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Title:

Strategies for future mechanisation in Central Europe

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Summary:

European agriculture displays an extraordinary large diversity of farm structures and types. Independent from the present structure the creation of an international competitive and, at the same time, environmentally-friendly land management is the major challenge for agriculture in Europe.

The future development of agriculture will be less influenced by mechanical-technical advances than by organisational-technical and electronically-technical advances. Both will use the possibilities of the new information technologies and combine them with new strategies.

This development will also have consequences on interfarm cooperations. The pressure towards rationalisation and cost minimising will cause that the typical agricultural businesses predominant in Europe today will be replaced by differentiated ownership / management / servicing structures.

Strategies for future mechanisation in Central Europe

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1. Introduction

European agriculture displays an extraordinarily large diversity of farm structures and types. This ranges from the small farm - often part-time - to industrialised large enterprises. In particular, the EU accession countries Hungary, the Czech Republic and Poland demonstrate an extreme differentiation in their farm industry structure: There are on the one side, large co-operative or state farms and on the other small farms which are often beneath rentability. This explains the difficulties of a common agricultural policy and the absence of a common ideal for EU farm policy. Thus, for example, farm policy targets are identified in the agricultural report of the federal government as:

- an efficient, market-oriented and environmentally-friendly agriculture which is internationally competitive,
- which can organise itself in different legal and economic full-time and part-time forms as single or multiple-person working units,
- which can make the diverse tasks inherent in the retention and care of the bases for natural life (tending of the landscape, regenerative raw material).

Thus, independent from the sector's present structure, the creation of an international competitive and, at the same time, environmentally-friendly land management is the major challenge for agriculture in Europe.

1.1 Competitiveness

For agriculture, one of the most decisive changes is the step by step transition to the global market. This is only partially in effect because of the high production costs in many European countries. Improvement of product quality, an increase in yields and a reduction of production costs are all critical to increased efficiency.

1.1.1 Product quality improvement

The quality of food and regenerative raw material crops will in the future be decisive for entry into the market and achievable profitability. Three rudiments are necessary here.

Integrated quality management

Control of the products alone is insufficient for meeting the rising demands for quality from the trade and consumer. Now, the type and method of production, from growing to processing, are part of a comprehensive quality management process.

More added value
The proportion of agricultural production value in a retailed food product has been decreasing for years and reaches today around 35%. A starting point towards higher prices and therefore increased profitability in this aspect features new technologies and organisation forms which allow a part of the processing and marketing to be made once again within the farming sector - a process which can be followed right through to direct marketing.

New products (genetic engineering)
The classic chemistry synthesises fossil, and therefore non-regenerative, raw material. At present, chemicals to manufacture high-value items are increasingly made by genetically modified microbes in biotechnological processes. Now, however, this process is already moving a step further on and features the creation of high-value products back on the field or in the livestock housings - producing highly sophisticated chemicals or medicines with the help of genetically modified plants and animals.

1.1.2 Increasing yields
An important step towards the improvement of the economic situation of farms in Europe is, despite all discussions on reducing production intensity, the increasing of yields and livestock performance. Farms with the highest yields also achieve the highest profitability, and this applies to arable farms.

1.1.3 Reduction of production costs and investments
Whereas in the period up to 1975 the commodity prices and the prices for the agricultural inputs such as labour, buildings and machinery followed a similar development, since then the commodity prices have stagnated whilst labour, buildings and machinery costs have risen steeply. This is more serious because these inputs cause 30 to 40% of total production costs. Further, it should be noted that the machinery and building costs have a very decisive effect on the liquidity of the farm business. Through farm business rationalisation in the last decades the labour inputs have been dramatically reduced, on arable farms from 9 labour units/100 ha in 1965 to the present 1 labour unit/100 ha. At the same time, the invested capital rose from DM 50000/labour unit to DM 350000/unit.

1.2 The ecological challenge
In the future, economical arguments alone will not be enough to support agriculture in Europe. In western Europe two thirds of the population demand an "ecologicalization" of agriculture. This has considerable effects on the EU agricultural policy. Whilst nowadays the largest portion of EU spending is still devoted to product price compensation payments and market stabilisation, already in the near future the EU will be rewarding mainly efforts towards environmental and landscape-care.

