
Off-Road Automation Technology in European Agriculture

- State of the art and expected trends -



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Keynote Lecture

Kyoto (Japan)
October 7-8, 2004



Crop Production Engineering



Off-Road Automation Technology in European Agriculture

1. Europe
2. Agriculture in Europe
3. Agricultural mechanization in Europe
4. Off-road automation in European agriculture
5. Future trends
6. Conclusions

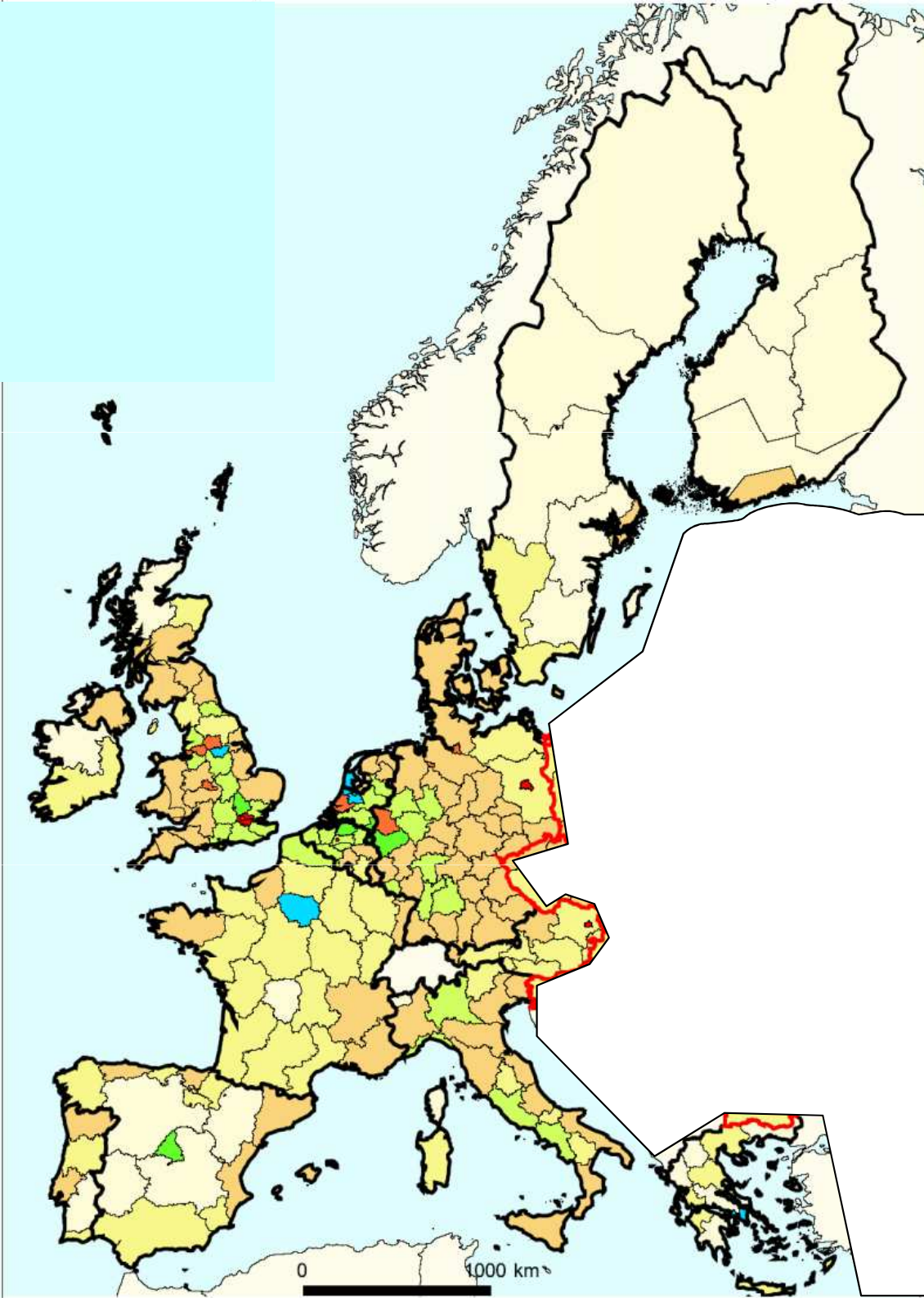
Off-Road Automation Technology in European Agriculture

1. Europe (just a view words)

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Unification of Europe

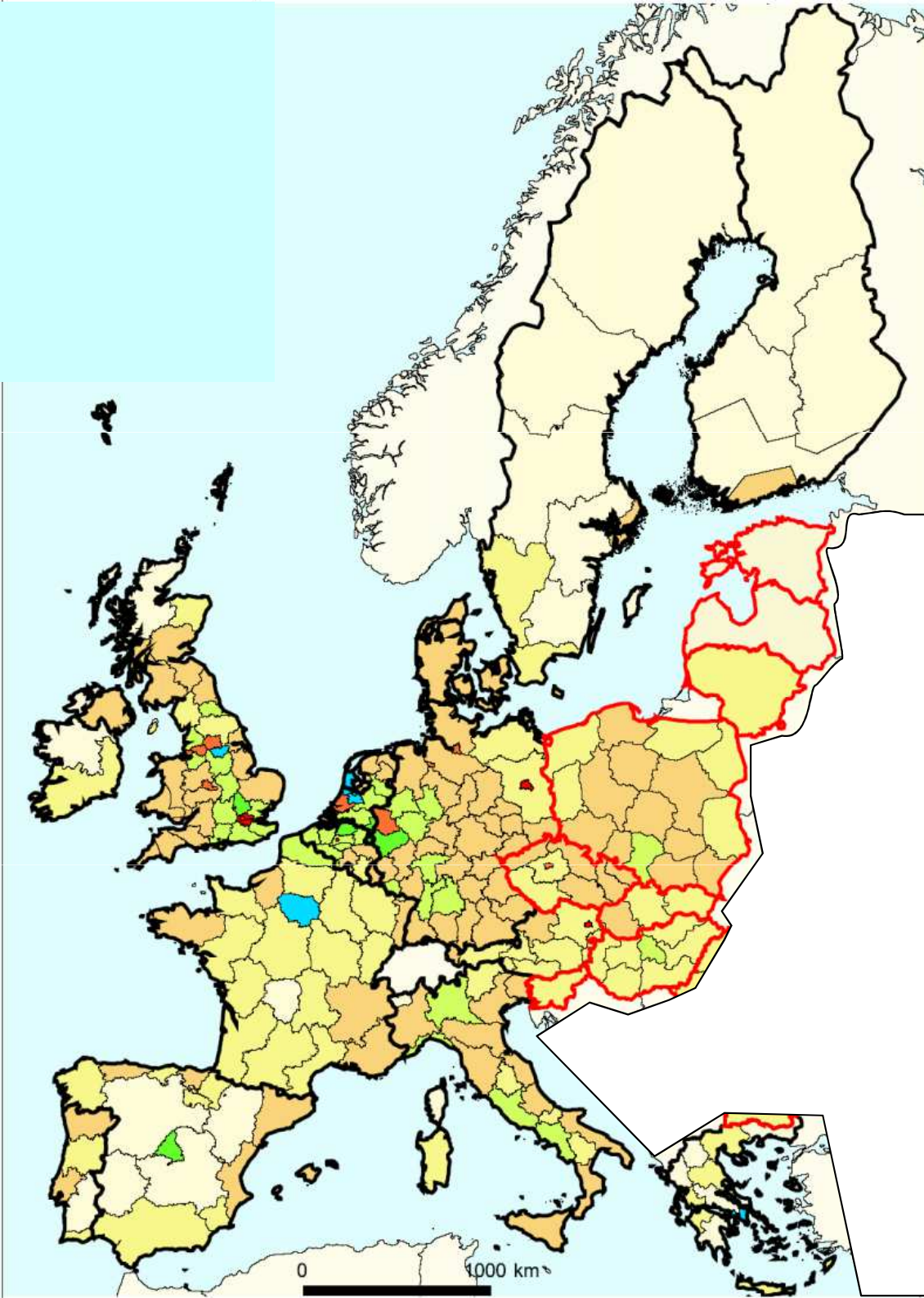
EU₁₅ in 1995, 330 million citizens



Unification of Europe

EU₁₅ in 1995, 330 million citizens

EU₂₅ in May 1st, 2004,
10 more countries
105 million more citizens



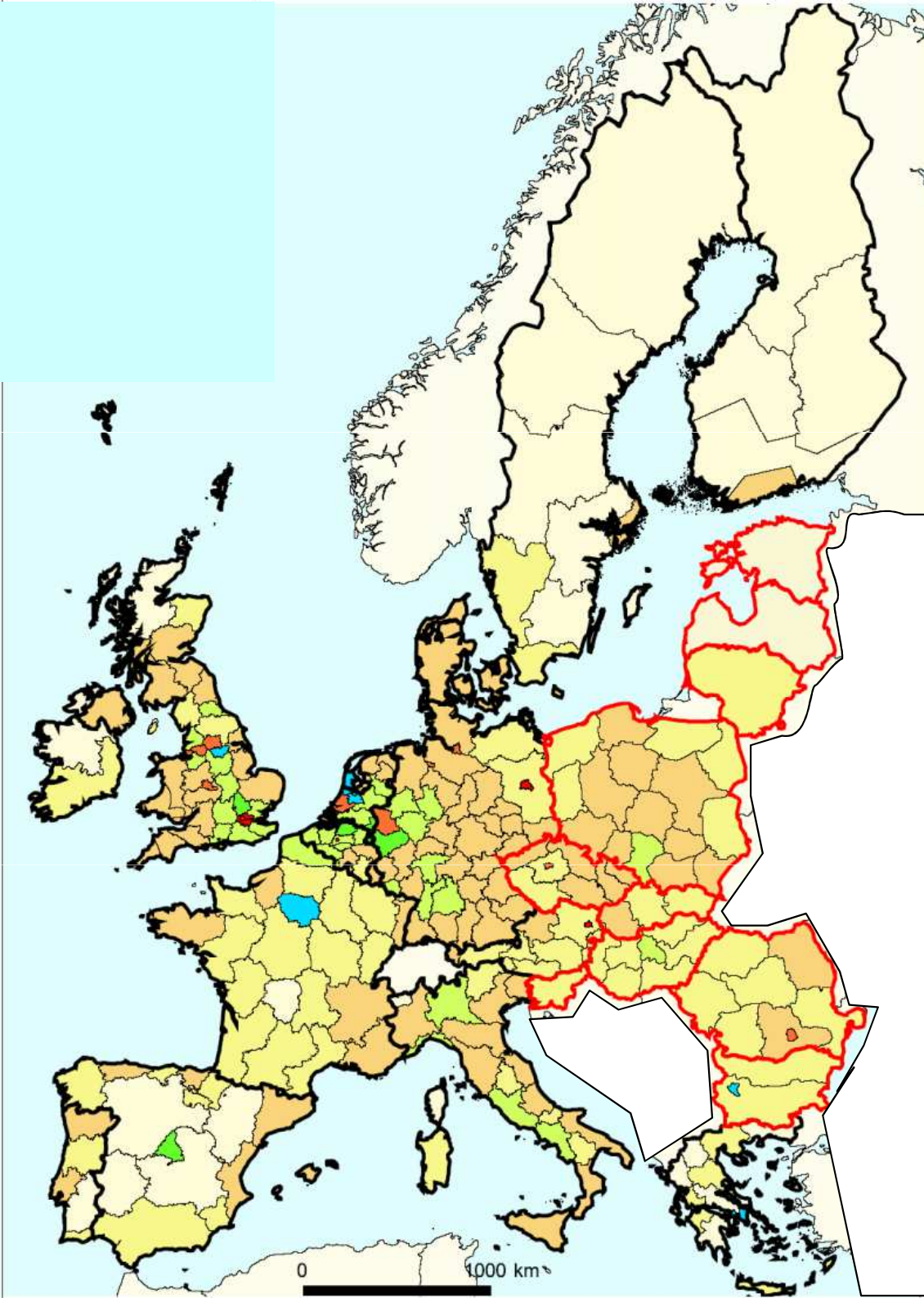
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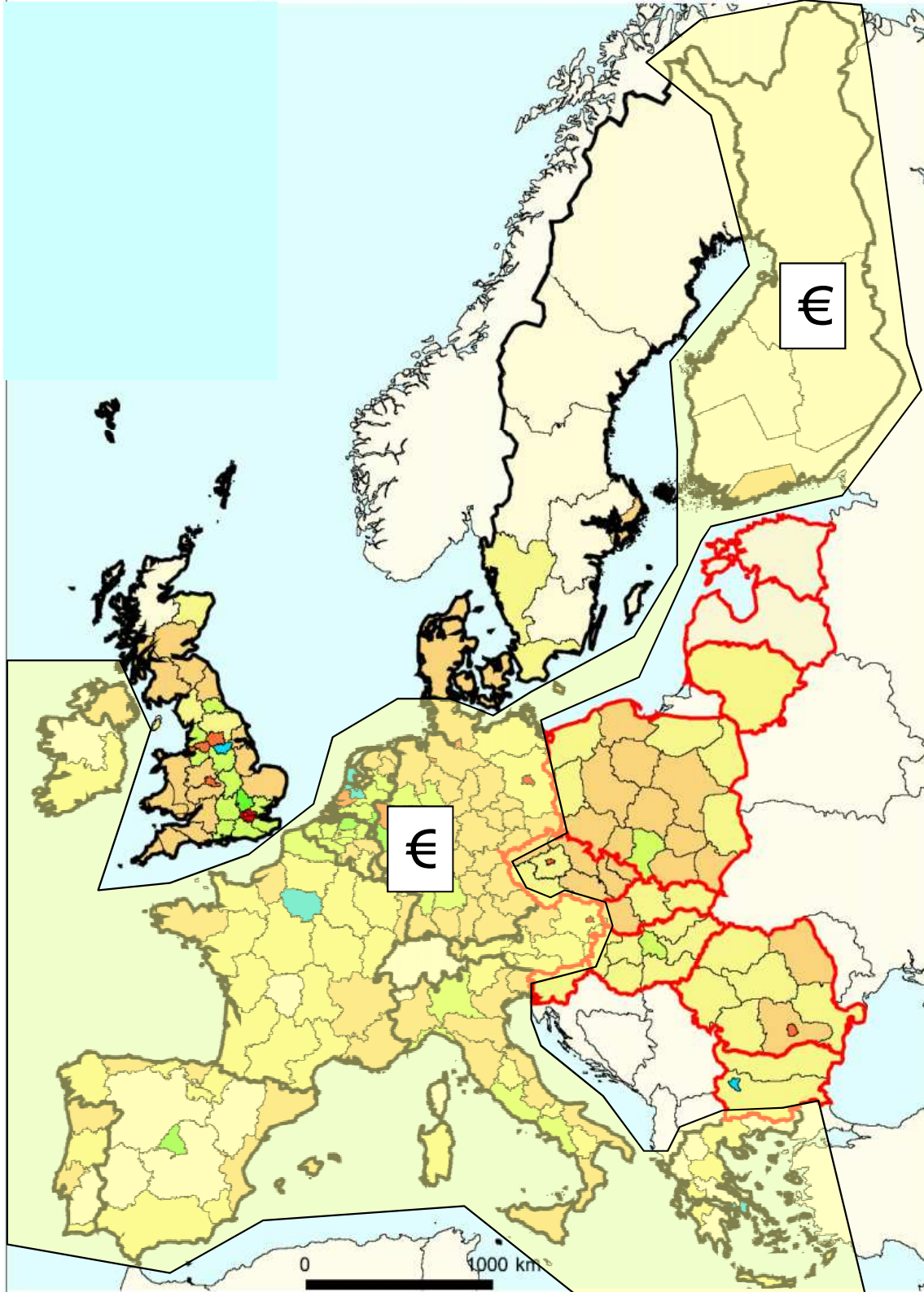
EU₂₇ in 2007,
2 additional countries
31 million more citizens

