aim: have reliable figures for all combinations

Total calculation

Financial Ratios	2012
Farms represented	56.793
GROSS RETURN TOTAL , million euros	**6.120**
PRODUCTION COSTS , million euros	**7.391**
Entrepreneurial Profit , million euros	-1.275
Family Farm Income , million euros	755
Profitability Ratio	**0,37**
=Earnings , million euros	**24**
=Hourly earnings	**0,3**
= Equity ratio	**77**
=Return on assets %	**-2,5**

Balance Sheet , million euros	2012
Farms represented	56.793
Intangible assets	**312**
Arable Land	6.880
Buildings	3.291
Machinery	2.762
Drainage and permanent crops	1.371
Livestock	703
Supplies and products	1.309
Cash and receivables	837
TOTAL ASSETS	**17.464**
Equity	13.372
Debts	**4.093**

Revenues , million euros	2012
Farms represented	56.793
GROSS RETURN TOTAL , million euros	**6.120**
Crop revenues	**1.269**
Rye and wheat	200
Barley	326
Oats and other cereals	230
Oilseeds	29
Grass crops	389
Potato and sugar beet	75
Pulses and other crops	21
Livestock revenues	**2.033**
Cattle revenue	1.508
Pig Production	314
Poultry revenues	175
Sheep and goat revenues	36
Glasshouse and outdoor horticultural revenues	**562**
Financial yields	**12**
Other income	**221**
The sum of Subsidies	**2.023**
CAP subsidies	617
LFA- and environmental subsidies	807
National and investment subsidies	596

Production Costs , million euros	2012
Farms represented	56.793
PRODUCTION COSTS , million euros	**7.391**
Material costs	**2.131**
Fertilizer. Lime	279
Other crop production costs	378
Fuel and lubricants	339
Electricity	203
Forage costs	558
Livestock costs	375
Farm use	**543**
Machinery cost	**1.061**
Depreciation of machines	578
Other machinery costs	483
Buildings costs	**379**
Depreciation of Buildings	317
Other buildings costs	62
Other cost	**903**
Insurance cost paid	308
Fixed rents paid	141
Other depreciations	50
Other costs	404
Wages costs	**1.522**
Wages paid	223
Wages claim	1.299
Interest costs	**852**
Interest paid	120
Interest claim of equity	732

| Income Statement , million euros	2012
Farms represented	56.793
Revenues , million euros	3.390
Subsidies	1.989
Turnover	**5.379**
Gross return total	**6.109**
Variable Costs , million euros	-2.704
Farm use	-543
Wages Demand	-1.299
Fixed Costs , million euros	-1.053
Operating margin	**511**
Depreciations , million euros	-945
Gross return	**-435**
Interest Paid	-108
Net Result	**-543**
Interest demand	-729
Entrepreneurs profit	**-1.275**