1.2.1 Closed material cycles
A requirement for the closed cycling of material in agriculture is the linking of livestock systems to plant production. With the increasing specialisation of farms this is only possible by the co-operation between farms. In such cases, e.g. compensation between manure over-production in livestock units and fertiliser demand from cropping enterprises must be realised. A low-loss liquid manure management demands, however, also the

In fact the hypothesis must be set up that, independent of farm size and organisational form, large machinery would dominate whilst all the technology matched to farm structure would lose importance. Through machinery use on several farms the use of large machines can be profitable, even where the farm structure is unfavourable.

Load bearing capacity of the soil
The ground's capability, from ecological and economical points of view, of bearing the machinery is increasingly a limiting factor. Thus the axle loads often exceed the maximum value set as protection against soil compaction. This is particularly relevant in unsuitable weather conditions. Improved drive mechanisms, which may reduce compaction risk, can therefore achieve greater importance from an economic point of view it is possible to extend the working hours of this capital-intensive machines.

Logistics
A further problem is the organisation of logistics for machinery operation on more than one farm. An example of this is the planning for the sugar beet harvest with self propelled six row harvesters. The operation expenses over a given number of field work days are decisively influenced by the actual productive harvesting time. In such a case, reduced harvesting costs are only possible through a strict operational plan.

2.2 Computer-supported crop production – „Precision Farming"
For exact surveillance and control in crop production satellite positioning is intensively discussed nowadays and, in some areas, is just on the verge of commercial application.

It makes a differentiated management of zones of fields possible, without hindering the efficient working of large-capacity mechanisation (fig. 2).

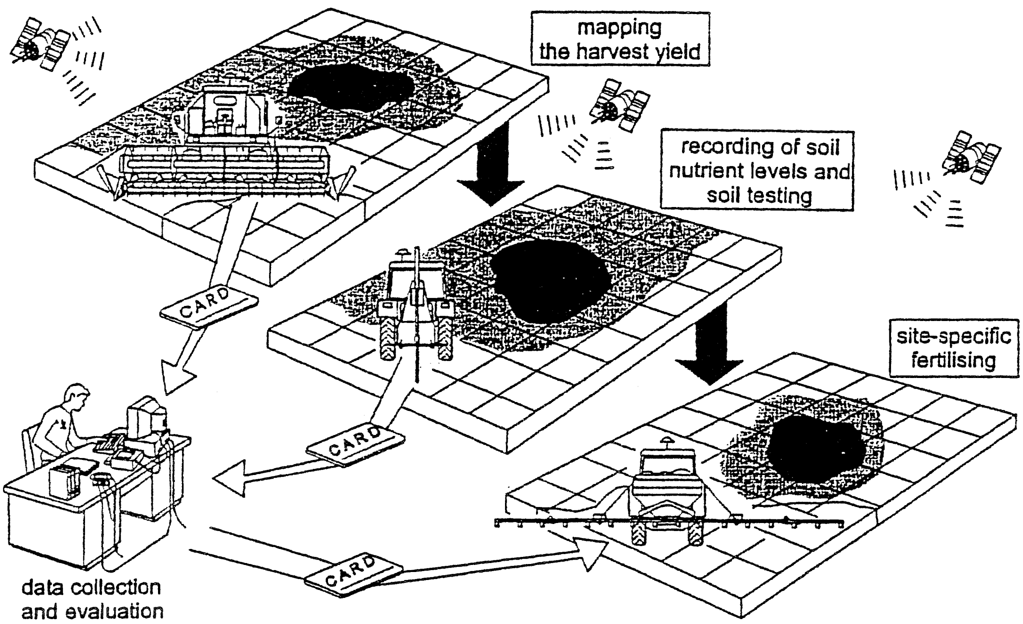

Figure 2: Site specific fertilising (Auernhammer, 1998).

reduction of all N emissions by, for example, the covering of manure tanks and the separation of liquid manure into a longer-active slow release dung and a quick-acting, liquid, manure.

1.2.2 Ecological optimisation of the energy flow

In an ecological optimisation of agricultural production not only the material flow, but also the energy flow, is of importance. The industrial society is no longer based on the utilisation of regenerative fuels. World-wide, we use in a single year the amount of energy that millions of years ago represented around 500000 years of sun energy bound or otherwise stored in carbon.

Agriculture as a whole is the only part of industry which shows a positive energy balance with a ratio of 1:1.8, and for plant production in fact 1:4.8. By the use of biomass agriculture could, therefore, secure the production of food in an energy-neutral way.

The core problem of regenerative raw material is its missing economic viability. The production of fuel from biomass goes down currently, not because of missing technology, but of the unfavourable economical infrastructure.