In total 466 million citizens



Currencies in Europe

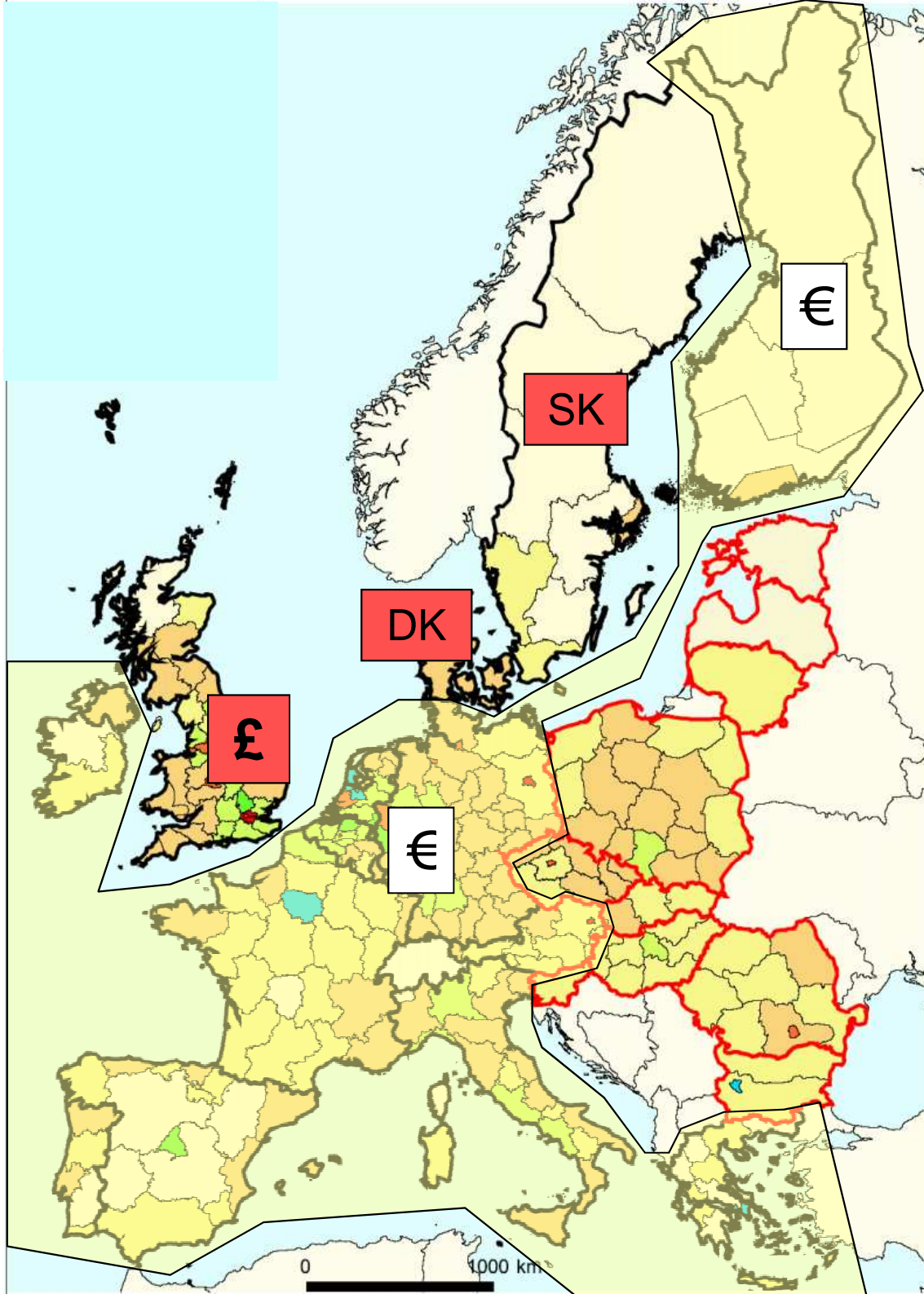
Euro zone



Currencies in Europe

Euro zone

Own currencies old members



Currencies in Europe

Euro zone

Own currencies old members

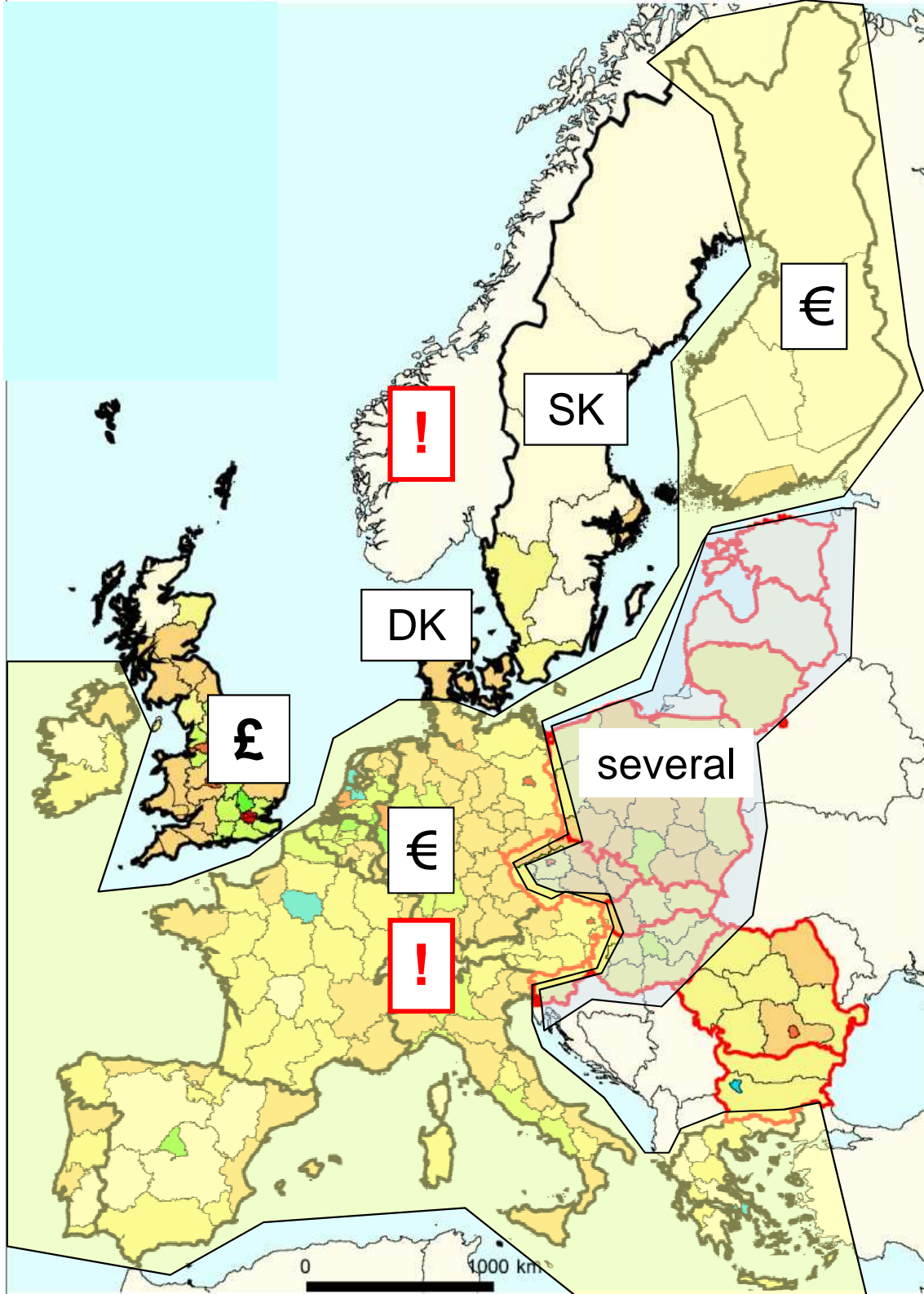
Old currencies, new members

Mention:

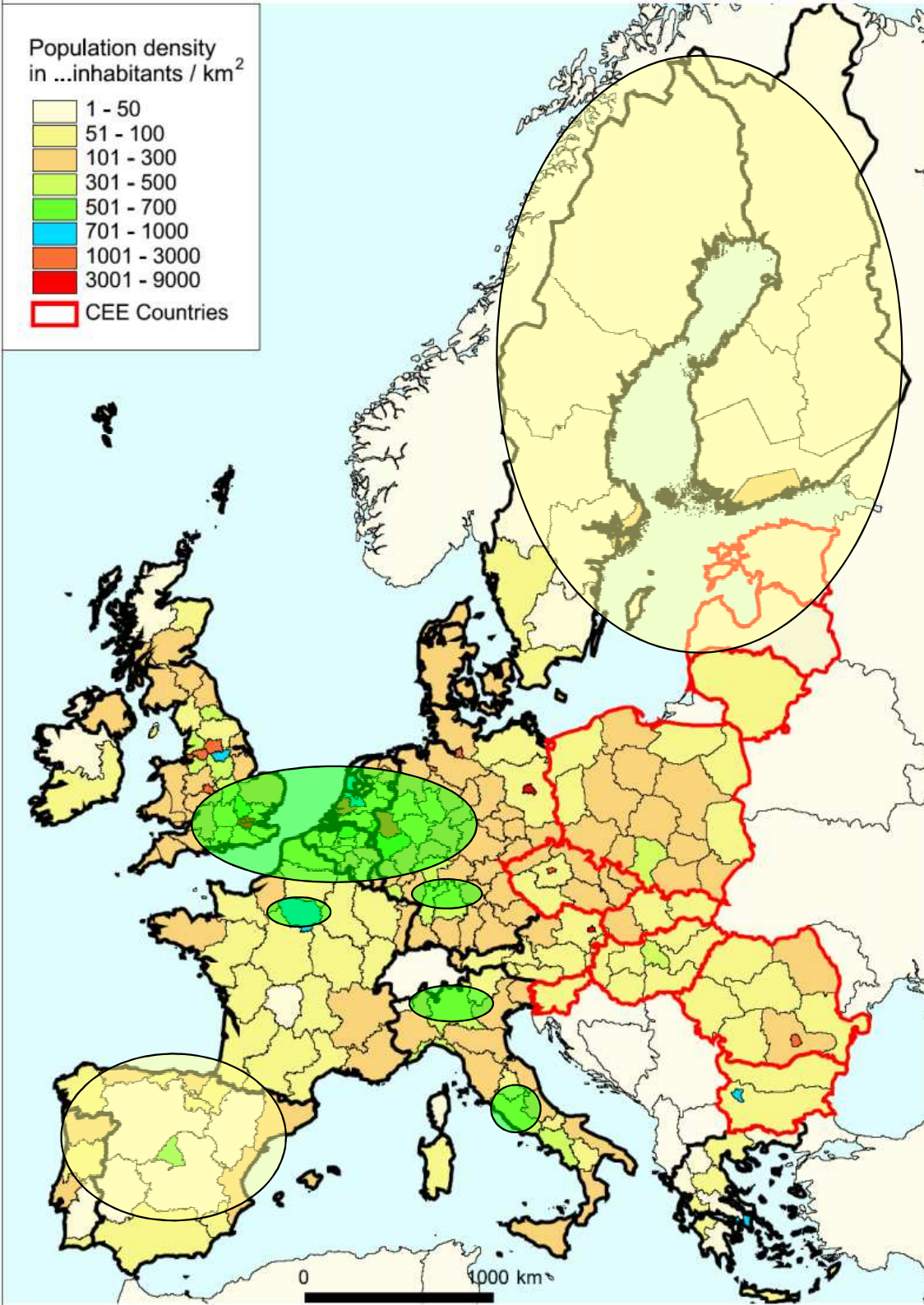
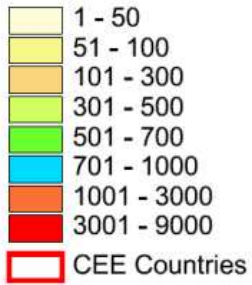
- **Switzerland**

- **Norway**

belong not to the EU !