Disctribution of farms in sample

- Sample of about 1000 bookkeeping farms

- Total number of farms in Finland: 55 000

- Few small bookkeeping farms: 0-5 in three smallest classes

- Few bookkeeping farms in northern support areas: C2P: 25, C3: 50 and C4: 10

Legend:
- C4
- C3
- C2P
- C2
- C1
- B
- A
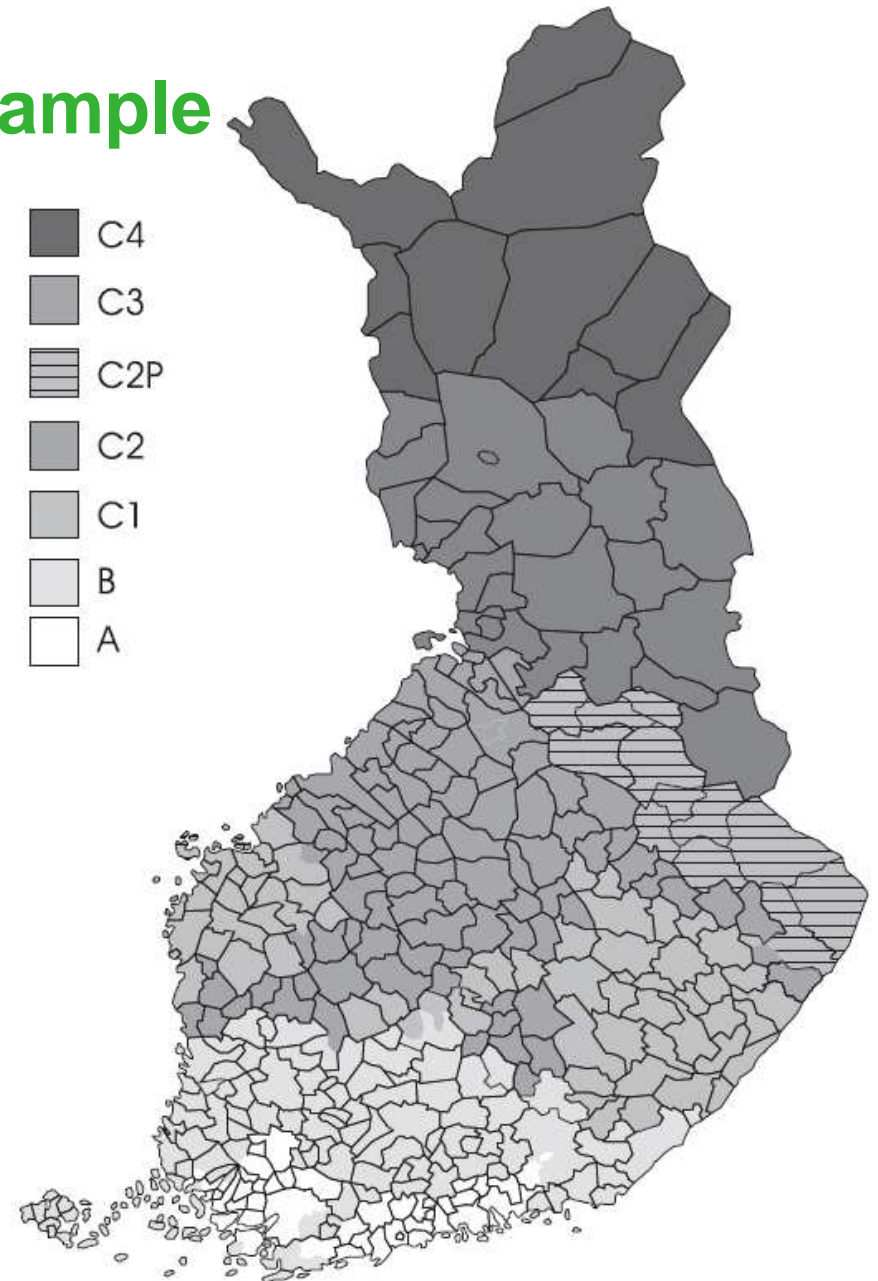
FADN weights

