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New Transport and Handling Technology for Optimizing the Logistics Supply Chain during Grain Harvest

Logistics have always been a major focus in grain harvesting. Increasing farm sizes and quality management requirements force farmers to question the existing procedures and to develop new transport chains. These transport chains, partially based on HGV (heavy goods vehicle), have been analysed and assessed by using data from existing businesses.

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Keywords

Logistics, grain, transport technology

Literature

Books are marked by •

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The agricultural grain logistics are in a process of radical change. The whole agricultural sector has to face various complex claims in their entirety. The most important aspect of these changes is currently the introduction of agricultural Quality Management Systems. The uncertainty of consumers due to food scandals has been responded by the legislature and the food industry with the EU Regulation 178/2002 (traceability), the EU Regulation 852/2004 (food hygiene) the EU Regulation 183/2005 (feed hygiene) and with the introduction of trading standards like QS, GMP, GlobalGap and IFS. [1]

Another aspect is the development of more effective combine harvesters, which led to a significant increase in transport volume per time for the individual farm. At the same time concentration and centralization processes take place at the agricultural trade, which result in a reduction of capacity for unloading and handling. A few years ago the average distance to the agricultural trader was about 11 kilometres, today it has increased up to a range between 20 to 30 kilometres [2, 3]. Further there is a continuous farm growth accompanied by a reduction of the manpower per area.

Due to these miscellaneous processes the transportation of grain from the field to the agricultural trade by tractor, like it has been done until now, becomes more complicated and expensive. Supply chains based on truck applications may represent a possible solution for this problem [4, 5].

Material and method

To solve this problem eight current logistics chains have been analyzed. The first option (1) is the purchase of trucks with semi trailers (approximately 25 t payload). Loading takes place at the field edge by the combine harvester. Own drivers are necessary. The second option (2) is the leasing of trucks with semi trailers. Payment is done per kilometre with a minimum use. The third option (3) is the assignment of a haulage contractor so that no own drivers are necessary. The transport fee depends on the distance, the duration of loading and additional fees in case of delay.

The fourth option (4) is also based on the assignment of a haulage contractor but with additional semi trailers which are disposed on the field edge and can be picked up by the semi-trailer truck. The driver is independent from the combine harvester. The transportation fee is calculated by distance, transport volume and supply costs for the trailers.

The fifth option (5) uses a mobile loading auger at the field edge. During the threshing grain is delivered from the tank into a trailer, pulled by a tractor. On the field edge the grain is reloaded with the mobile auger into the semi trailer or into the truck, which is provided by the haulage contractor. The loading capacity is up to 65 tons per hour.

In the sixth option (6) the combine harvester delivers the grain into a reloading wagon which transports the grain to the trucks on the field edge. The seventh option (7) uses intermediate storage on the farm. A tractor transports the grain to a nearby intermediate storage where it is stored for a short time until a truck transports the grain to the agricultural trader.

Option number eight (8) includes semi trailers with dollies. The haulage contractor provides semi trailers on a central place. From there they will be transported with the

Table 1: Assessment of system parameters of the different procedures

Procedure	Hygiene regulations	System stop	Flexibility
Buying of trucks and semi trailer	0	0	0
Leasing of trucks	0	0	0
Haulage contractor trucks	+2	0	-1
Haulage contractor and additional semi trailer	+2	0	-1
mobile auger	+1	0	0
Reloading wagon	+1	+1	+1
Interim storage	-1	+2	+2
Dolly trailer	+1	+1	+1