Population density
in ...inhabitants / km²



Population density 1997

Low and very low density regions

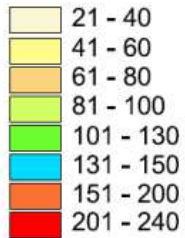
High density regions

Interpretation:

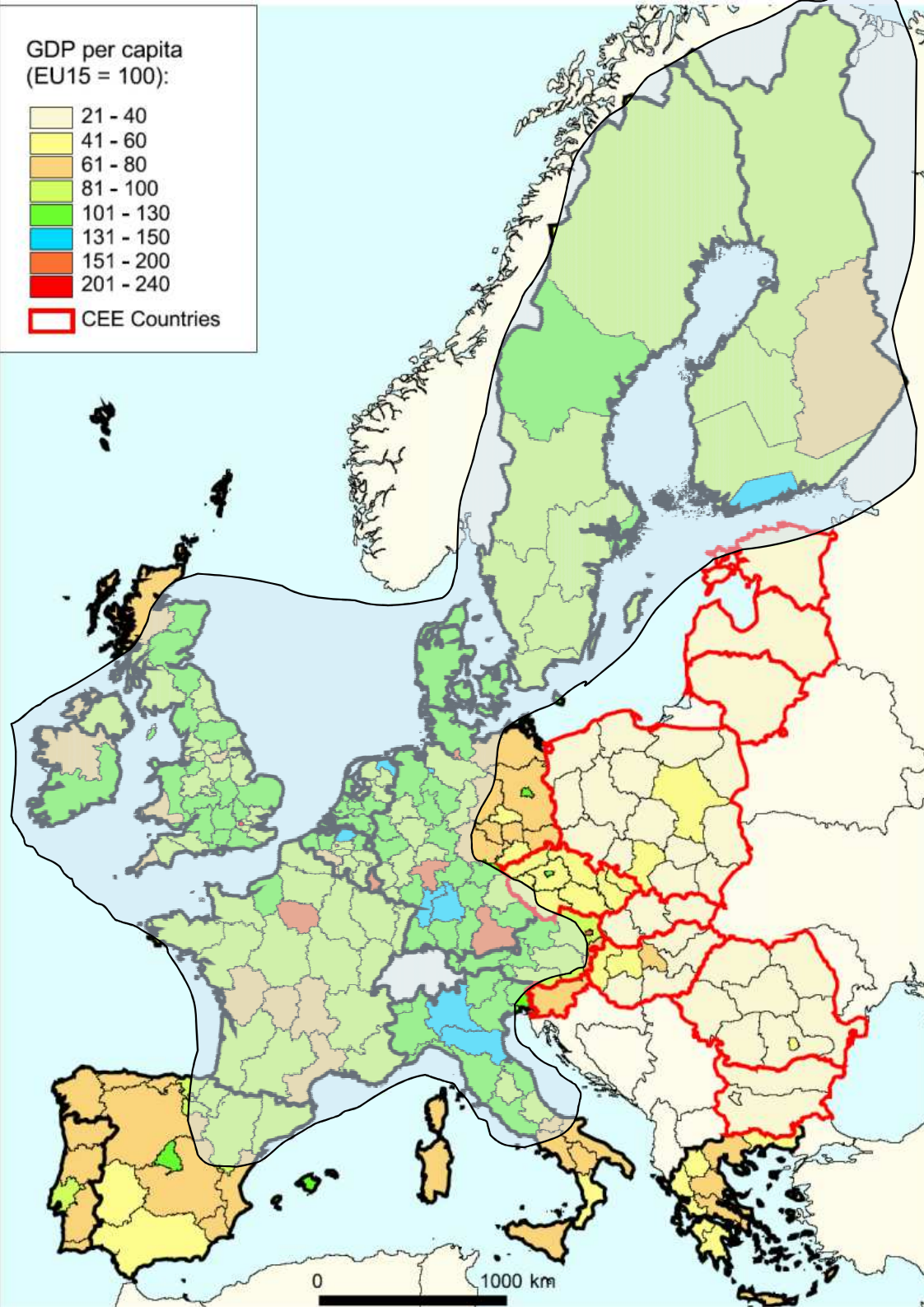
Low = need for automation ?

High = no need for automation ?

GDP per capita
(EU15 = 100):



CEE Countries



Cross domestic product per capita 1997

Fairly well developed CDP in a
wide area of Europe

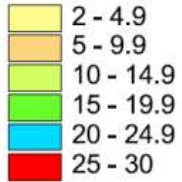
Interpretation:

= money for more automation ?

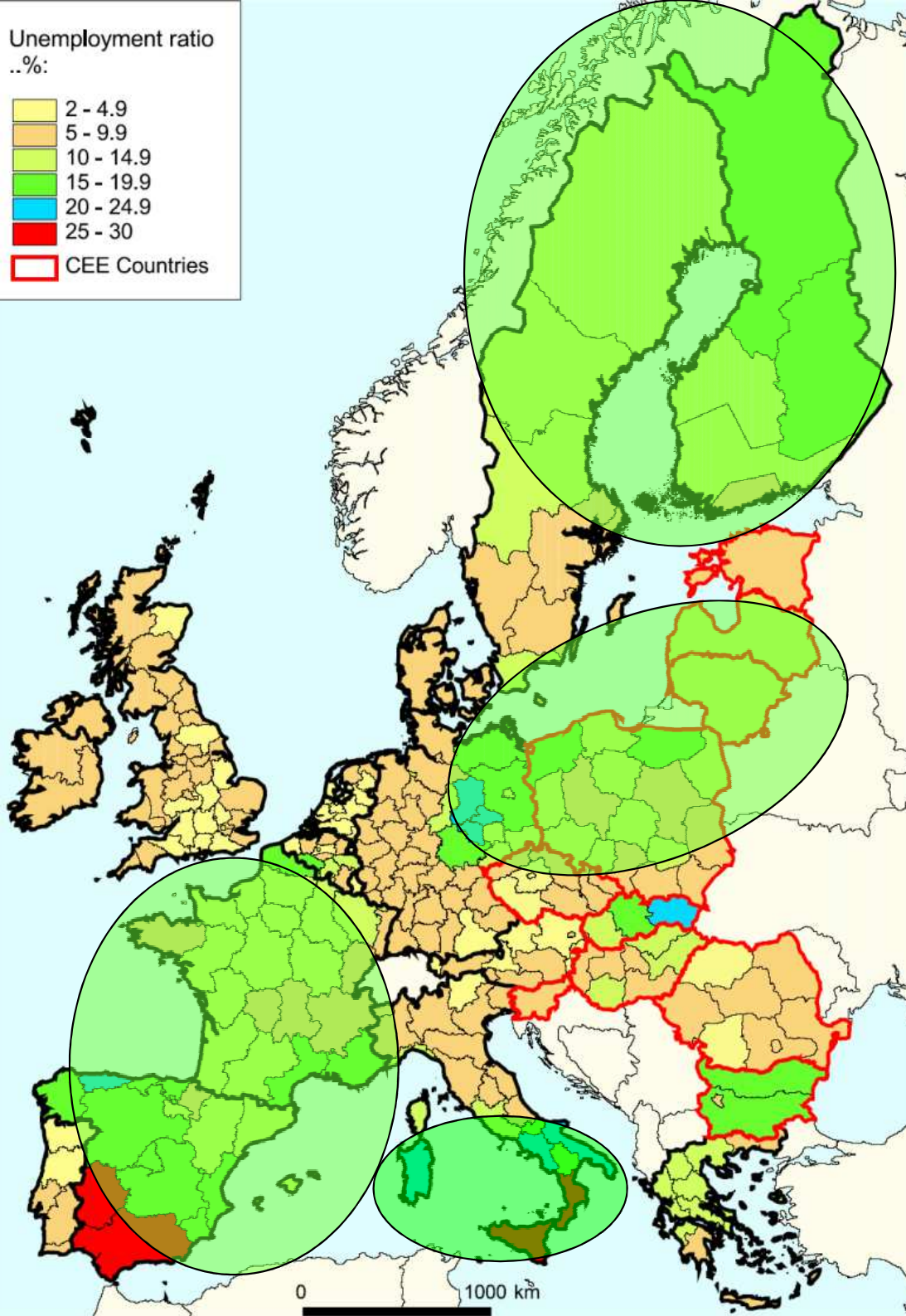
= money for more comfort ?

Unemployment ratio

..%:



CEE Countries



Unemployment ratio 1998

Very large area (about 50 %) with high and very high unemployment

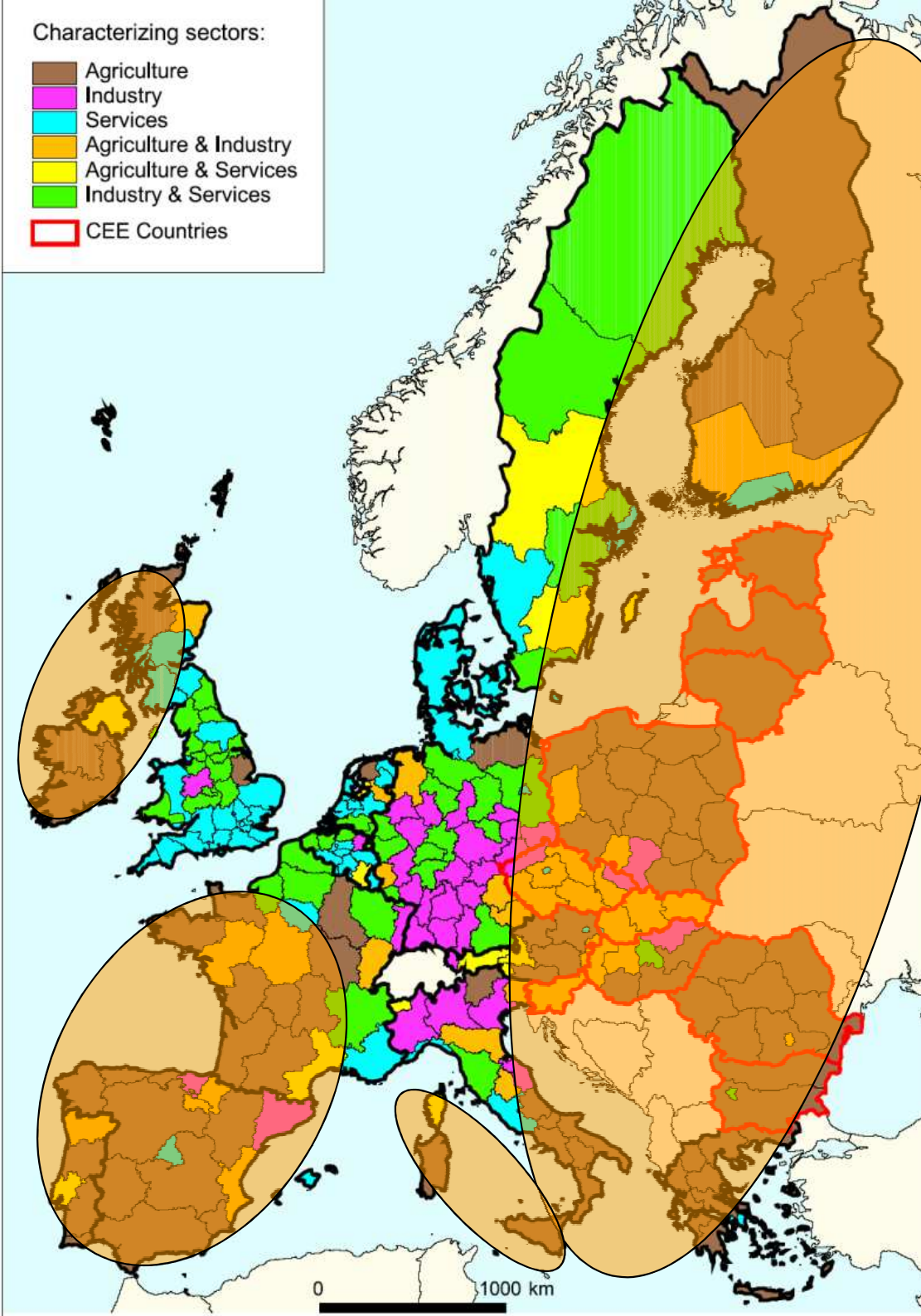
Interpretation:

= no need for automation?

= no money for automation?