- All weights are equal in the same cell
- E.g. 100 farms and 5 FADN farms in a cell: all FADN farms have a weight of 20
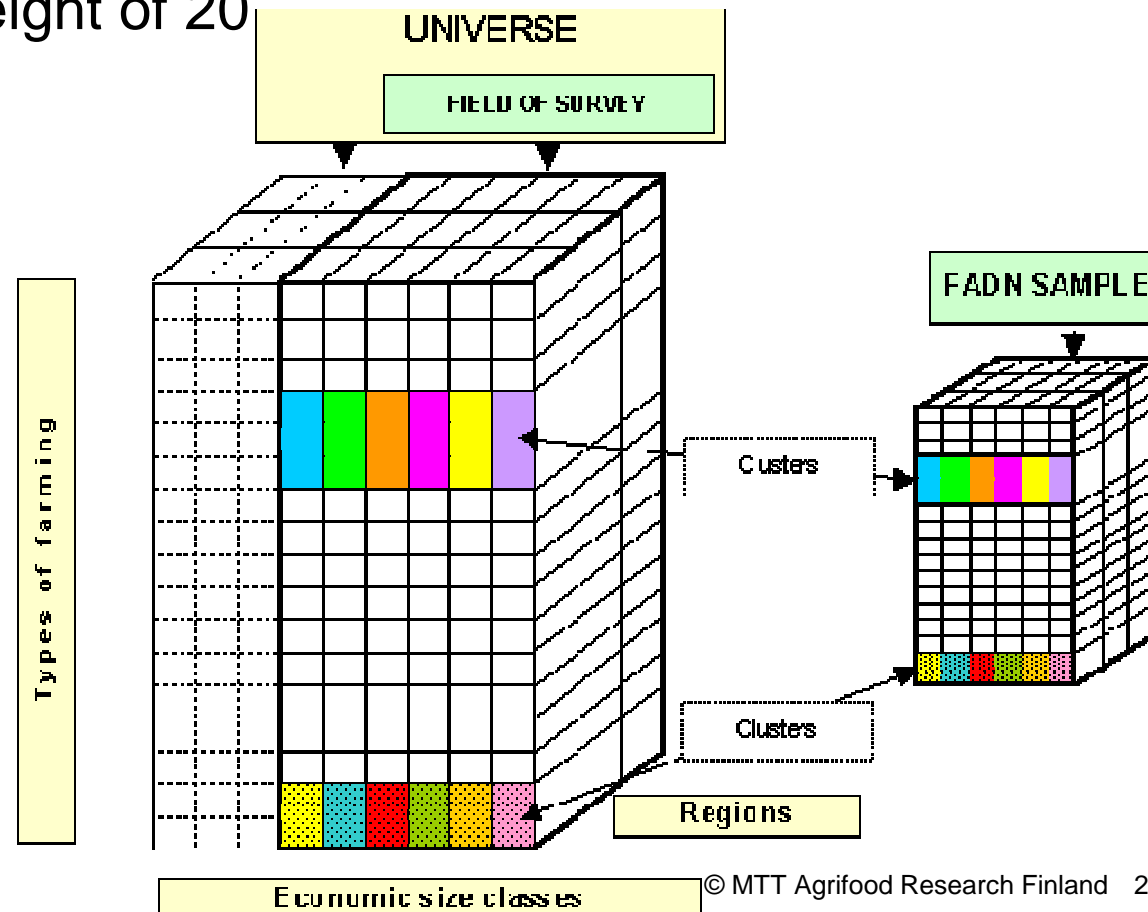
Weight calibration in total calculation

- Adjust the FADN weights so that the number of farms and cultivation areas in certain classes match the true values known from other sources

- Represent all 55 000 farms

- Initial weights: FADN weights d

- The weights w of the bookkeping farms B are adjusted so that they change as little as possible but fulfill a set of constraints