2. Technology's contribution

The contribution of technology towards overcoming the future challenges shall be looked into in greater depth with two examples, although in the future the development will be less influenced by mechanical-technical advances but instead

- organisational-technical advances,
- electrical-technical advances.

2.1 Organisational-technical advances in the operation of machinery

Where the technology is efficient, the lowest machine costs are usually achieved where the machine is run at full load. This applies above all to self-propelled harvesting equipment (fig.1), but also increasingly for drilling and cultivation operations.

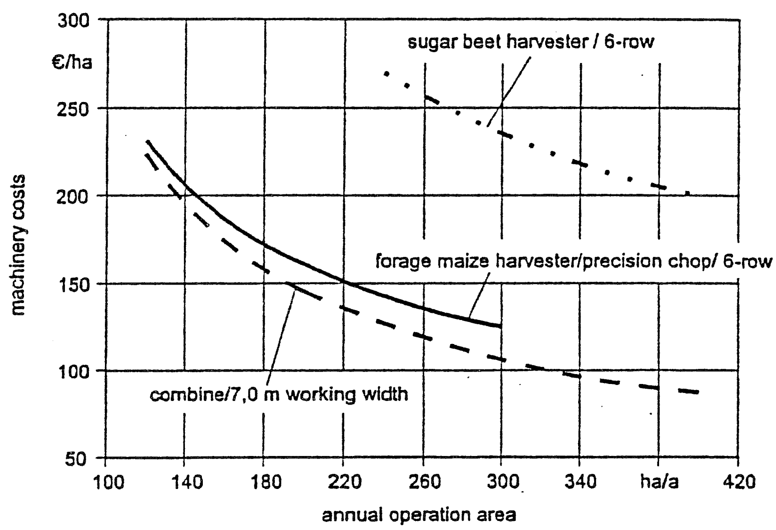

Figure 1: Machinery costs versus utilisation (KTBL, 1996/97).

Positioning
With the satellite positioning system GPS (Global Positioning System), a free of cost positioning and timing service is available for everyone although, however, with insufficient precision. For most utilisation in agriculture positioning and accuracy of ±1 m would be required. The accuracy of ±1 m can be achieved via land-supported correction systems with an investment of from DM 2000 to DM 5000. More precision, however, still requires substantially more technical and financial investment at this time.

Yield mapping
Yield measurement systems on the harvesting machines together with GPS deliver an important data base on the local yield potential. Nowadays a number of yield recording systems is available for combines ranging in price from DM 8000 to DM 12000. These can assess spatial grain yield with a mistake margin (2s) from 7% to 8% and record also the moisture content of the grain. For non-cereal grains, the required sensors are still being developed or in field tests. Transferred to yield maps over several year these information form the basis for estimating the long-term yield potential of field areas.

Spatially variable fertiliser application
These yield potentials for different areas of the field are, within the system of precision farming, a basis for spatially variable seeding, fertilising and crop management (fig. 3).