Characterizing sectors:

- Agriculture
- Industry
- Services
- Agriculture & Industry
- Agriculture & Services
- Industry & Services
- CEE Countries



Economic sectors 1998

Two regions:

- Large agricultural area
- Large industrial area

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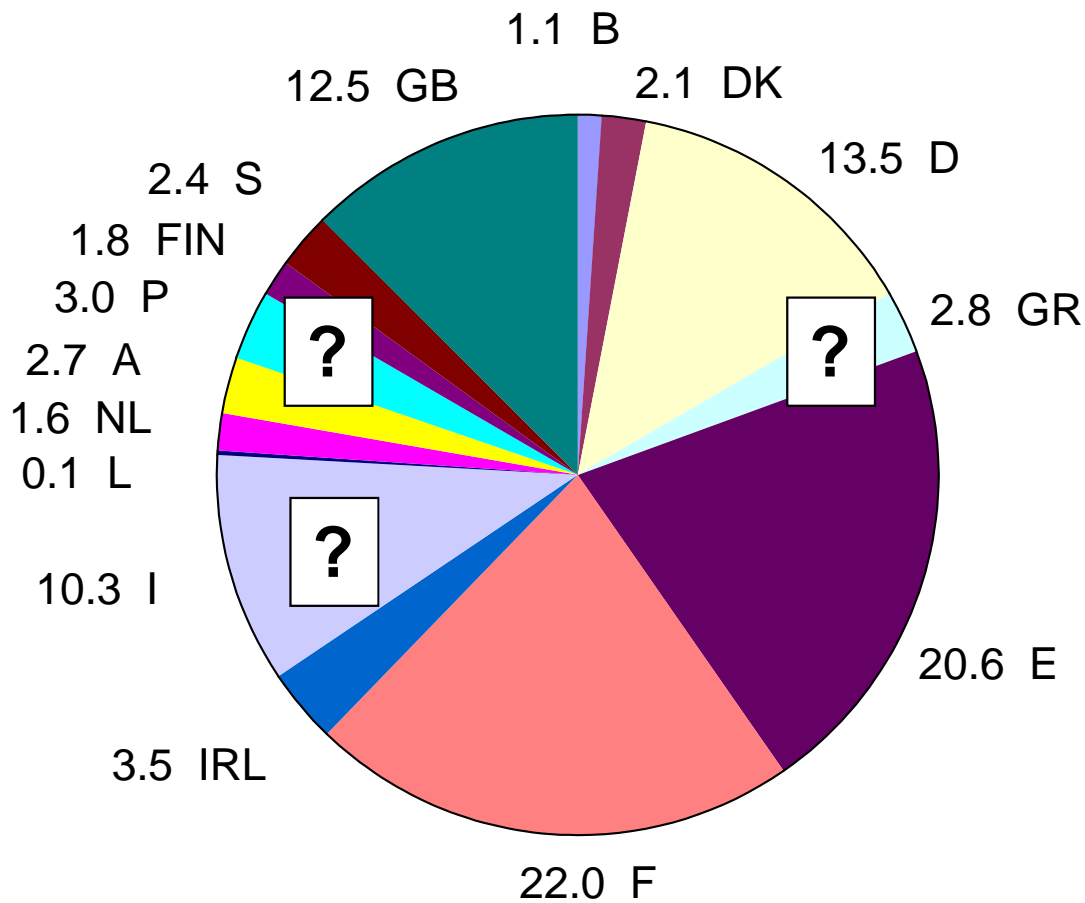
6. Conclusions

Farms partitioned due to sizes in 1999/00

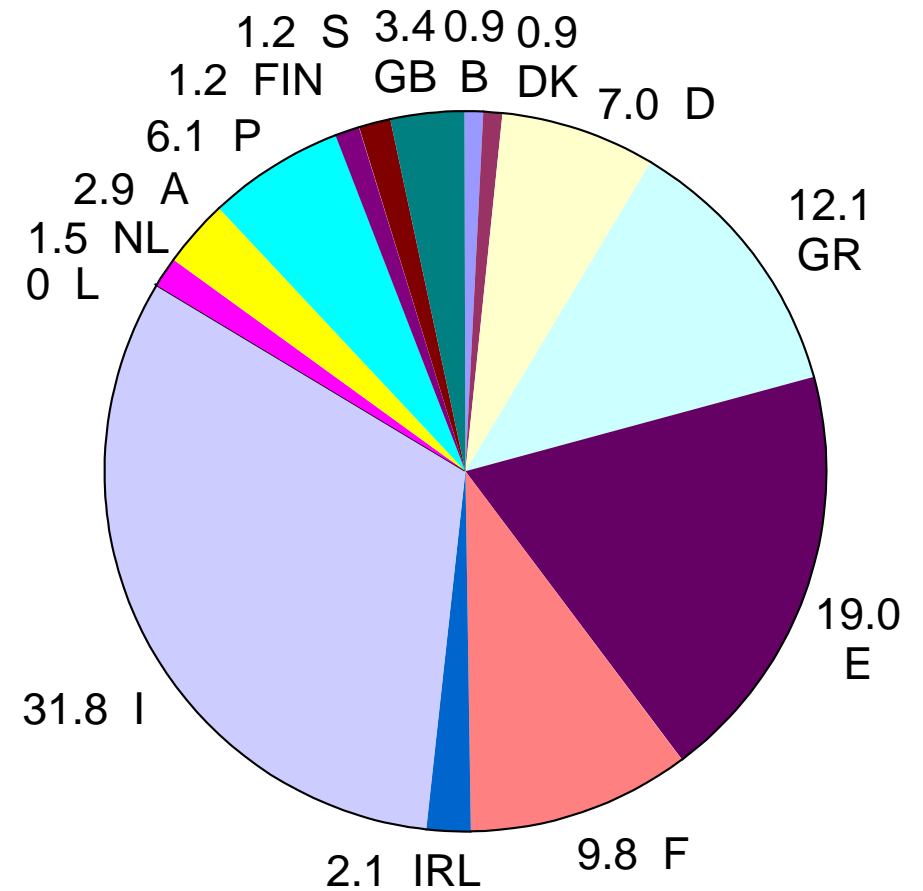
Size (area) from ... up to ... ha							Overall
less than 5	5 - 10	10 - 20	20 - 30	30 - 50	50 - 100	100 or more	
Number of Farms in 1,000							
3,902.1	834.1	691.2	349.0	389.3	369.0	234.4	6,769.1
Relative Number of Farms based on Overall Number in %							
70 to 80 % will disappear			5.2	5.8	5.5	3.5	100
Area of Farms in 1,000 ha							
6,593.4	5,885.8	9,822.7	8,548.1	15,063.8	25,687.0	55,196.7	126,797.5
Quota of Agricultural used area in %							
5.2	4.6	7.7	6.7	11.9	20.3	43.5	100

Relative area and relative farm number of EU₁₅ members

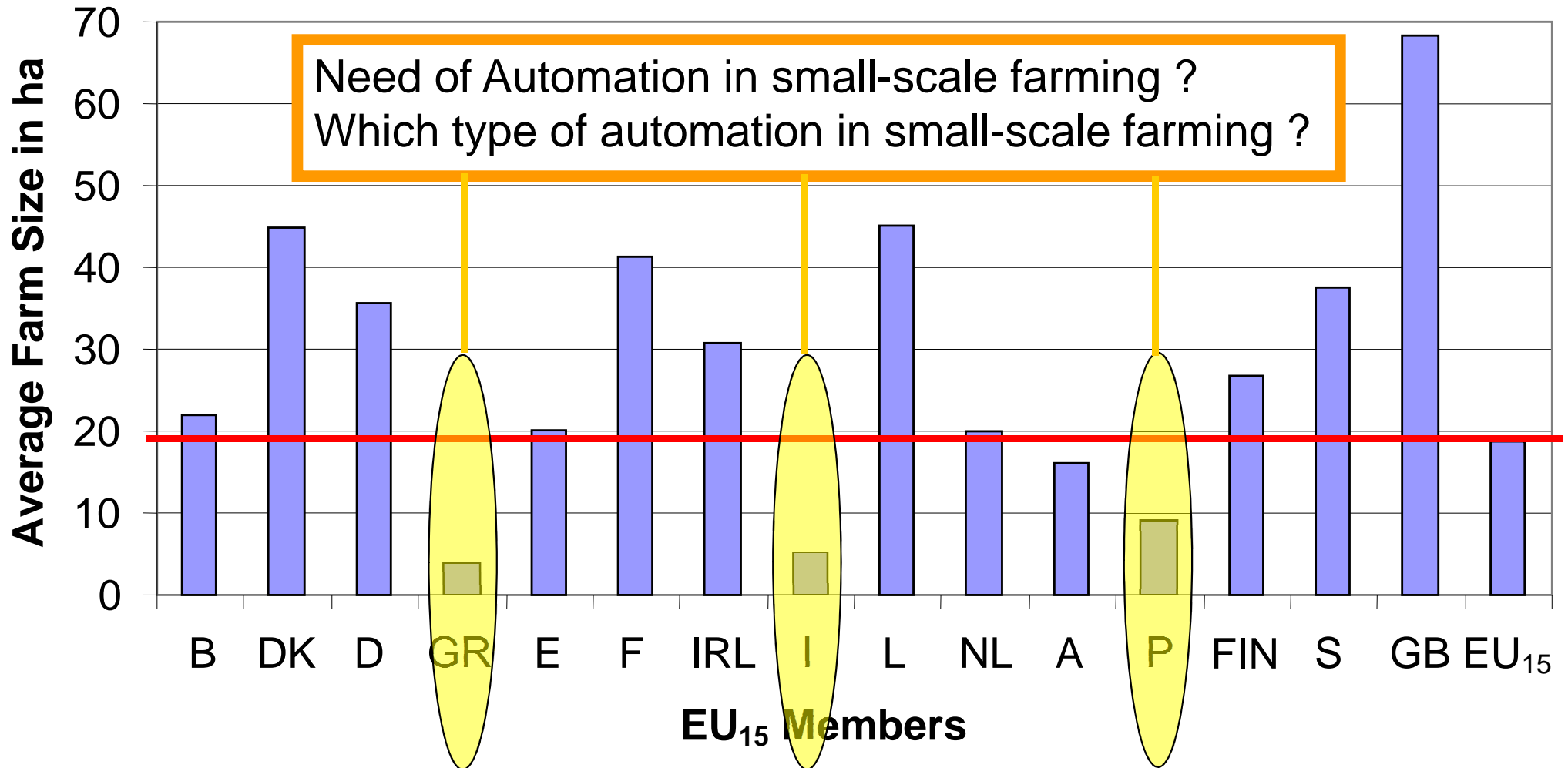
Area (%)



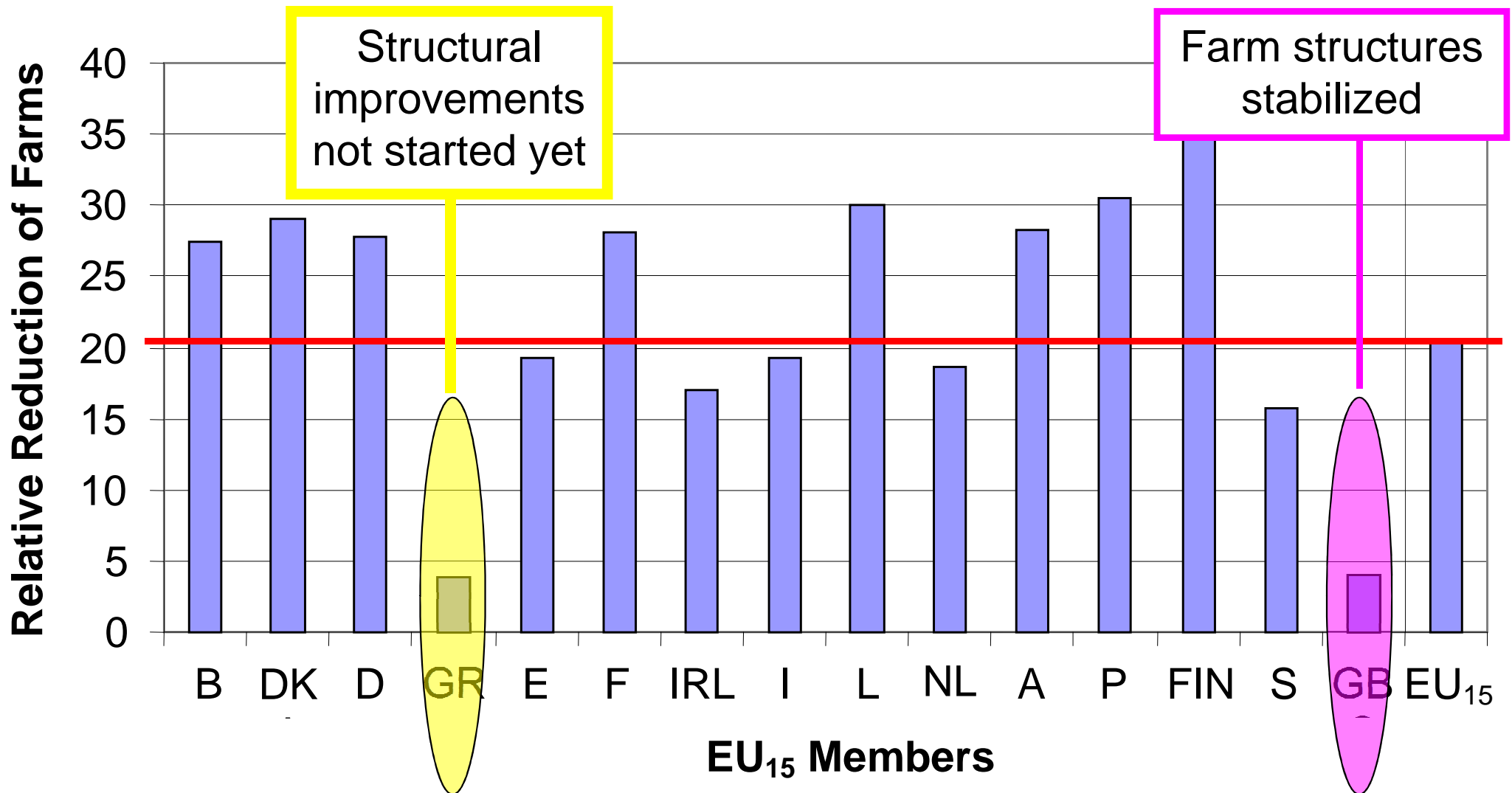
Farm numbers (%)