$$\min_{w_i} \sum_{i \in B} (w_i - d_i)^2$$

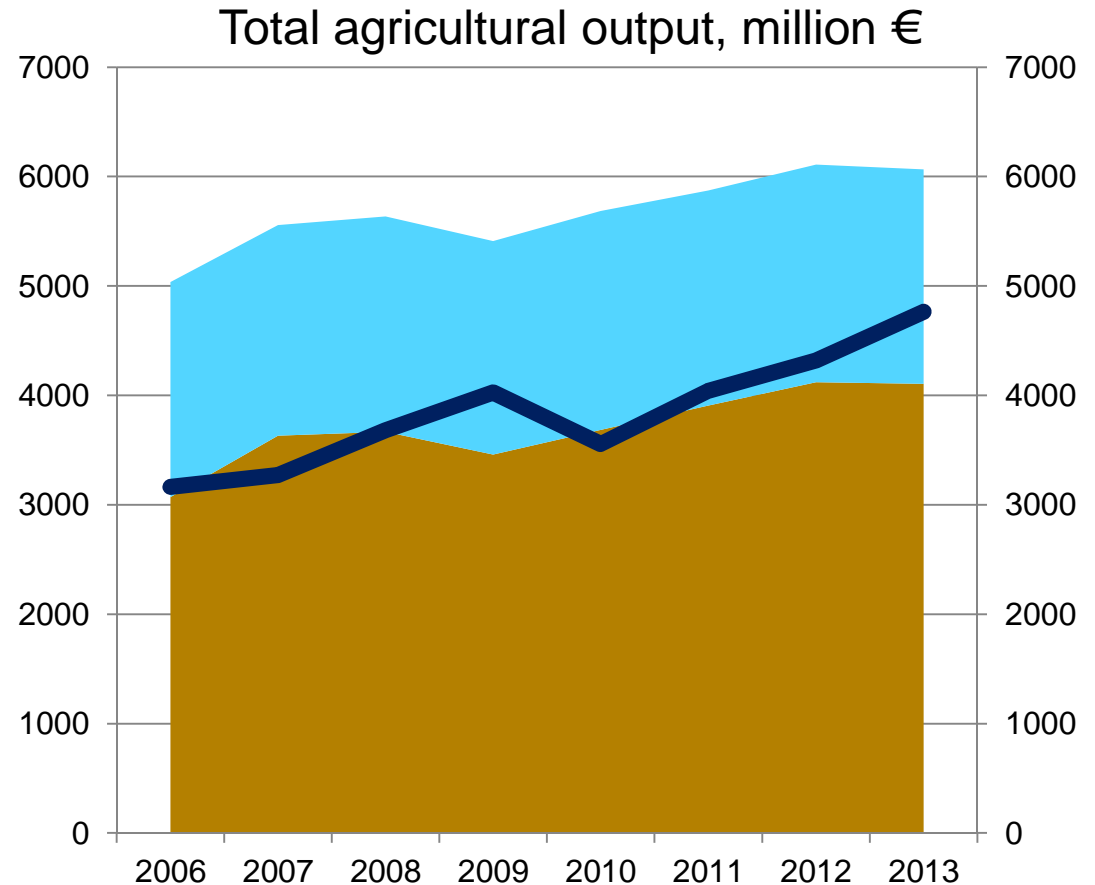- Numeric optimization using MATLAB & Optimization Toolbox

Constraints in weight calibration

- UAA of each support area: A, B, C1, C2 (4 constraints)

- Total UAA of support areas C2P, C3, and C4

- Total number of farms in size classes 1-4 (economic size<15 000 €)

- Number of farms in each size class: 5-9 (5 constraints)

- Total number of farms in size classes 10-14 (economic size≥500 000€)

- Number of farms in each type of farming: cereal farms; other crop farms; horticulture, indoor; horticulture, outdoor; dairy farms; cattle farms; sheep, goats and other grazing livestock; pig farms; poultry farms; non-classified (10 constraints)

- Number of farms in each support area: A, B, C1, C2 (4 constraints)