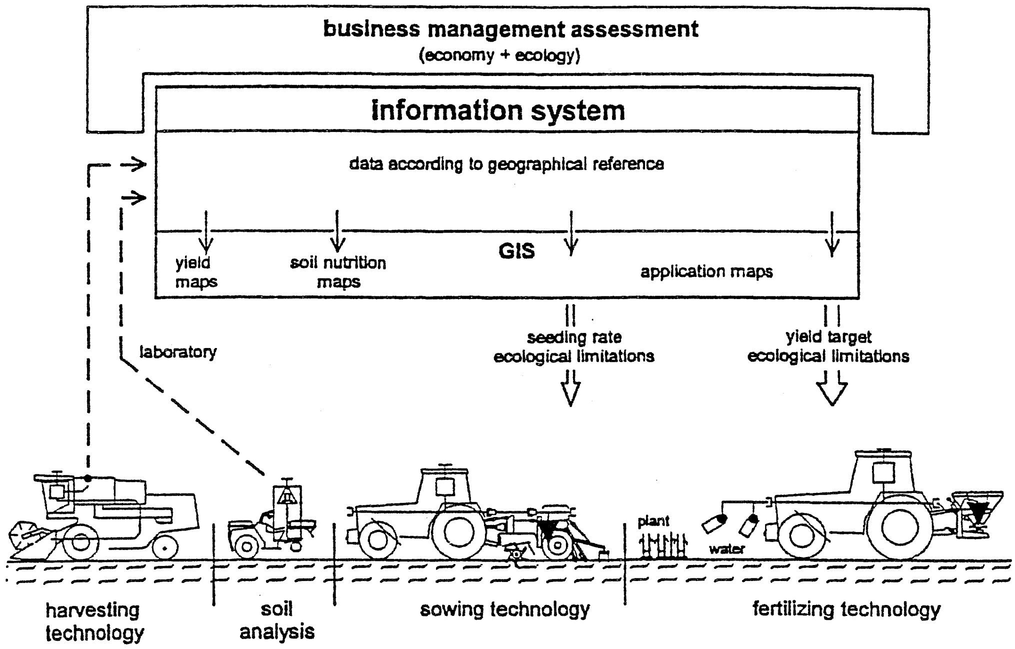

Figure 3: Research group „Information system site specific crop management" IKB- Dürnast (Auernhammer, H., 1999).

For this a comprehensive information system is required in which long-term yield potential of field areas must be linked with information on current nitrogen supply, on weather patterns, on economic viability and on the ecological restraints. At the moment suitable simulation and management programs are not available for this level of control.

Computer-supported organisation of plant production

The future aspects of computer-supported cropping apply, however, to far more than spatially variable plant production. The potential reaches from a future automatic operation of field machinery, over the documentation of production data, to computer-supported logistics and managing individually-owned fields as whole (fig. 4).

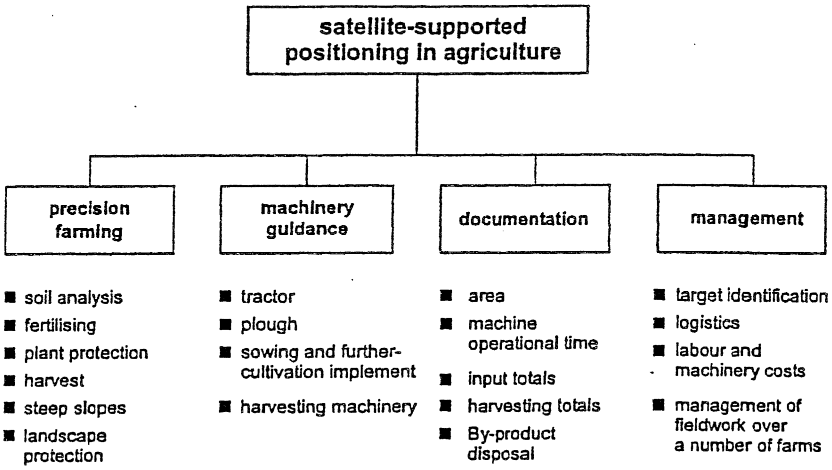

Figure 4: Application of satellite-supported positioning in agriculture.

It could also be possible, in areas of small farm infrastructure, to manage whole areas of individually-owned fields as a whole and despite this, be able to produce individual field calculations. In this way, expensive farm and land consolidation programmes could become superfluous (Auernhammer, 1998).

2.3 Computer-supported stock farming – „Precision Livestock Production"

In the case of computer-supported procedures in livestock production, even more far-reaching effects on production and business organisation should be available such as those displayed for dairy cow husbandry in figure 5.

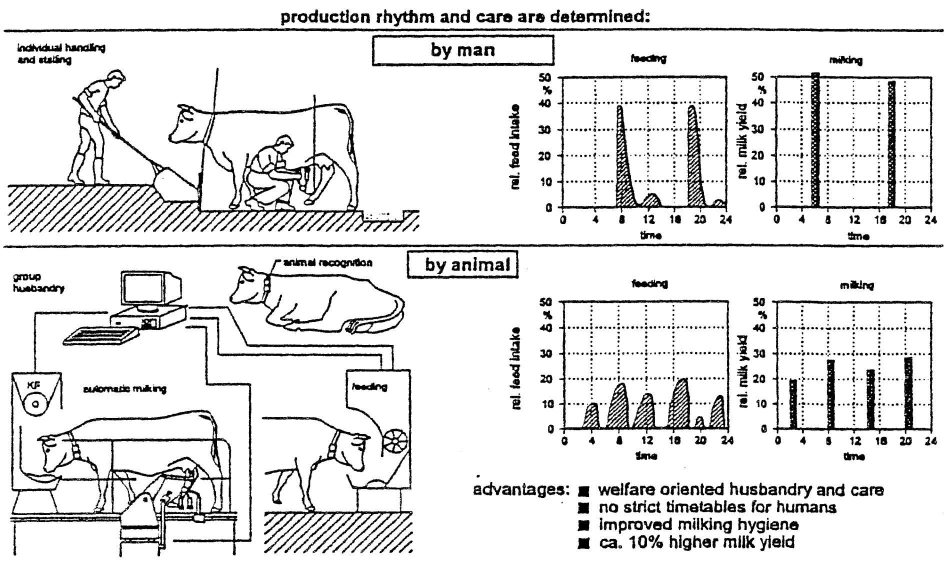

Figure 5: Species adapted dairy cow keeping by computer supported milking, feeding and animal supervision.