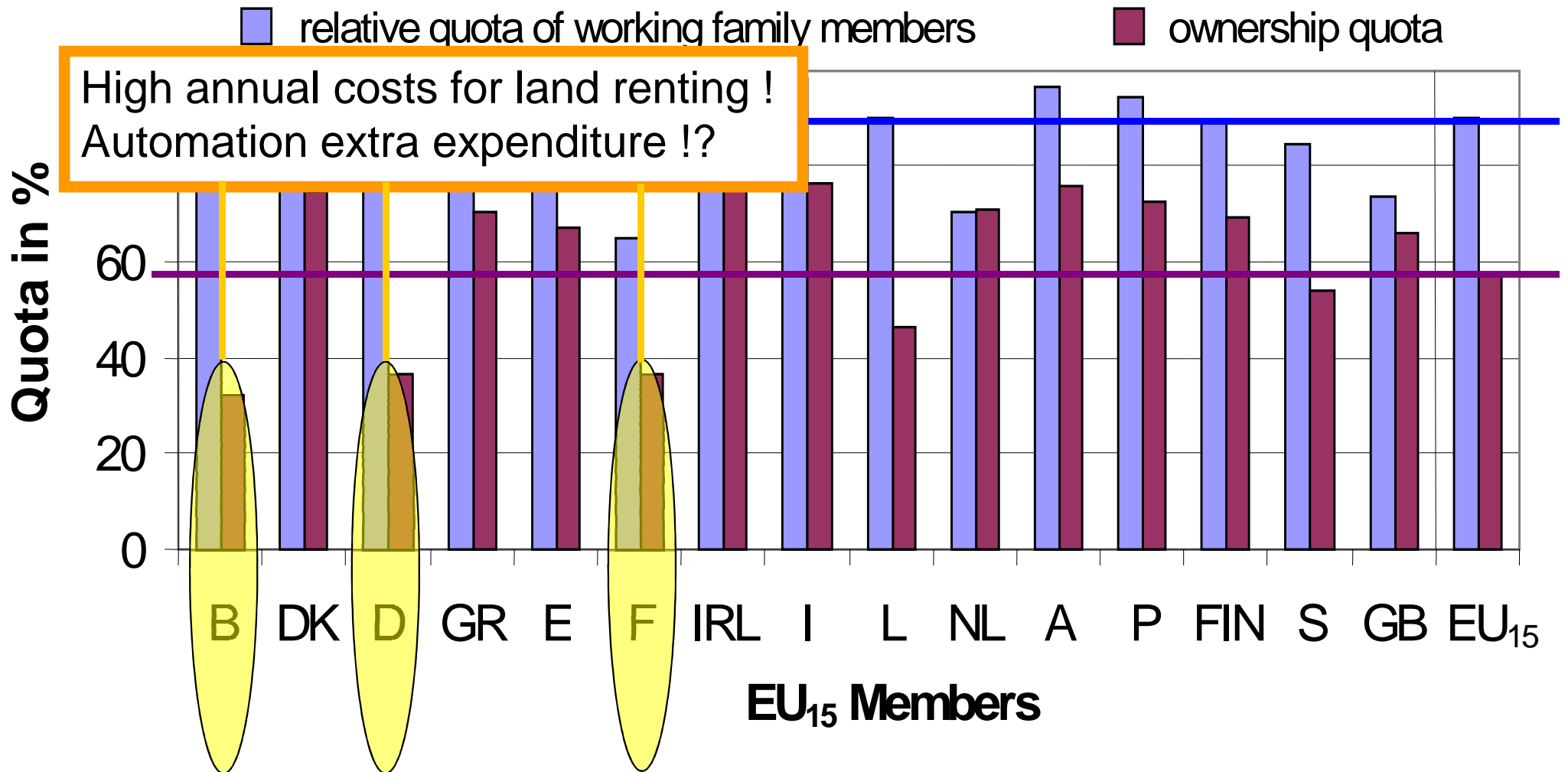
Average farm size in the EU₁₅ 1999/00



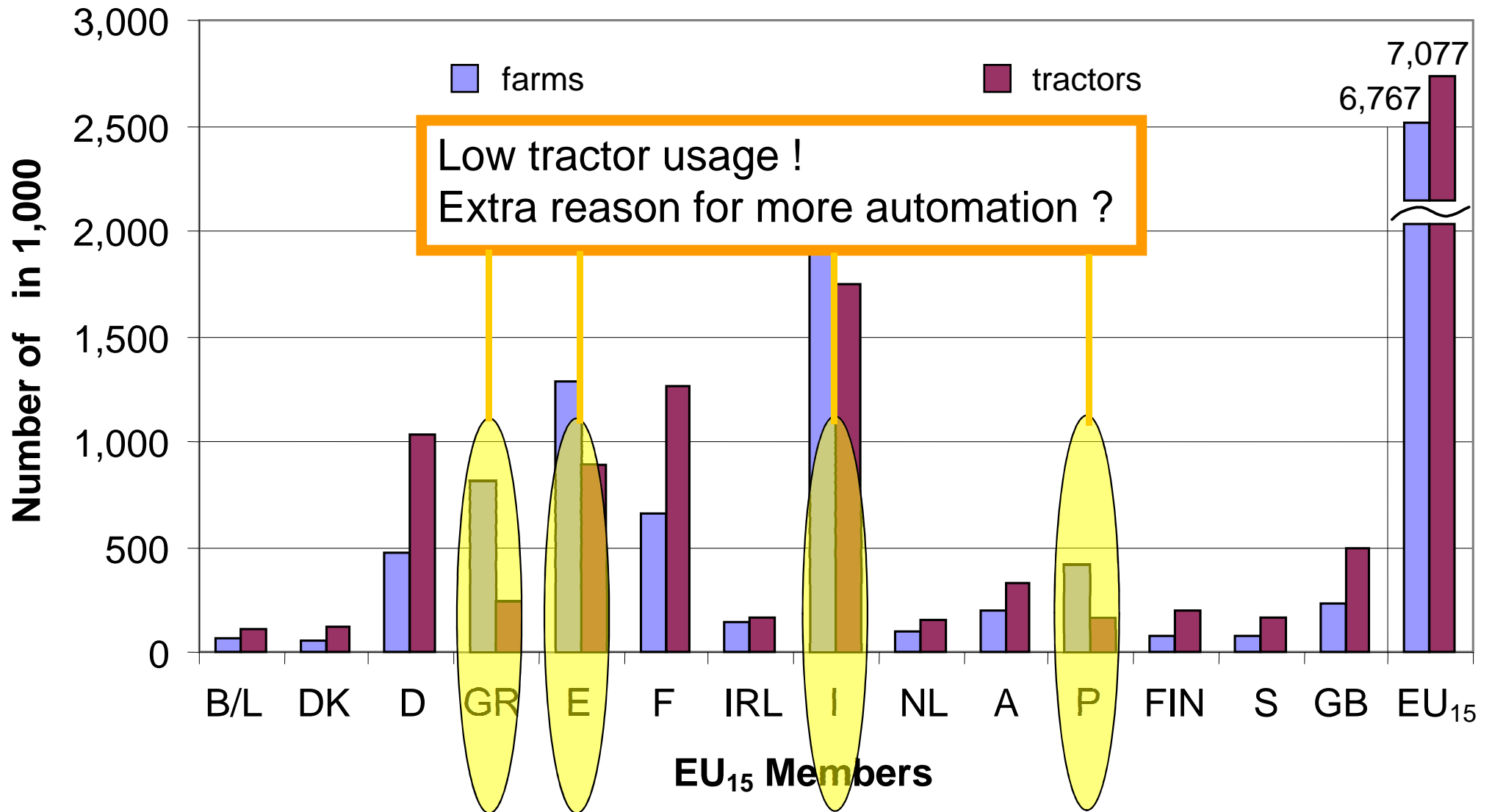
Farm decline of each member country (EU₁₅) between 1989/1990 and 1999/2000



Relative quota of working family members and ownership quota of EU₁₅ members 1999/00



Number of farms and tractors per EU₁₅ member



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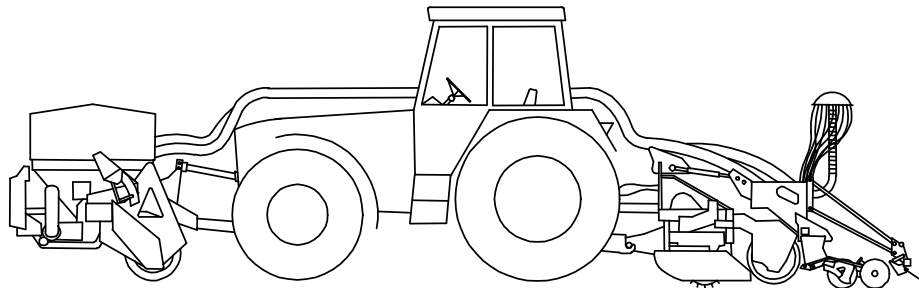
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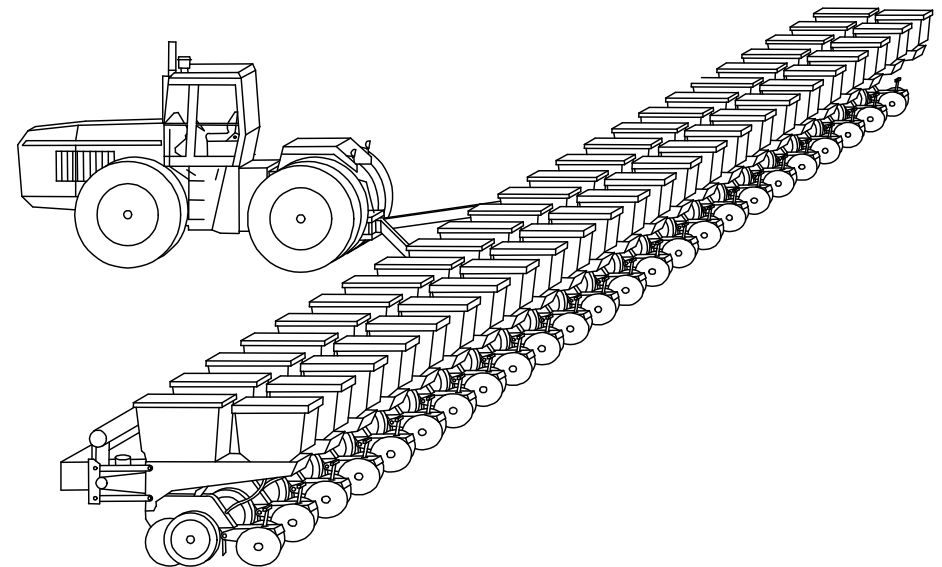
Typical European tractor-implement combination for high performance

Small-scale farming



- Extending in length (combination)
- Self propelled unit
- Fast on road (40 km/h; 50 km/h)
- High concentration at field end
- High concentration during work
- **Large demands to the driver**

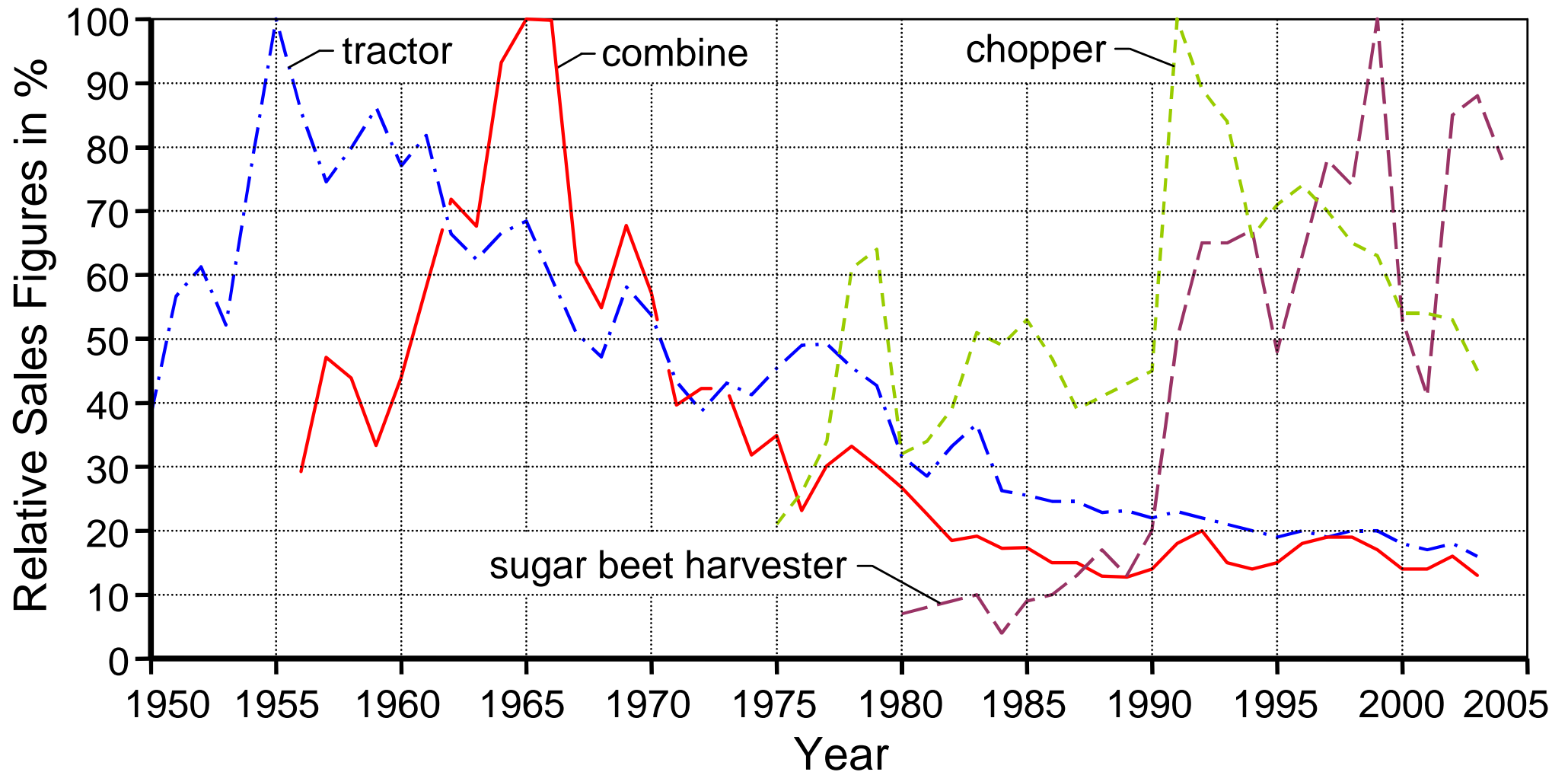
Large-scale farming



- Extending in width
- Towed implements
- Lower max. speed
- Lower concentration during work
- **Lower demands to the driver**