- Total number of farms in support areas C2P, C3, and C4
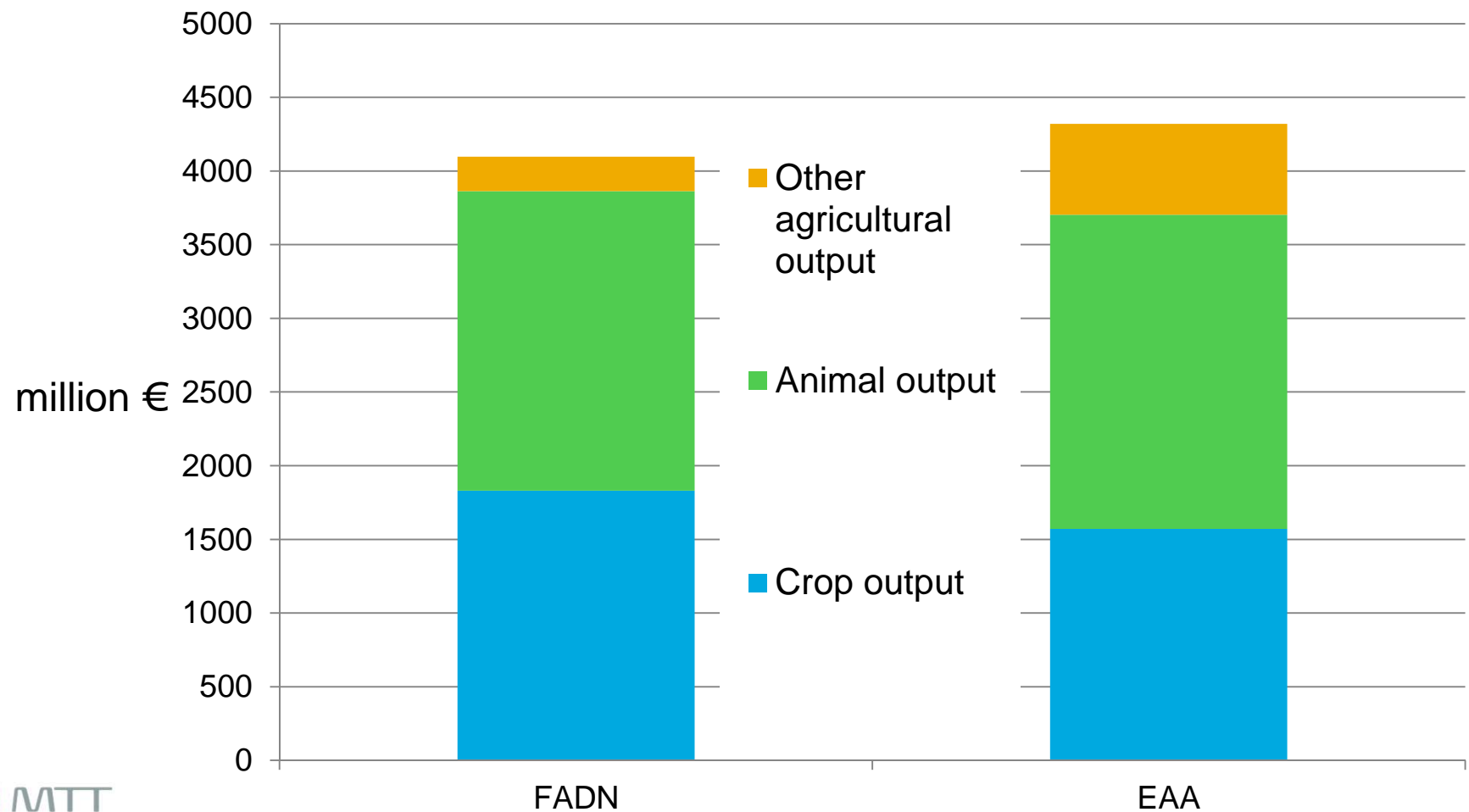
- No bookkeeping farm may have a weight below one

Advantages of the calibration method

- Country-level results are good
- The procedure finds constraint satisfying weights every year without manual adjustments
- Comparison with economic accounts for agriculture (EAA) figures from Eurostat

Total agricultural output, million €

FADN   EAA

Subsidies   Gross return   Output of the agricultural "industry"

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Advantages of the calibration method

- Agricultural output 2012: structure

Difficulties in weight calibration

- Reliability of results of support areas need to be improved
- Distribution of farm types in support areas is not correct
- Distribution of farm sizes in support areas is not correct
- Distribution of farms sizes in farm types is not correct

