Daniela Stoffel, Hohenheim

Providing Biomass for Biogas Plants

Providing raw materials for biogas plants is an important criterion for the economic efficiency of their operation. Therefore, different provision methods, using forage maize for silage as an example, are compared on their economic efficiency. Optimizing potential could especially be found in the transport of forage maize for silage. Farmers and biogas plant operators, planning to invest in this area, should choose their transportation equipment very carefully.

Due to the amendment of the EEG (Renewable Energy Law) in Germany and to the related payment for electricity from renewable energy resources, the number of biogas-plants in Germany has increased significantly. In consequence the acreage with maize has more than doubled since 2005. About 11.6 % of the maize acreage is used for biogas-production. In course of the rising number of biogas plants and their rising capacity, the hunger for feedstock of these plants is growing bigger and bigger.

Feedstock-needs of different biogas-plants

Table 1 one shows the need of maize silage in tons and ha for different plant sizes. The need of acreage strongly depends on the plants used and the kind of plant. Therefore in literature different information can be found. In this case we assume only maize silage as feedstock with an underlying fresh yield of 50 tons per hectare with a dry matter content of 33%. This results in a biogas-yield of 8970 m^3 and corresponds to an electrical power of 2.2 to 2.6 kW/ha.

On these basics the need of acreage ranges from 58 to 227 ha. The needed storage capacity varies between 3257 and 16214 m^3 in the silo [1].

Costs of biomass production and transportation

Table 2 shows, that harvest and storage of maize silage can have a big share within total cost of biomass production. In the following the costs for transportation in different methods for different field sizes and different yielding levels are compared. The transportation methods are based on the deployment of a 6-row 250 kW and a 6-row 300kW self propelled forage harvester respectively [3].

Thereby it can be shown that depending on the yield level not the field size is the critical parameter but that the expected yield level is determining criterion. At a low yield level the different transportation methods differ hardly in terms of full costs. Bid transport carts are not profitable until a relatively high yield level is attained and in this case, compared to a double 6-tons three-way tipper, only at big field sizes.

Transporters with too little load capacity, like a three-way tipper with 5 tons load capacity, should be regarded critically in case of harvesting silage maize.

The difference between the cheapest method, mostly 40 m^3 trailer for chopped-forage, lies between 24.26 and 77.05 €/ha. That can make a big difference with bigger fields

Table 1: Feedstock acreage required as well as needed storage capacity for different sizes of biogas plants

Power (kW)	**150**	**290**	**500**
Planted area [ha]	58 – 68	111 – 131	192 – 227
Yield [t]	2320 - 3400	4440 - 6550	7680 - 11350
Storage capacity [m^3]	3257 - 4857	6342 - 9357	10971 - 16214

1) Assuming only forage maize as input with 50 t/ha fresh yield with a dry matter content of 33%, corresponding to an electrical power of 2.2-2.6 kW/ha.

Table 2: Full costs of forage maize silage free on field, free on silo and after storing for the whole ration of a biogas plant [2]

Plant	**150 kW**	**290 kW**	**500 kW**
Free on field [ ]	44660 - 65450	85470 - 126087	147840 - 218487
Free on silo [ ]	62315 - 91324	119258 - 175933	206284 - 304861
After storaging [ ]	77720 - 113900	148740 - 219425	257280 - 380225

[1]) The calculation considers recycling of nutrients and calculation of premiums. Calculations are based on an averaged yield of 50 t fresh yield per hectare and a mean transport distance of 2-3 km. For higher distances 0.30-0.32 t•km should be added [2]

Daniela Stoffel is a scientist in the department Engineering in Plant Production at the Institute of Agricultural Engineering of Hohenheim University, Garbenstraße 9, D-70593 Stuttgart;
e-mail: *stoffeld@uni-hohenheim.de*

Keywords
Biomass production, forage maize, biogas plant

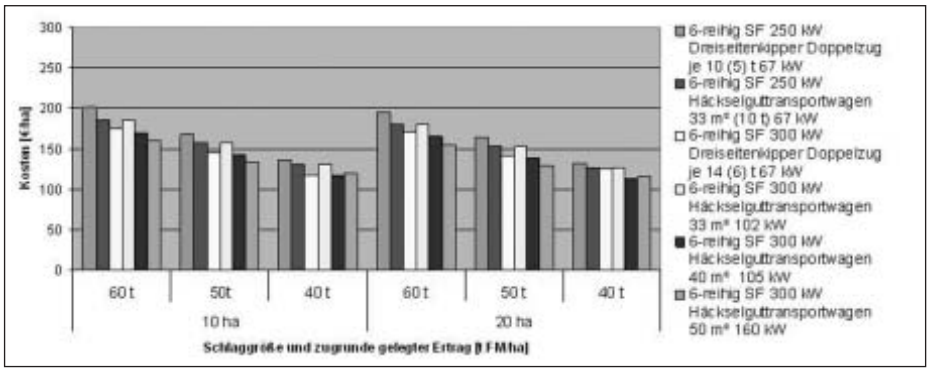

Fig. 1: Cost for different transportion methods for varying yields and an acreage of 10 and respectively 20 ha [3]