Self propelled off-road vehicles

(Relative sales figures of tractors and self-propelled harvesters in Germany)



First self-propelled tillage unit (LEMKEN Brilliant, 2003)

**Following the trend !?
or
„missing link“ ?**



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The Agricultural BUS System (LBS) in accordance to DIN 9684 / ISO 11783

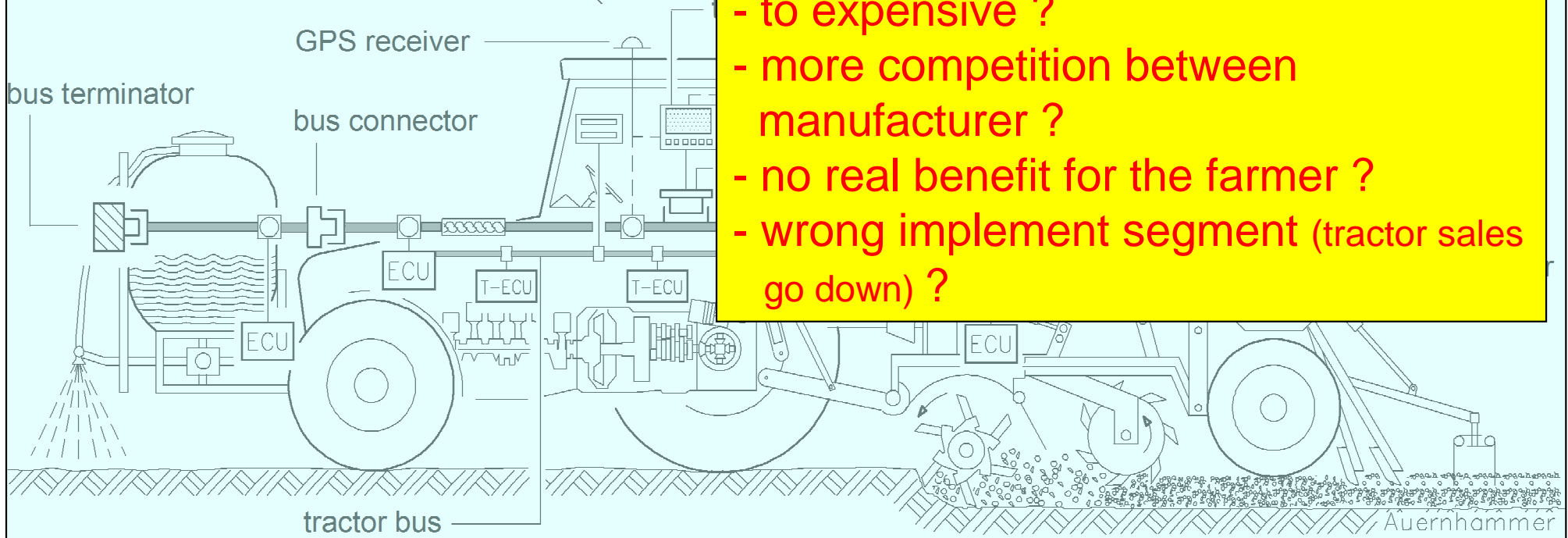
High-tech for agriculture

- early-state developed
- easy-to-use

Required by the farmers

7 years after standardization still not available !

- too complicated ?
- too complex ?
- too expensive ?
- more competition between manufacturer ?
- no real benefit for the farmer ?
- wrong implement segment (tractor sales go down) ?



N-online fertilization systems

(regime: 3 to 4 dressings)

High-tech for environment protection!

- closed-loop control
- easy-to-use

Emulates farmers work !

3 years after introduction still only a small number in use !

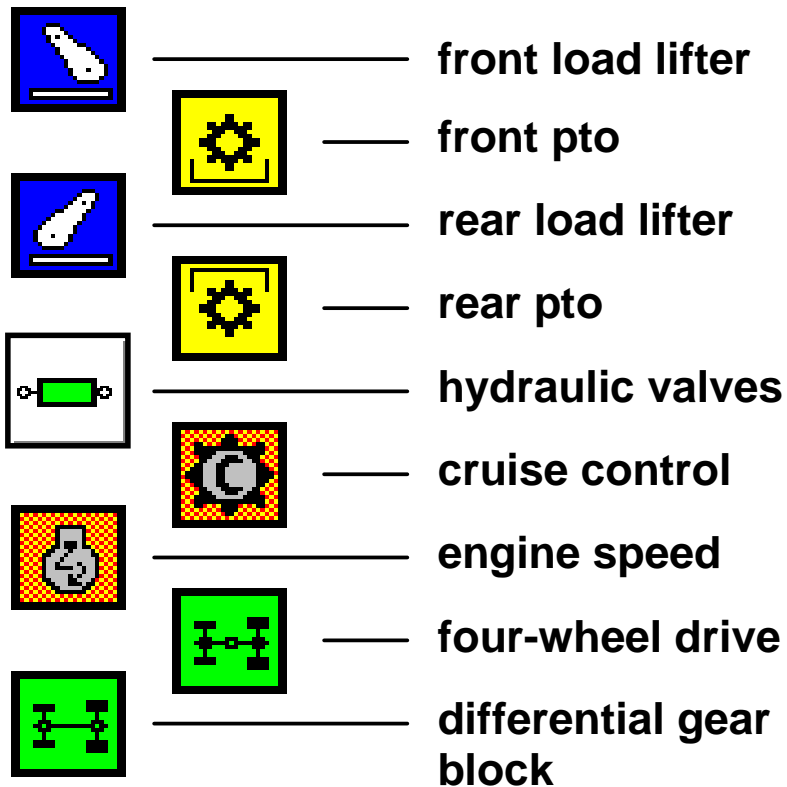
- too expensive ?
- too less financial benefit ?
- no extra benefit for environment protection ?



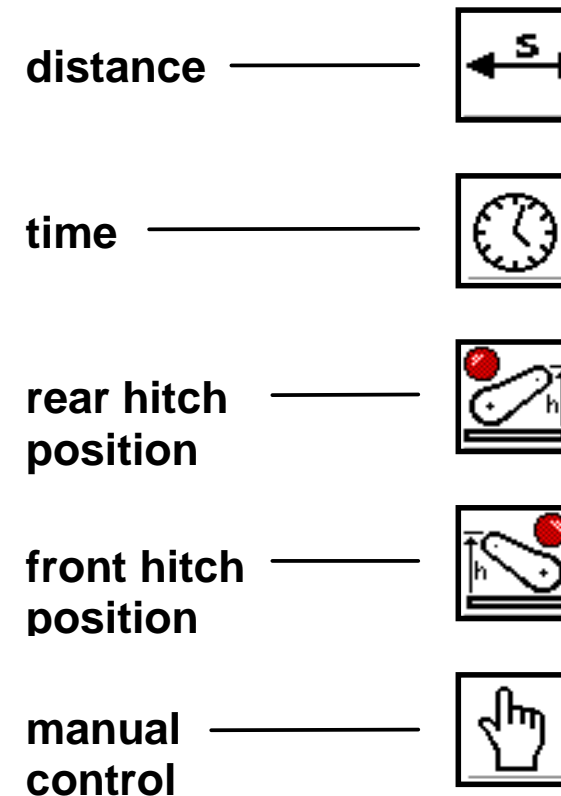
Automated headland control with "Teach-In" (FENDT)

Recording - Editing - Storage - Play-back - Control
of up to 16 different functions and 5 devices

Integrated Functions:



Automated execution in dependence of:



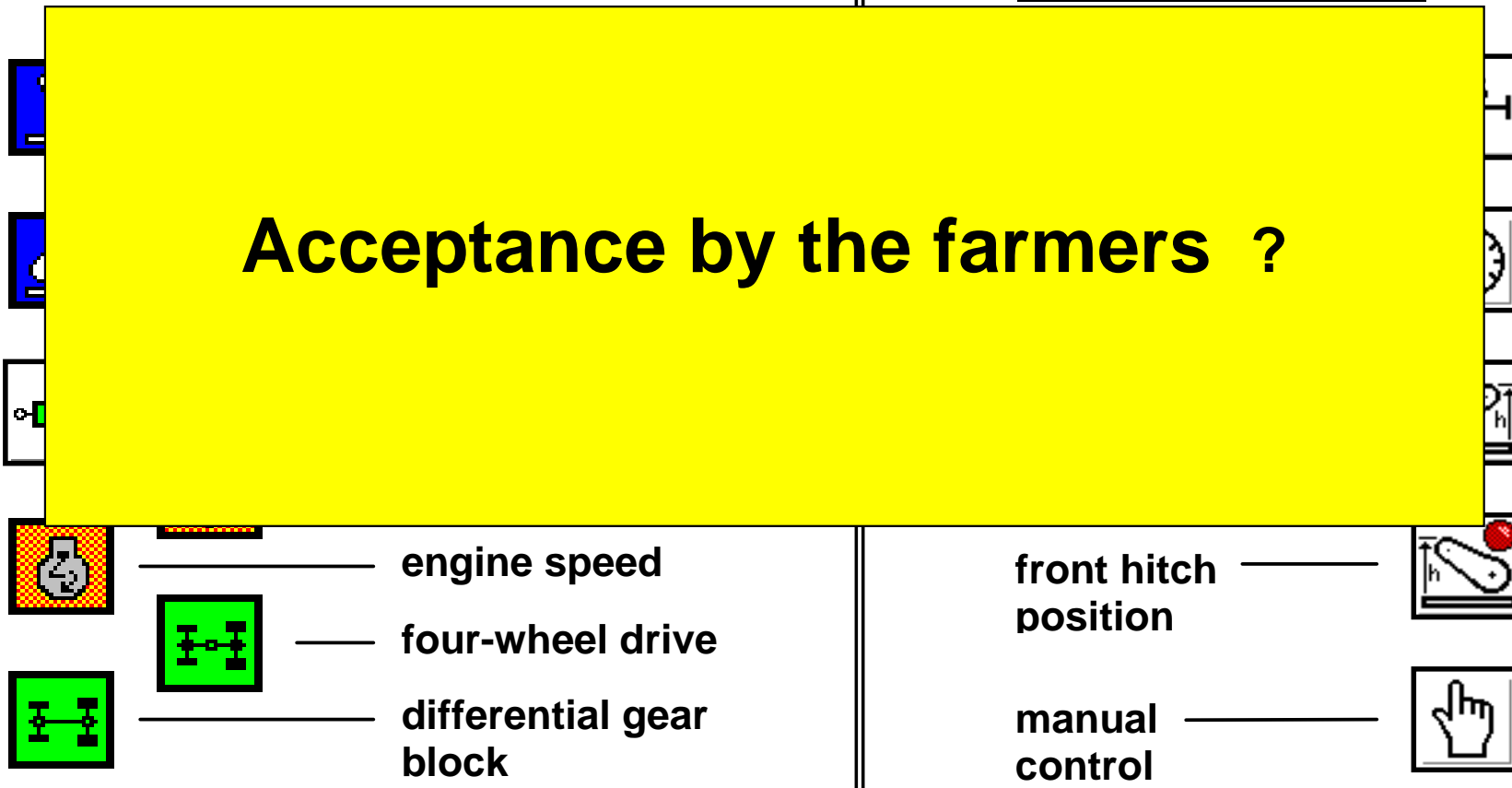
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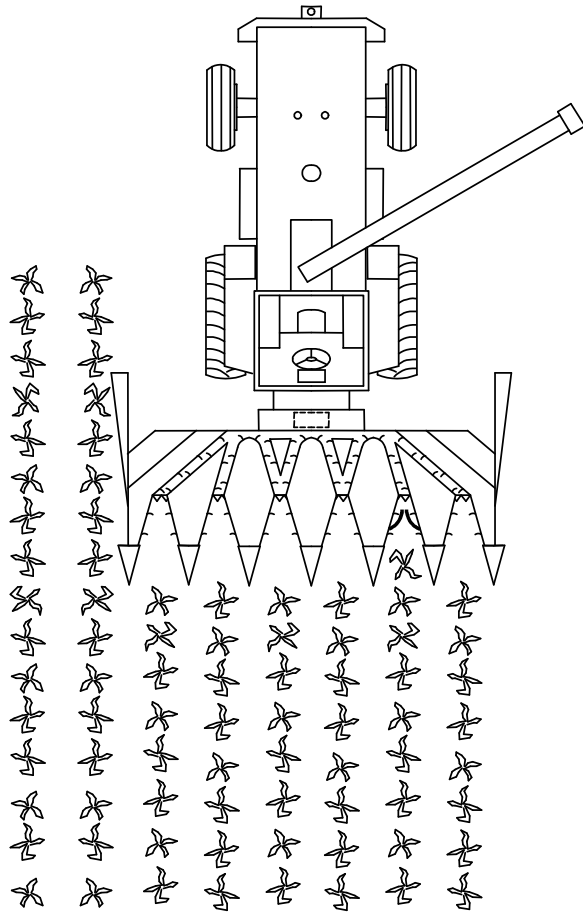
Automated execution
in dependence of:

Acceptance by the farmers ?