Difficulties in weight calibration

- Some cells do not contain any farms
- We tried to have a constraint for the number of each type of farms in each support area, i.e. (50 constraints)
  - Cereal farms in support area A
  - …
  - Cereal farms in support area C2
  - Cereal farms in support areas C2P, C3 and C4
  - Other crop farms in support area A
  - Other crop farms in support area B
  - …
- Some types of farming had to be combined in some areas because there were too few bookkeeping farms
  - E.g., bookkeeping pig farms in support area C2 had to represent both the pig farms and poultry farms in that area
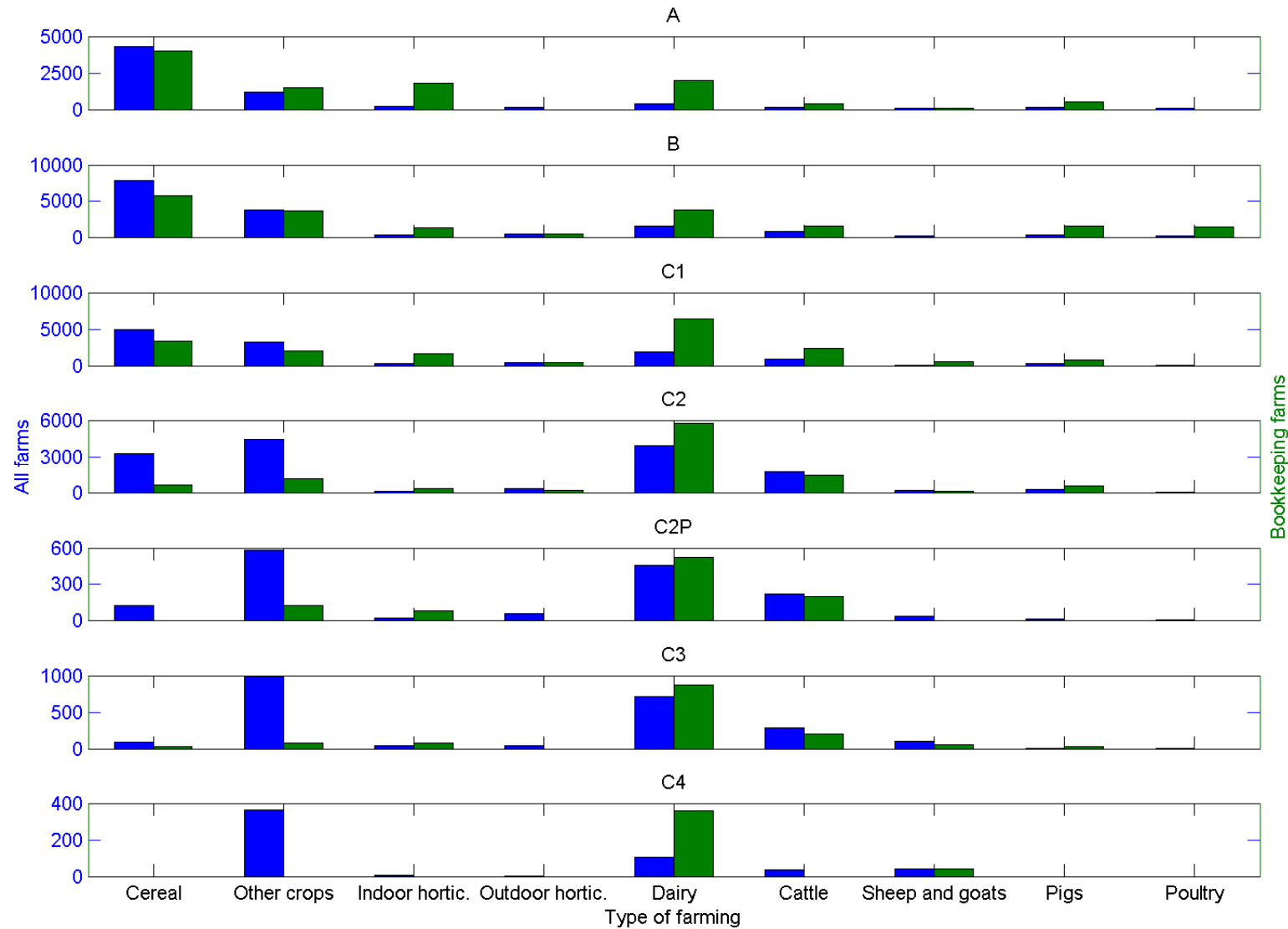
Difficulties in weight calibration

- The distribution of bookkeeping farms changes every year

- A calibration system that has so far worked every year may not work next year

- Complexity of calibration increases this risk

- Ad hoc solutions may have to be invented when new data arrives
  - E.g., the last bookkeeping farm of its type quits in some area
  - Different combinations of types of farming in different years

