

Transborder farming in small-scale land use systems

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Abstract

In many regions of the world farming can be characterised as small-scale land use systems. Huge time consumption, relatively high production costs and large portions of headland reduce agricultural productivity. Virtual land consolidation may be an effective alternative with the possibility to start rapidly. By the application of information technology both economic and ecological management targets can be implemented. The first results analysed in a model calculation are encouraging. They were already realised in some pilot projects in Germany.

1. Aims of the investigations

In many regions of the world farming can be characterised as small-scale land use systems. Large portions of headlands are causing huge working time input and severe soil compaction during operation. Furthermore application of fertiliser and of plant protection products is different to the main field. The use of efficient machinery is very difficult or even impossible. New technologies cannot be used at all or only delayed. And last but not least high production costs per unit can not be balanced out through high yields.

A consolidation of farmland can lead to first improvements under these circumstances. The construction of roads for an improved infrastructure is therefore very important. Usually the field sizes can be tripled and will grow up from about 0.3 ha to somewhere around 1 ha. However relatively high costs result and the procedures are long-lasting. In addition many procedures fail because of the resistance of a minority of farmers, who fear disadvantages after the possession rearrangement or see no benefit while going out of farming and leasing their land to other farmers.

A new possibility is opened by the application of information technology. With the aid of the Global Positioning System GPS a "virtual consolidation of farmland" is implemented where ownership structures remain unchanged. Only the settlement of a common crop rotation is required. Tillage, cultivation and harvesting are organised in larger units disregarding existing boundaries (Fig. 1).

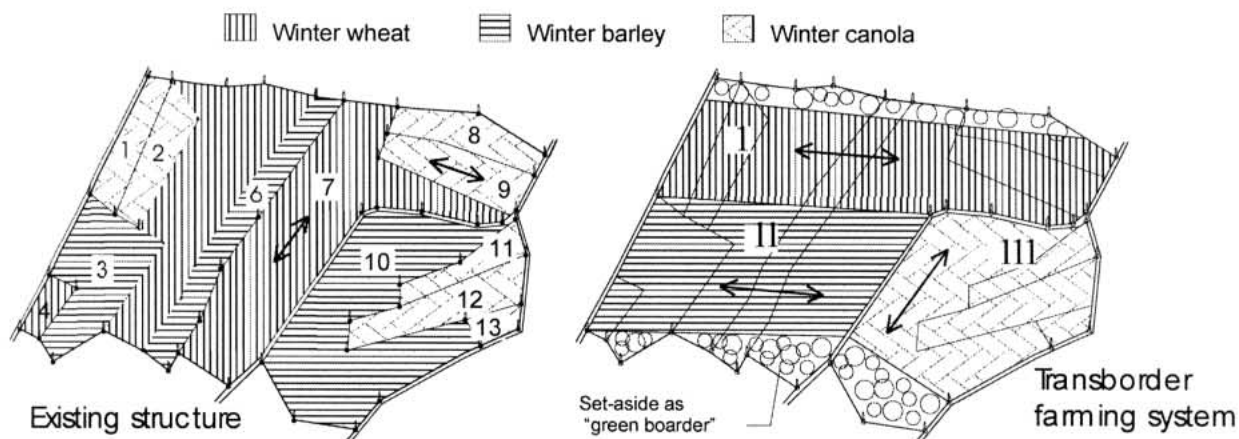


Figure 1: Virtual land consolidation

2. Methods

The realisation of transborder farming follows several successive steps:

1. *Definition of joint areas:* In a first step the farmers must agree on the common farming of an area consisting of different plots. In an ideal case all farmers from a village are integrated, in the most unfavourable case only portions of their farmland can be integrated.

2. *Safeguard of field borders*: In the next step field boundaries need to be secured in two different ways:
 - Saving the coordinates of existing field marks
 - In case of missing field marks saving the current situation is realised using GPS and/or remote images. This measure constitutes a basis to re-establish the original boundaries.
3. *Lowering field marks*: In order to reduce possible perturbations marks within the enlarged field have to be lowered. Magnetic marks are used to simplify the localisation. This way the original position can easily be restored.
4. *Settlement of a common crop rotation*: All involved farmers must agree on a common crop rotation. In case of one-crop farming for instance rise or maize there is no necessity.
5. *Definition of the management targets*: Theoretically transborder farming can be organised following purely economical or ecological targets (Fig. 2). The local conditions are diversely considering the chosen targets and differ in their economical and ecological effects (Tab. 1).

