NUTRIENT CIRCULATION

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The farming operations are divided into the following sectors:

Farm (agriculture land)

- Direct Marketing – Selling Christmas trees and fire wood

- Forest 38,00 ha
- Agriculture land 186,00 ha
  thereof crop production: winter wheat, winter barley, maize silage, clover grass, grassland

Soil condition:

- Predominantly loamy sand above gravel
- Fertilizers: Digestate, compost, mineral fertilizer only for the late fertilizing of grain crops

Farm (livestock)

- Cows 90
- Young cattle, female 85
- Fattening bulls 65
- Breeding bull 1
- Milk production 9,000 kg per cow and year

- Daily feeding - mixed rations:
  Feeding with maize silage, clover grass, hay, grain, soy flour and minerals

Biogas plant for waste, constructed in 1996

- Digesters 3 volume: 2,800 m³
- Secondary digester volume: 3,600 m³
- Digestate storage tank volume: 5,600 m³
- Biogas storage capacity volume: 3,050 m³

- CHP units: 4 with 160, 190, 380 and 380 kW electric
- Electricity fed into grid: approximately 4,5 million kWh/year

- Input materials: liquid manure from the own livestock, waste materials from food industry such as skimmed grease, food residues, fruit and vegetables waste, dairy waste and similar materials

Biogas plant for energy crops, constructed in 2006

- Digesters 2 volume: 2,800 m³
- Secondary digester volume: 2,200 m³
- Digestate storage tank volume: 5,600 m³
- Biogas storage capacity volume: 1,250 m³

- Gas cleaning and gas sale to the city of Munich: 14,0 million kWh heat per year

- CHP units: 2 with 380 and 380 kW electric
- Electricity fed into grid: approximately 3,8million kWh/year

- Input materials:
  exclusively energy crops: silo maize and grass,

Composting plant (since 1988)

- Area of 12,000 m²
- Collection tanks for leachate

- Input materials:
  - garden waste
  - leaves

- Input material for heating systems:
  - wood
  - boughs
  - shrubs

Possibilities for recycling organic waste

In my view, there are three essential uses for organic waste:

1. Wood and wood-like waste (high lignin content) for thermal utilization
2. Energy-rich organic Waste, suitable for fermentation, e.g. bio-waste container without pollution for utilization in biogas plants
3. Mixed waste, e.g. Garden waste for utilization in composting plants

I try to implement these three possibilities of exploitation in my company. In other countries, we are trying to demonstrate these possibilities too, e.g. four weeks ago in Japan.

Experience with organic fertilizer (I)

Since 1989 we apply the compost regularly on the cropland (on average 25 t per ha and year)

Since 1997 we have applied fermentation residues on the cropland and also on the grassland

- The increase in humus content resulted in an improvement of the soil fertility as well as an improved water holding capacity
- Off course, we also saved the money for mineral fertilizer
- The fertilization of the cropland is, however, more difficult since the flow of nitrogen is not as controlled as with mineral fertilizer.
- The nutrient amount of the composting plant and the biogas plant for waste are of course too much for my own farm, therefore about 75% of the nutrient go to other farms without livestock for the fertilization.

Experience with organic fertilizer (II)

Costs of delivery for the organic nutrients:

for compost	6-8 €/t
for fermentation residues	3-6 €/t depending on field removal

Major disadvantages of the organic fertilizer:

- The low nutrient content per ton of green mass
- The high application costs in relation to the mineral fertilizers
- The soil compaction due to the use of heavy transport vehicles

Experience with organic fertilizer (III)

- Basically I am of the opinion that the organic waste belongs into the cycle management of the agriculture farms in order to bring back the corresponding nutrients and humus loads into the circulation. This is especially necessary for the waste recycling plants of the biogas sector.
- Worldwide, billions of tons of organic waste are still buried in landfills and are thus lost to the agricultural sector as a nutrient.
- The global nutrient management in the fertilization of agricultural areas can be significantly improved by biogas plants.

A comment on the state extensification programs

- In my company I use the Bavarian cultural landscape program with the measure to apply organically, low-emission fertilizer.
- These programs should not hinder a reasonable application of the nutrient cycle, but support the closure of nutrient cycles.
- Programs that support the closure of the nutrient cycles also serve to save resources, because the degradation of fossil nutrients is slowed down!

Conclusion (I):

- In order to close nutrient cycles, the consequent use of organic residuals and waste materials is imperative in the field of fertilization of agricultural land. Main advantage are resource savings.
- Organic waste should be used consistently through the biogas plants!
- The technique of liquid manure treatment is becoming more and more efficient. In 2017, for example, we will be setting up an evaporation system at our plant.
- The favorable mineral fertilizers also do not contribute to the equalization of the situation.

Conclusion (II):

- In the past, the 1950’s, farming still was a diverse business and used the crap and manure as a valuable fertilizer; there were no surpluses and the nutrient cycle was closed. Meanwhile the manure is regarded as a "waste product" of the animal husbandry and this has to be changed again.

- By the inevitable specialization in livestock farms and crop production farms, there are different concentrations of nutrients in the regions.

- A remedy would be to spread the livestock concentration to greater areas, e.g. max. 2 cows/ha

- In the sector of livestock feeding, the nutrient cycles can only be closed or improved worldwide, if nutrients are consumed in the region in which the raw materials are produced, or if they are transported back.

Thank you for your attention

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