Farm size distribution in support areas
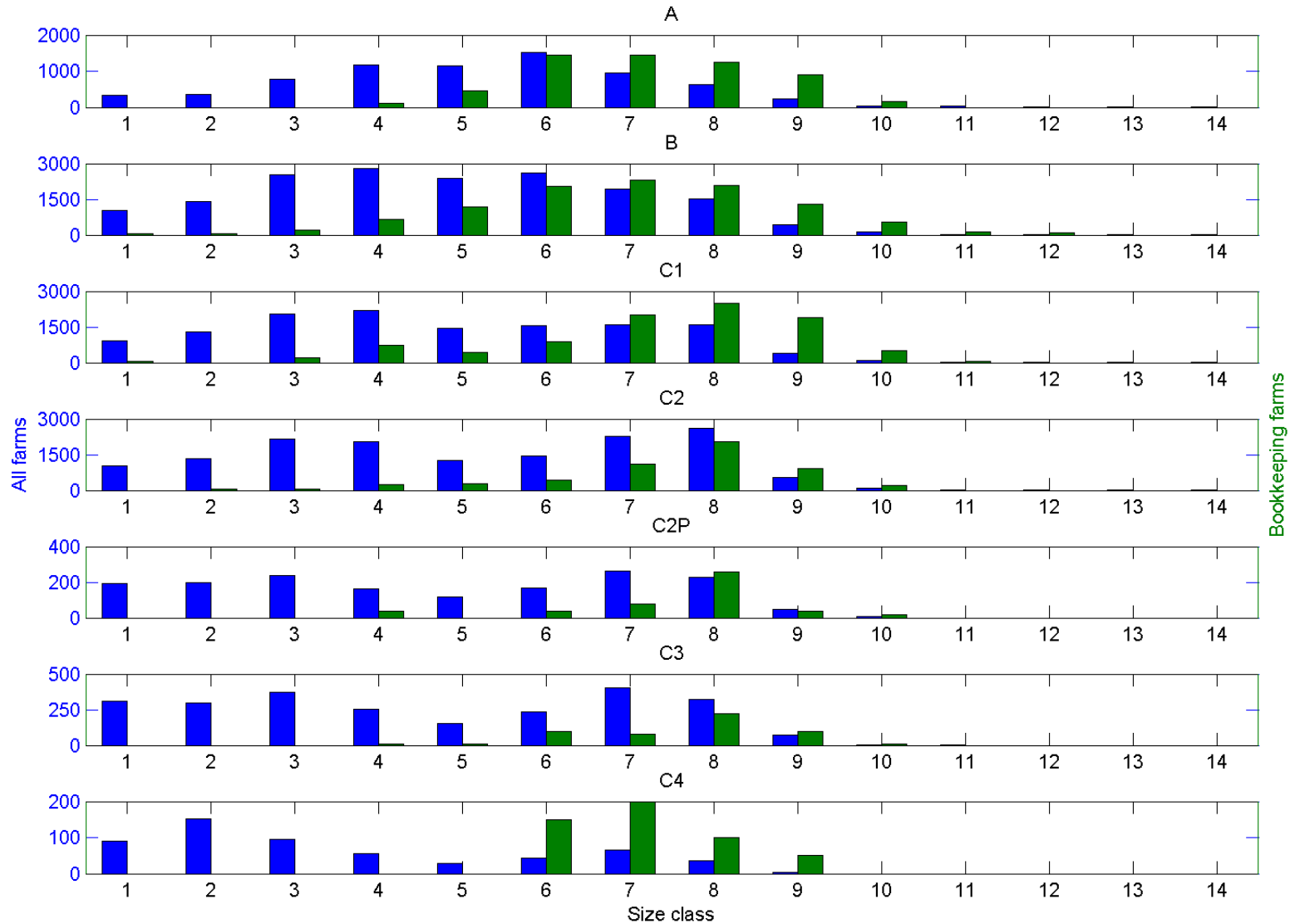
Farm type distribution in support areas

Difficulties in weight calibration

- Only large bookkeeping farms in some support areas
- Example:
    - UAA of the smallest bookkeeping farm is 100 ha
    - Total UAA is 10 000 ha
    - Total number of farms is 500
- Impossible to fulfill both UAA and number of farms constraints
- To fulfill UAA constraint the weight of the smallest farm has to be about 100 -> too low number of farms
- To fulfill number of farms constraint the weight of the smallest farms has to be about 500 -> too large UAA: about 50 000 ha