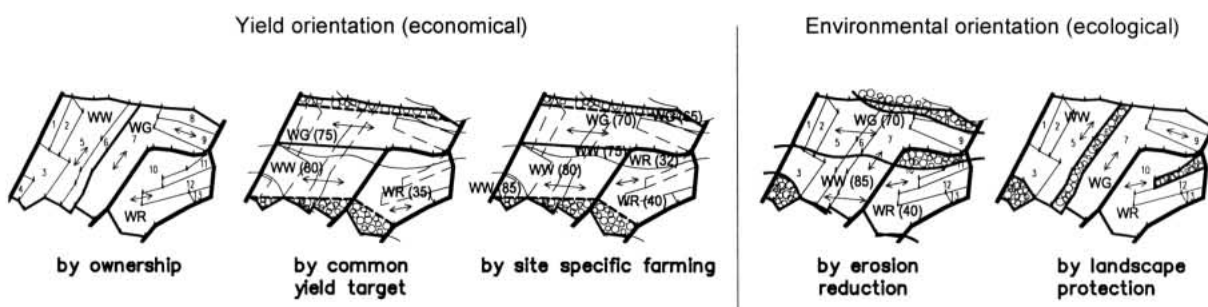


Figure 2: Management targets in transborder farming

Table 1: Management targets of transborder farming and its economical and ecological effects

	Management targets				
	Yield oriented (economical)			Environmental oriented (ecological)	
	by ownership	by common yield target	by site-specific farming	by erosion reduction	by landscape protection
	1	2	3	4	5
Definition of yield targets and application rates	Plot owner defines its yield targets and its application rates	Definition of a common yield target with common unified application rates	Management depending on information from local yields and site-specific applications	Combination of field parts regarding topographic issues across existing borders	Enlarged fields are dependent on a mainly unchanged landscape structure
Management and documentation	Recording of application rates and yields per integrated plot	Expenses and yields are settled depending on the portion of integrated land	Management and documentation with site-specific technique	All measurements are documented by ownership structures	Recording of application rates and yields per integrated plot
Economical effects	High investments with unused yield potentials	Minimum investments still with unused yield potentials	Highest investments in an optimised production process	Little investments and stable conditions	Highest investments with a low production level
Ecological effects	Only slightly changed countryside	Probably local supply problems	Local conditions are taken under strong consideration	Settlement of a maximised reduction of erosion	Social demands are taken into consideration

6. *Settlement of the farming type*: Independent from the determined targets the management can be established in three different ways:

- I) Management community: The farmers do all work by themselves. The use of the best available technique is possible within the management community just like the application of the best available specialised knowledge of a farmer and its (probably very good) technique.
- II) Machinery ring: If the performance of the available technique is not sufficient, additional technique can be organised through the machinery ring.
- III) Contractors: In areas with dominant supplementary income the equipment for larger units is generally missing. In addition machinery ring performance is no longer available. Therefore contractors with highly specialised knowledge and suitable technique can do all necessary works.

7. Completion of the used equipment with information technology: The requirements depend on the defined management targets (Tab. 2):

Table 2: Necessary technique for the different management targets of transborder farming

	Management targets				
	Yield oriented (economical)			Environmental oriented (ecological)	
	by ownership	by common yield target	by site-specific farming	by erosion reduction	by landscape protection
	1	2	3	4	5
Additional necessary technical equipment	Local yield detection	(local yield detection)	Local yield detection	Local yield detection	Local yield detection
	Process documentation	Process documentation	Process documentation	Process documentation	Process documentation
	Variable drill technique Variable fertilising technique (Variable spraying technique)	Weighing bridge	Variable drill technique Variable fertilising technique (Variable spraying technique)	Variable drill technique Variable fertilising technique (Variable spraying technique)	Variable drill technique Variable fertilising technique (Variable spraying technique)

- In all cases a mainly automated doubt free documentation has to be provided. The used technique has to be equipped with GPS, electronic communication and implement indicators.
- By establishing site-specific crop management a local yield determination and a site-specific application for seed, fertilising and plant protection must be integrated.