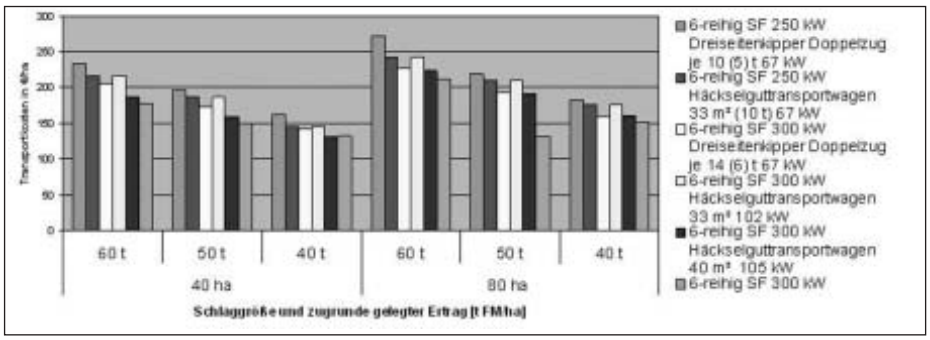

Fig. 2: Cost for different transportion methods for varying yields and an acreage of 40 and 80 ha respectively [3]

and the high biomass needs, e.g. by large biogas facilities.

The 50 m^3 trailer for chopped-forage can prove his advantage first at an expected fresh yield of 50 t/ha. Also the 33 m^3 trailer for chopped-forage does poorly in this comparison.

Transportation costs in case of the assumed biogas plants

Figure 3 shows the total costs for transportation of forage maize for the assumed biogas plants. Here the costs for the each cheapest with the most expensive method were compared at different yield levels. The calculations are based on an averaged field size of 20 ha. It can be shown that at a low yield level and less acreage the choice of a suboptimal method does not have as serious effects as on good locations with a high yield level and big field sizes.

Conclusions

In the harvest of forage maize the transportation costs can make a share of up to 55% of total costs. For optimizing transportation costs the customary yield levels should be considered. Contrary to common opinion the transporters with the biggest volume are not always the cheapest. Specialized trailers for chopped forage can be used reasonably at good locations with high yield levels and for far transport distances. At averaged and low forage maize yields and small field sizes the customary 6-tons three-way tippers can be deployed as a competitive alternative. Of course one should consider that the shown data are derived from exemplary calculations and in individual cases customary circumstances need to be involved.

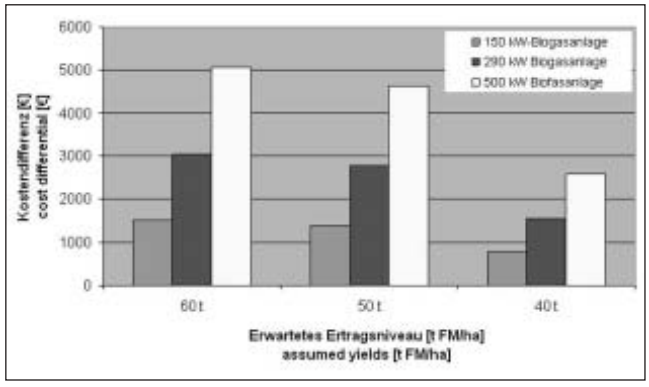

Fig. 3: Differences in transportation costs between the lowest and the most expensive variant for an assumed acreage of 20 ha

Literature

[1] *Dederer, M.*: Staatliche Biogasberatung. Wirtschaftlichkeit von Biogasanlagen unter Beachtung der Fruchtfolge, Humusbilanz und Wärmenutzung. http://www.landwirtschaft-mlr.baden-wuerttemberg.de/servlet/PB/show/1203348/Vortrag% 204-%20Dr.%20Dederer%20VLF%20Energietag%202007.pdf

[2] *Dederer, M.*: Anbau nachwachsender Rohstoffe für die energetische Biomassenutzung – Chance für die Landwirtschaft oder nur Preistreiberei. 59. Landwirtschaftliche Woche Nordhessen, 2007

[3] Kuratorium für Technik und Bauwesen in der Landwirtschaft: Betriebsplanung Landwirtschaft 2004/05

[4] www.maiskomitee.de/dmk_download/fb_fakten/dateien_pdf/flaeche_biogas_0506.pdf (24. 7. 2007)