UAA distribution and average UAA

UAA (red line: average of all farms)
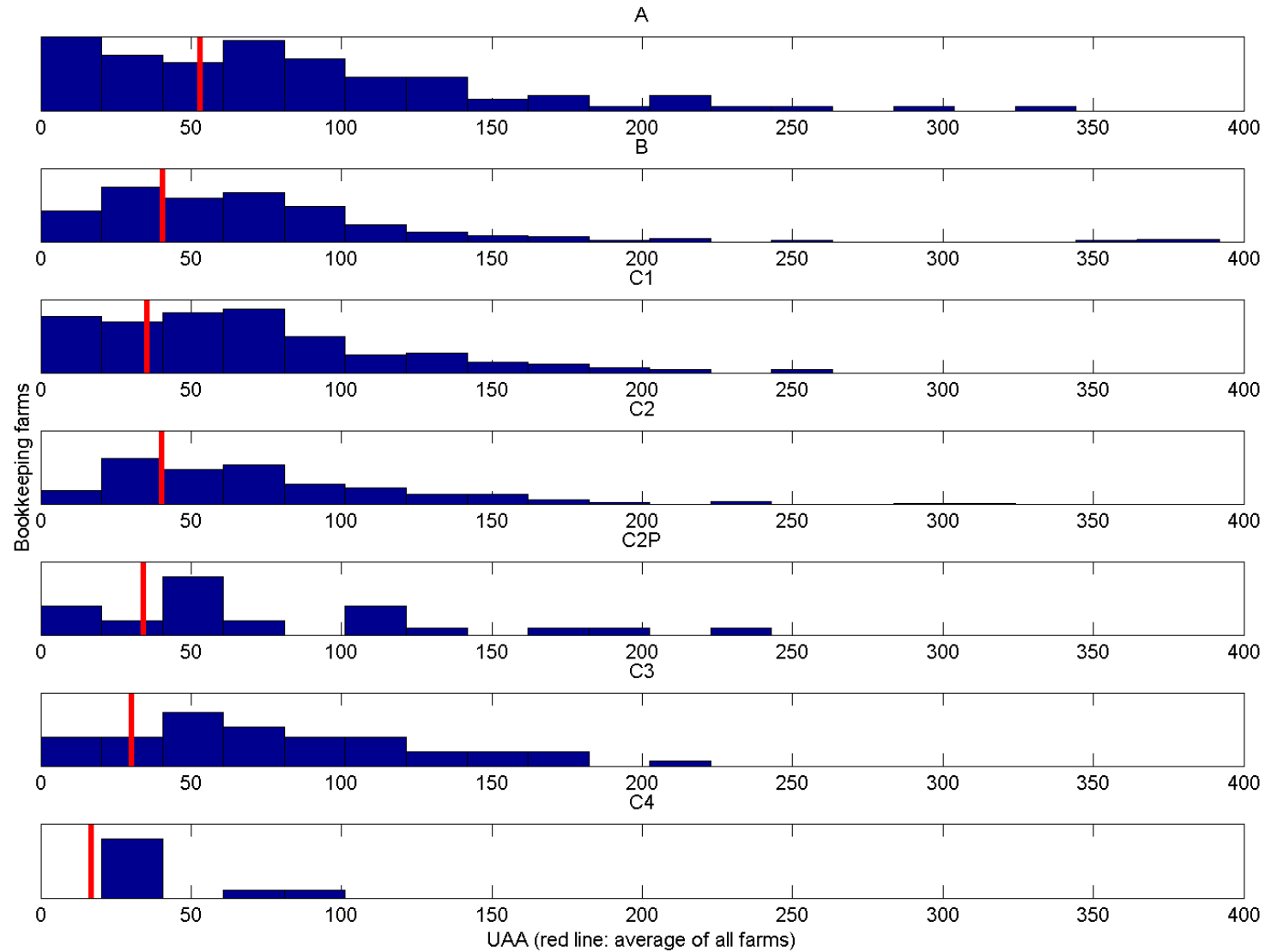
Possible improvements

- Add new constraints to some support areas and production types
  - But how many? New constraints always increase the risk of failing to find a solution next year.

- Generate artificial farms to empty cells
  - Result is not a weighted sum of bookkeeping farms anymore

- Use a regression model for obtaining the results
  - Complexity of model decreases understandability of calculation

Summary

- Total calculation gives a comprehensive picture of Finnish agriculture
- Coutry-level results are reliable
- Weigths are calibrated so that a set of constraints is fulfilled
- More constrains are needed to improve spatial representation
- Difficulties with few farms and a lot of cells
- Difficulties with biased sample