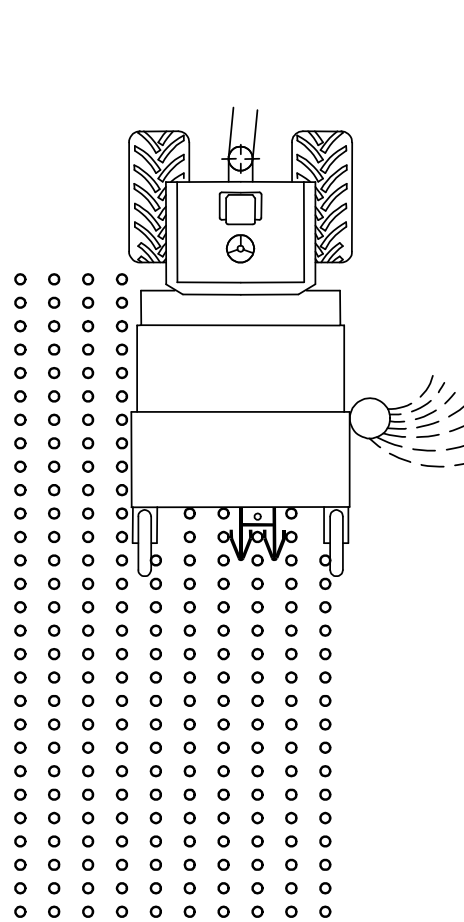


Steering controller in self propelled combine harvesters

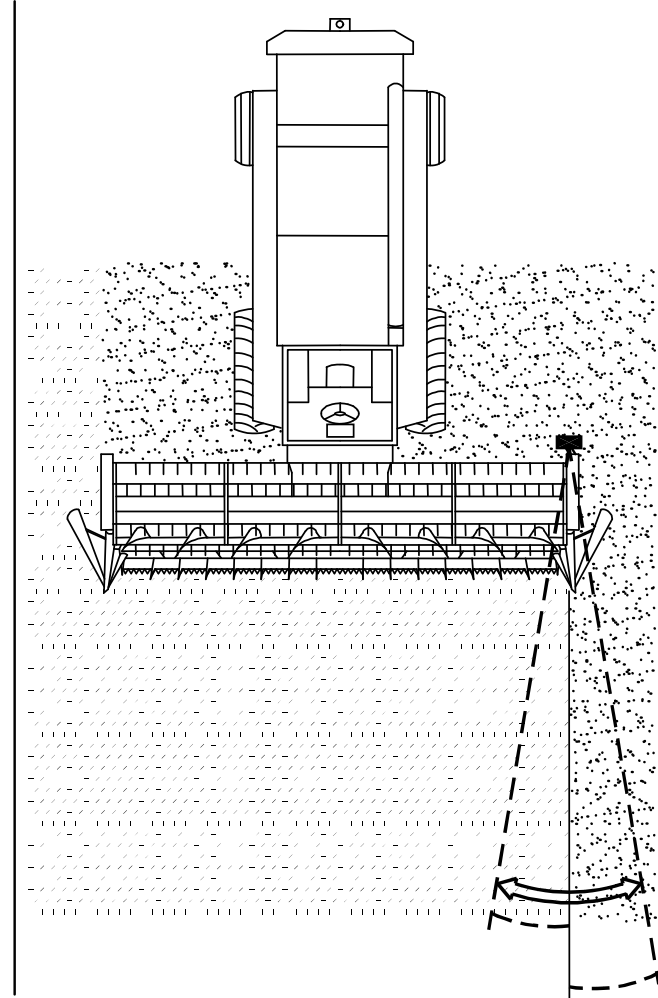
Chopper
(CLAAS)



Sugar beet harvester
(HOLMER)



Combine harvester
(CLAAS)



Steering controller in self propelled combine harvesters

Chopper
(CLAAS)

Sugar beet harvester
(HOLMER)

Combine harvester
(CLAAS)

Fully accepted by the farmer ?

- simple to use (just push a button) !
- offers comfort !
- increases performance !
- increases profit !

Automation fully accepted in serialized products

Electronic Hitch Control (EHR) in tractors >40 kW

Four-wheel and anti-slip management (tractors > 80 kW)

VRT (**variable rate transmission**) with about 40.000 units

Auto-Contour in combine harvesters (> 4 m working width)

Reasons again:

- **simple to use** (just push a button) !
- **offers comfort** !
- **increases performance** !
- **increases profit** !






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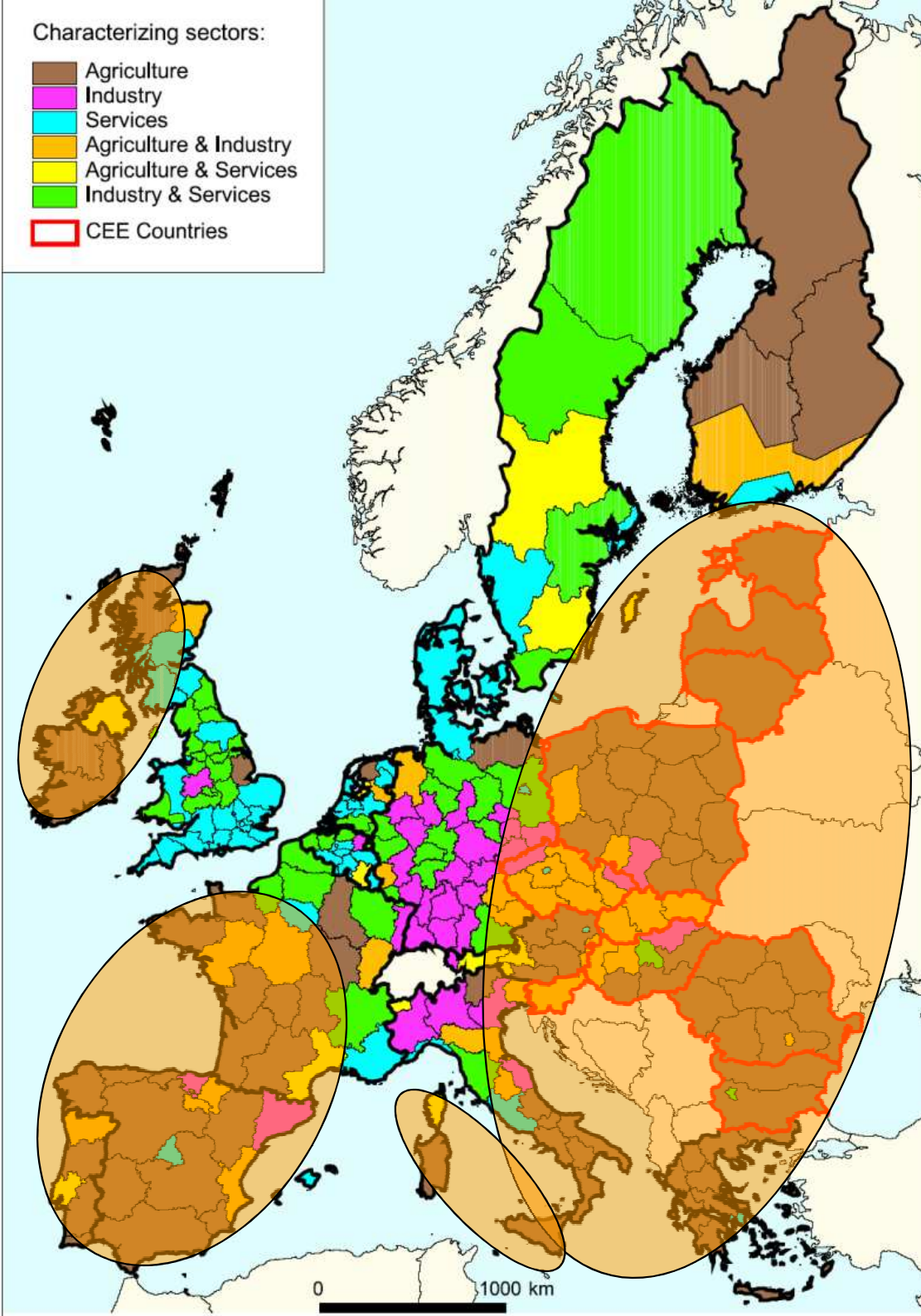
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Characterizing sectors:

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-  Services
-  Agriculture & Industry
-  Agriculture & Services
-  Industry & Services
-  CEE Countries



Trends for Automation

Large agricultural area

Large industrial area

Interpretation:

Two regions !

Low density population, high unemployment and less income

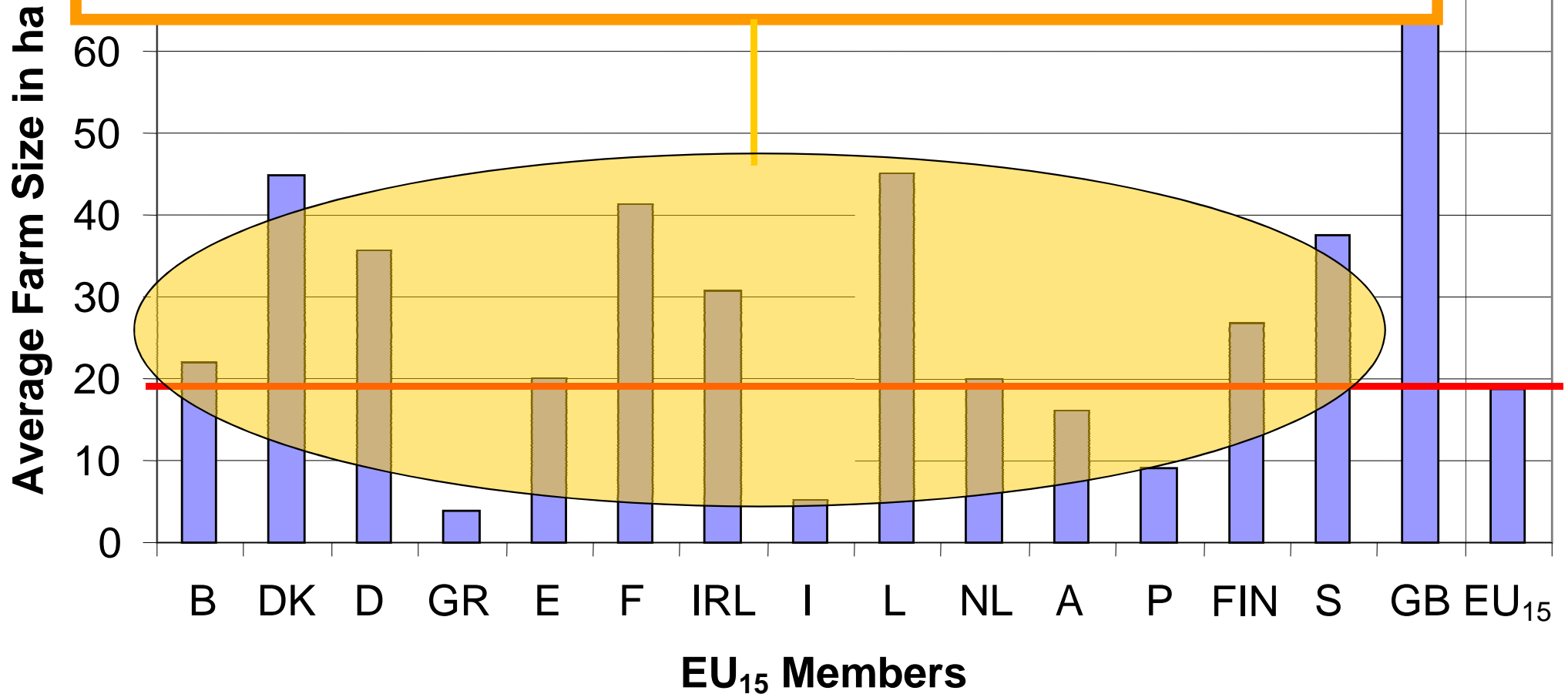
= no pressure for automation

High density population, low unemployment and high income

= pressure for automation

Improvement of Average Farm Sizes

Small-scale farming with very large farm declines !
Automation can assist structural changes (Transborder Farming) !



Parallel tracking

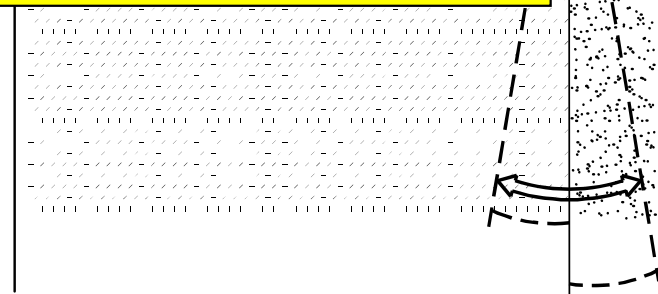
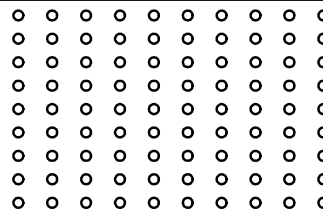
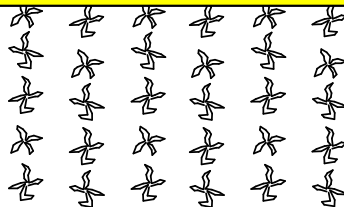
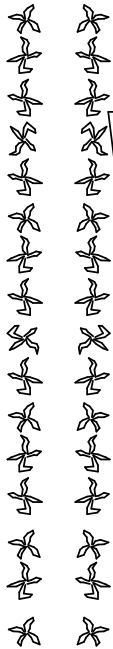
Chopper
(CLAAS)

Sugar beet harvester
(HOLMER)

Combine harvester
(CLAAS)

Yes - fully accepted by the farmer !