The decisive technical breakthrough came with electronic animal recognition and automatic milking. In this way a new phase in the development of animal welfare oriented, and more socially-acceptable, livestock husbandry systems have been made possible, a phase in which the production process is no longer steered by humans but instead by the behaviour of the animals.

This allows the development of capital-sparing natural husbandry systems and relieves the farmer from strict-timetable feeding and milking schedules. On the other hand, the demands on management and stocksmanship increase. Automatic livestock systems demand, however, a matching of herd size to milking capacity. This will significantly speed-up the structural change within agriculture. For the family business a herd size of 70 to 80 cows becomes necessary. These specialised farms will increasingly change over to let fieldwork and forage harvesting be done by organisations like contractors or machinery rings.

3. Consequences for interfarm-cooperation

These examples of economical, ecological and technical tendencies create radical changes for European farming and have far-reaching consequences for task sharing between farms.

The pressure towards rationalisation and cost minimising causes that the typical agricultural businesses predominant in Europe today will be increasingly replaced by differentiated ownership/management/servicing structures (fig. 6).

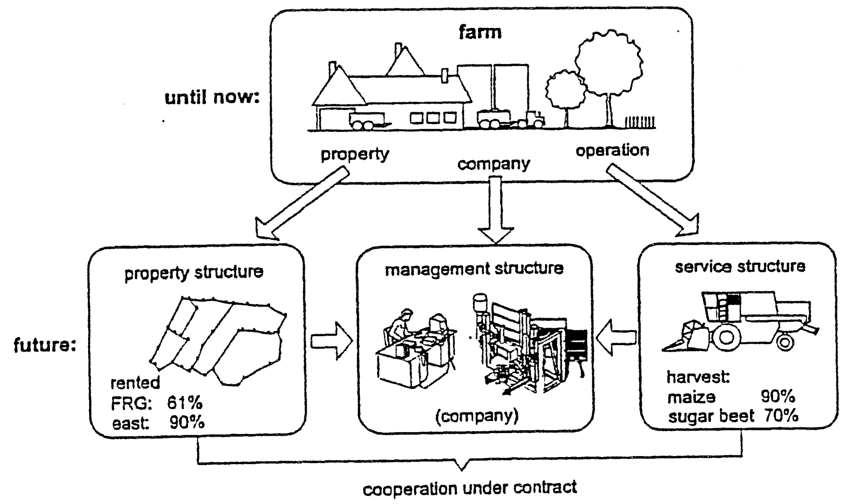

Figure 6: Change of organisational structure in agriculture.

Already today, for instance, 48% of the agricultural used land in western Germany and over 90% in eastern Germany is rented to larger business enterprises. The discussions in the past on the future infrastructure of farming - meaning ownership structure - have, because of this development, lost in importance. Far more decisive in the future will be the management qualities of the farm manager, his specialised production/technological knowledge and the available capital. At the same time, a third structure is developing, namely that of the service supplier or contractor who takes-on an abundance of tasks over many farms. Starting from the operation of large machines, such services will increasingly take over the total range of field work, including the diverse jobs in landscaping, care of municipal "green" areas, in agricultural service and in quality management.

With this, the inter-farm service industry would become the third pillar of future land management; applying just as well to part-time farms as to larger enterprises.

4. Conclusions

European agriculture displays an extraordinary large diversity of farm structures and types. Independent from the present structure the creation of an international competitive and, at the same time, environmentally-friendly land management is the major challenge for agriculture in Europe.

The future development of agriculture will be less influenced by mechanical-technical advances than by organisational-technical and electronically-technical advances. Both will use the possibilities of the new information technologies and combine them with new strategies.

This development will also have consequences on interfarm cooperations. The pressure towards rationalisation and cost minimizing will cause that the typical agricultural businesses predominant in Europe today will be replaced by differentiated ownership / management / servicing structures.

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