3. Realisation and results

So far first investigations took place at two locations in Bavaria under different conditions:

3.1 Area without field marks in the "Nürnberger Land"

In 1998 four farmers defined two joint transborder fields with 7,8 (13 plots, average plot size 0,70 ha) and 13,4 ha (27 plots, average plot size 0,52 ha). A high portion of the involved plots is rented land. Missing safety in the tenancy agreements and difficulties on legal issues about doubtless border protection led to substantial delays in the realisation.

Effects of transborder farming were analysed in a model calculation. Following operational conditions have been taken as a fundamental assumption:

- for the actual situation of self-management the operational conditions and real mechanisation have been taken into account
- necessary work in the joint transborder fields is carried out in the way of a management community
- the best available technique is taken for cultivating operations
- the yield in the new organised areas is not supposed to increase

- no price advantages with the purchase of larger means of production quantities and no higher product prices by larger uniformly produced quantities for the enlarged land units are subordinated.

According to these calculations the size of headland was reduced between 15 and 25 % and concerning work time requirement between 20 and 30 % (Fig. 3).

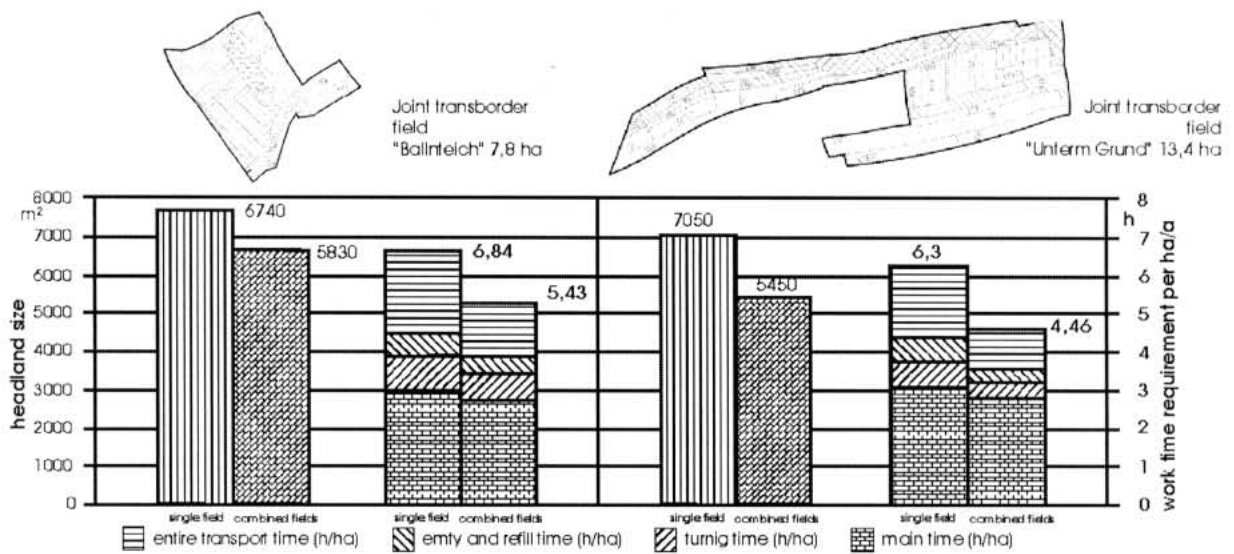


Figure 3: Headland and working time effects

For the calculation of the cultivation costs different labour costs were subordinated. In addition an increased use of the "best available technique" was considered and a reduced decreased utilisation of machines no longer used were taken into account. Possible proceeds of machinery sales were not included. In addition two theoretically joint areas from the neighbour village were calculated to consider the effects of different field sizes (Fig. 4).