- usable to a wide range of applications
- simple to use (just push a button) !
- offers comfort !
- increases performance !
- increases profit (may be seen immediately) !



Cross compliance in the EU

From 2005 onwards EU agricultural policy will change !

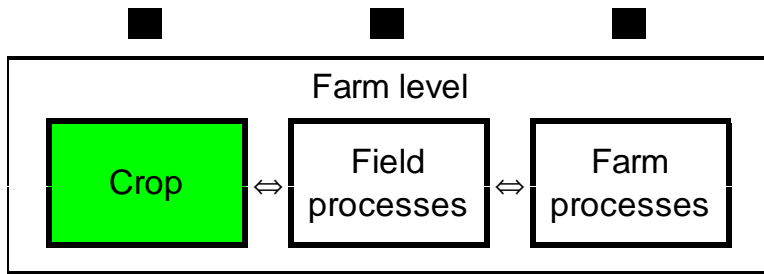
- subsidies may be given only in conjunction with documentation
- environment friendly sound measures get an extra value

These are new driving forces for “Precision Farming” with extra values

- in fertilizing
- in spraying
- in mechanical weed control

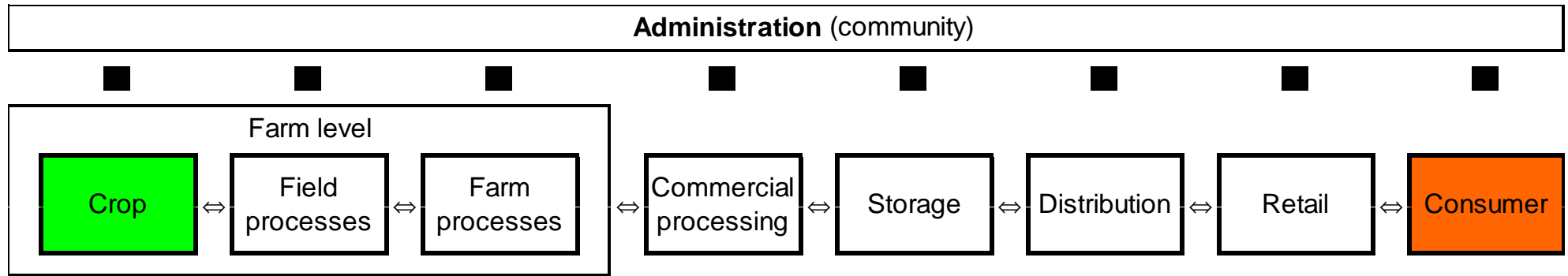
Traceability and Precision Farming

Administration (community)



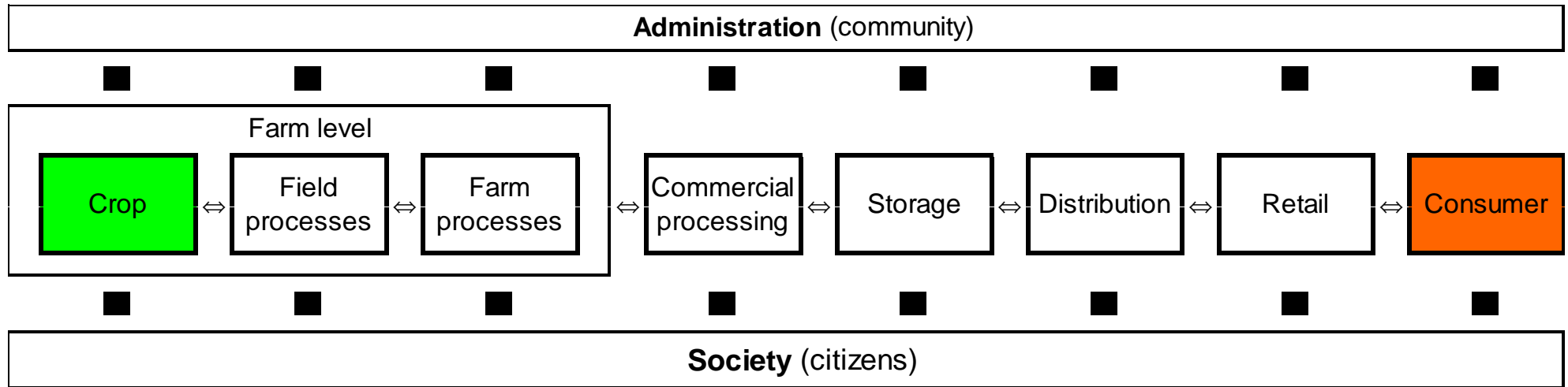
The administration is one side of the medal,

Traceability and Precision Farming



The administration is one side of the medal,
the consumer is the other !

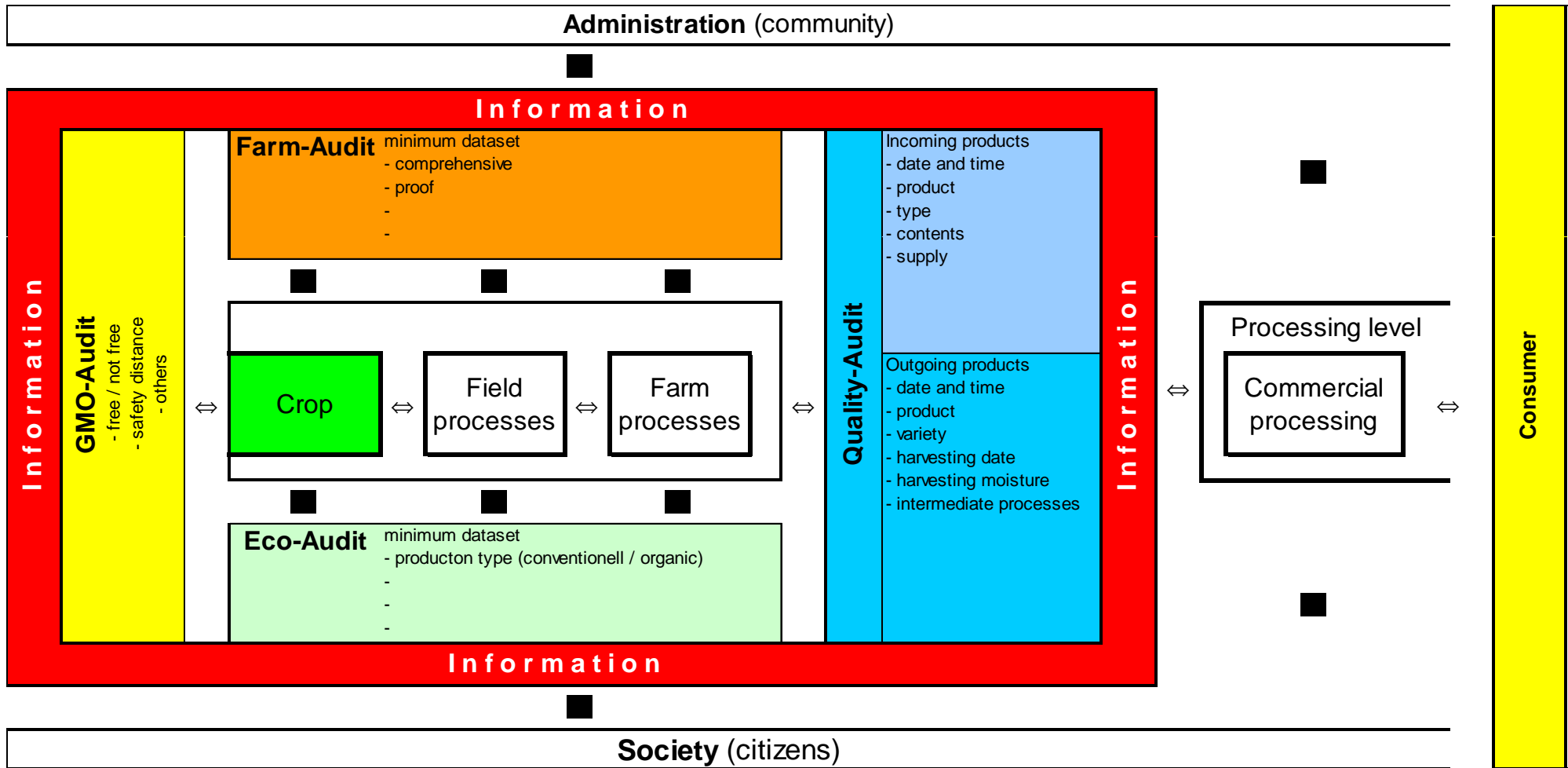
Traceability and Precision Farming



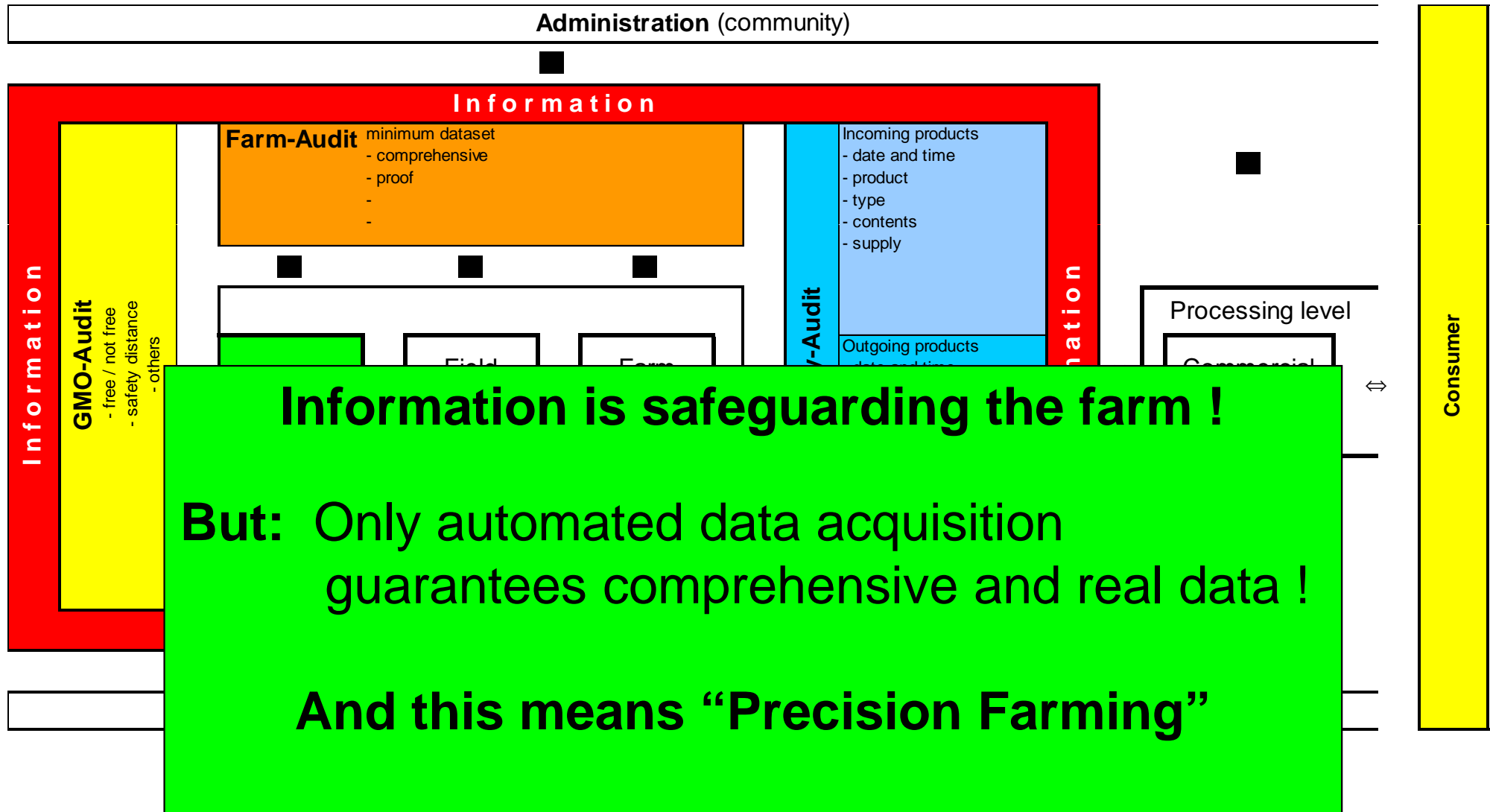
The administration is one side of the medal,
the consumer is the other !

and the Society is more and more sceptical against farming !

Self-declaration and self-explanation



Self-declaration and self-explanation



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Conclusions I

Agriculture in **Europe is highly heterogeneous.**

To a great extent, agricultural cultivation is done in **disadvantageous small structures** (about 1 ha field size).

The **structural changes** towards larger cultivation **units are rising.**

The **differences within the member** countries are increasing because of the extension of the EU.

Conclusions II

The **mechanization has reached a very high level** with various cutting edge technologies.

The trend of **self-propelled machinery** is advancing. For this, electronics is used to relieve the driver in combination with enhancements in performance and safety.

Nevertheless, the **tractor will still be the central machine** for farming.

Conclusions III

Precision **farming concentrates on high yields** using optimized nitrogen fertilization strategies.

Site specific farming will overcome the small structures by **virtual land consolidation**.

Conclusions IV

All in all, **environmental protection is the driving force** in precision farming. When having additional investments in technology, at first requirements of the society will be addressed.

The **public claims continuous documentation** which therefore defines the challenges of automation in future.