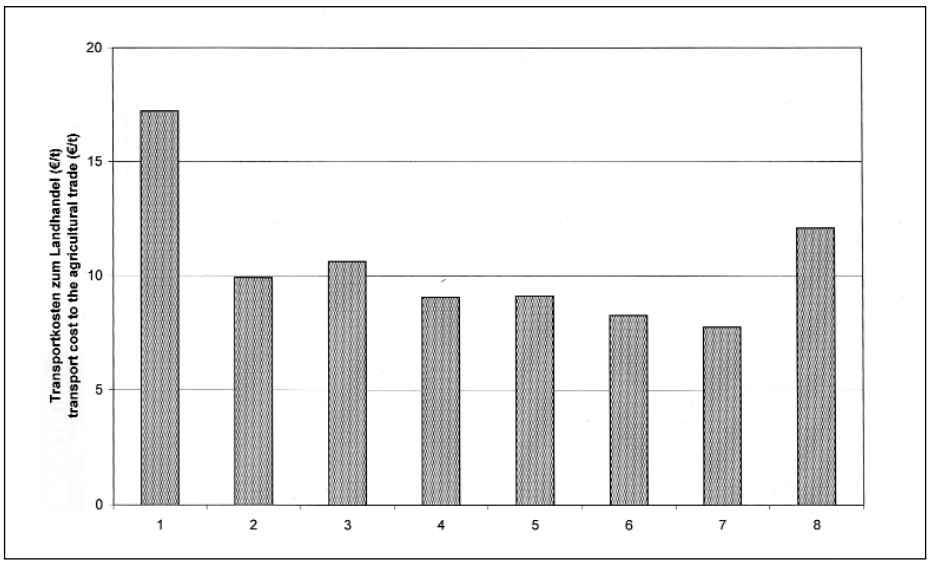

Table 1: Transport costs of the different variants

dolly and the tractor to the field, loaded by the harvester on the field edge and brought back to the central place. To make the different logistics supply chains comparable their use is analysed based on the data of a real existing farm.

The farm has a size of 400 ha on a slightly hilly terrain with an average field size of 3.4 ha and a farm-field-distance up to 25 km. The distance to the agricultural trader is about 35 km. The combine output is 30 tons per hour for winter wheat, 20 tons per hour for winter barley and 14 tons per hour for rape. If the grain is reloaded on the field edge the combine output is reduced by 25%.

Process costs

On the basis of market prices the logistics cost analysis for the different logistics chains shows the following costs (*Fig. 1*). The purchase of trucks is the most expensive method, if they are only used for the transport of grain so that the utilisation of the capacity is not provided during the whole year. The dolly trailer is, due to its investment and transportation costs, also relatively expensive.

If the trucks can drive directly to the field there is a cost reduction which cannot be balanced by the flexibility of the dolly. For the mobile auger and the reloading wagon it can be shown that the higher technology costs are profitable because of the higher flexibility and the reloading on the field. The cheapest option is the use of an intermediate storage, if the farm-field distances are short and only logistics costs are considered and not the costs for the intermediate storage.

Analysis of system parameters

Only with the analysis of the logistics costs it is not possible to give a qualified statement about the requirements for grain logistics. Key parameters are the difficulties in complying with the hygiene regulations, the danger of a breakdown of the harvesting process, caused by the logistics chain and the flexibility of the logistics chain to react on current changes such as weather modification or machinery breakdown (*Table 1*).

In general the use of reloading wagon and dolly trailer has positive effects. The intermediate storage is superior concerning the risk of a machine downtime and flexibility, but is inferior in fulfilling the hygiene guidelines. The use of a haulage contractor has very positive effects for the fulfilling of the hygiene guidelines but has a negative impact on the harvest flexibility. This is the main reason why in the last years this option was not chosen often.

Discussion

All logistics systems show a number of advantages and disadvantages under the considered aspects so that none of the systems can be seen as a universal solution.

In general practice a combination of the different systems will be chosen, because topography, farm size, field roads and farm-field-distances differ from farm to farm.

An example for a combination of procedures can be that for nearby fields an intermediate storage is used, while for more distant fields grain is directly picked up by trucks.

Another alternative is that only during peak times an intermediate storage is used. Furthermore for smaller fields a reload on the field edge is possible while for larger fields reloading wagons are rented.

These or similar combinations could be the optimum for the individual farm. The investigation shows that the use of a reloading wagon or an intermediate storage is currently the cheapest alternative. But such statements cannot be generalised, because each farm has different conditions and every farmer has other priorities in the selection of grain logistics chains.

Another aspect is the development of the relevant organisation and management structures. Many farms are not able or don't want to build the logistics chains by themselves. They need partners. Possible partners are machinery rings, contractors, contractor communities or the agricultural trade.

For the farmers the agricultural traders are currently only partners for commercialisation. To integrate them into logistic systems they must offer the single logistic aspects like transport, storage and marketing independently of each other.

But also the combination of purchase, sale and logistics is still used inadequately by the market participants. If an intermediate storage is available, the combination of grain sale and purchasing fertiliser can be mentioned. The same trucks can be used to transport the fertilizer to the farms and pick up the grain.

With this method transport costs can be reduced to less then 60 % of the costs for single transport tours and the sales profit for the farmer and the agricultural trader is optimized. To manage these logistics systems the use of professional logistics software systems with online communication and tracking is necessary. These systems guarantee also traceability after EU Regulation 178/2002.