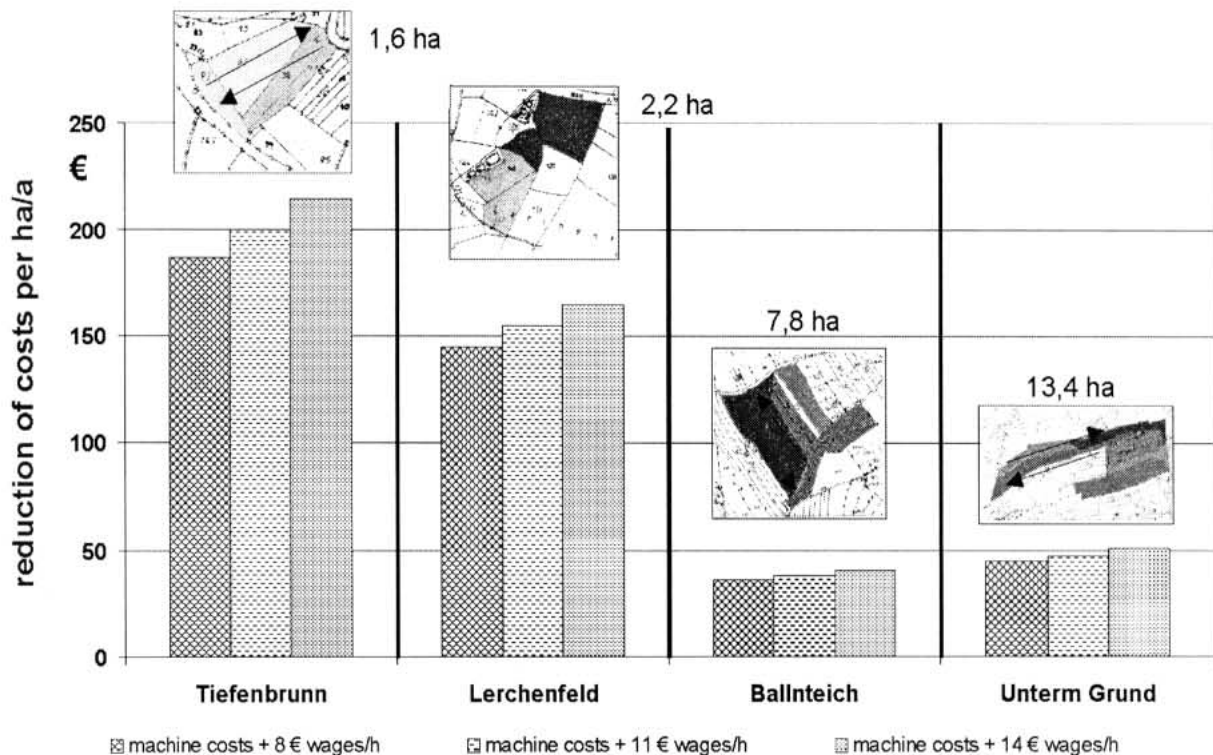


Figure 4: Reduction in operational costs

3.2 Area with field marks after consolidation of farmland in "Lower Franconia"

In the village named Zeilitzheim three joint transborder fields were created in 1999. Due to the favourable starting situation and a good infrastructure fields of approximately 8 hectares could be achieved (Fig. 5).

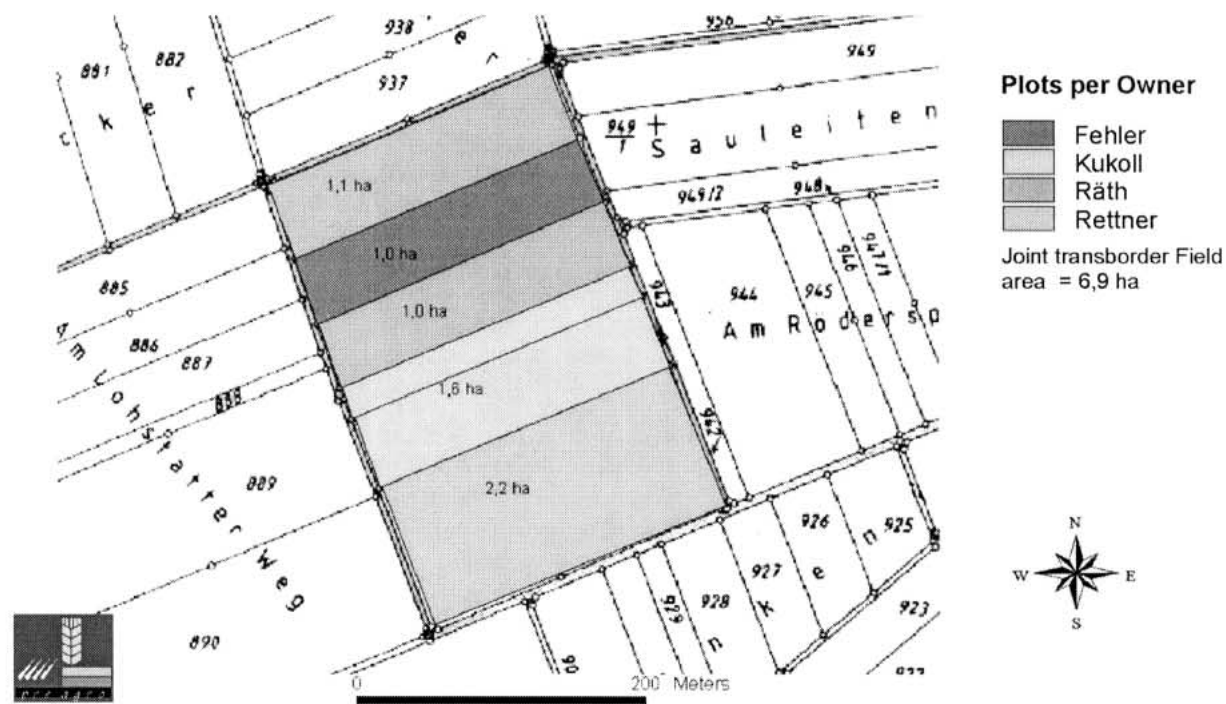


Figure 5: Joint transborder field named "Hausäcker" with sugar beets in the village of Zeilitzheim, community Kolitzheim

Beside ongoing infield measurements for this joint transborder field model analyses were also carried out. Their basic assumptions have been:

- the whole area of all joining farmers (102,5 ha with 15 different joint transborder fields) were taken into account
- crop rotation fulfils the requirements of all participants according to their needs
- best available technique was used
- attention was paid to boundary effects by under/over supply and increased yields according to the highest yield of the best farmer

Relating to the variable cross margin per ha each crop shows different effects:

- highest cost reductions are found in sugar beets, followed by winter wheat, winter barley and silage maize
- Without labour saving costs (cross margin I) between 170 €/ha and about 100 €/ha can be earned. The labour savings add another 15 % to this margins. For the total transborder farming community annual benefits of 10.430 € respectively 13.880 € will be realistic effects of the new farming operation concept.

4. Conclusions

Transborder farming opens new perspectives in the future management and in the world-wide competition to small-scaled farming areas:

- It enables an optimised use of the information technology.
- It creates larger structures for land cultivation with advantages in soil protection, work time requirement and expenses.

- The biggest chances are situated in a combination of economical and ecological management targets with the possibility of introducing Precision Farming into regions with small scale farming and realising a maximum reduction in soil erosion in the same way (Tab. 3).

Table 3: Possible steps into transborder farming

	Management targets				
	Yield orientated (economical)			Environmental orientated (ecological)	
	by ownership	by common yield target	by site-specific farming	by erosion reduction	by landscape protection
	1	2	3 + 4		5
Suitability (idealised targets)	Only an exceptional situations, if owners or landlords agree only to this way of transborder farming	Cheapest step getting into transborder farming with necessary additional fertiliser application on different plots	Reduction of heterogeneity within the joint transborder fields by taking all local conditions into account and reducing the risk of erosion !		Possible way of farming if the society requires the remaining of the existing structures

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