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Feeding soil microbes, animals or humans?

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Introduction

Conversion losses by grain feeding for enriching the human diet with meat and milk are frequently criticised with arguments that the animals of the rich would eat the food of the poor. With regard to organic farming, however, it has rarely been realised that the high green manure input of this production system is associated with remarkable conversion losses by soil respiration due to feeding soil microbes.

Objectives

- To compare relative C conversion losses of feeding animals and green manure application
- To show that under German conditions sufficient animal manure is available for stabilising soil carbon, additional green manure is not needed
- To substantiate that in the tropics perennials are more efficient for stabilising soil C than manure application due to a fast mineralisation

Results of literature data

Conversion losses

Feed conversion losses (kg feed required per kg animal product) for animal production ranged between 68% for milk and 90% for beef. The corresponding loss of chicken meat was 74%, of pork 77%, of eggs 78% and of fish 83%. The energy content of all feeds was adjusted to barley feed, the lower energy content of animal products as compared to barley was adjusted for milk, eggs and fish. There was no adjustment for undigested carbon in excreta.
Dry matter conversions losses of organic fertilisers (kg yield increase per kg fertiliser input) are available from long-term (≈100 years) farmyard manure (FYM) experiments in temperate climates and a 6-year alley cropping trial in the tropics of West Africa. Conversion losses ranged between 63 and 80% of external FYM inputs in the temperate zone and 89% of inputs from tree prunings that were produced within the field.

Feeding animals and the soil

In the temperate climate of Germany, green manure would not be required for maintaining a stable SOM, because grassland and fodder crops provide enough carbon input with manure and slurry (2.2 t ha^{-1} yr^{-1}) for balancing the demand of the food crop area (2.1 t ha^{-1} yr^{-1}). Since in the tropics, the decomposition of organic fertilisers is 4-times faster than in the temperate zone, even high animal densities per crop area as in Western Europe would not provide sufficient manure for stabilising soil carbon on the food crop area. Studies with tree plantations and sugar cane, however, indicated that perennials can sustain soil C. This may be explained by a higher biomass yield due to permanent light interception and by less soil cultivation because cultivation doubles the turnover of soil C relative to native soils.

Conclusions

- In the temperate zone, green manure can be completely replaced by animal manure
- In the tropics, perennials can sustain soil C and convert a larger fraction of the primary production potential into economic yield than annuals.

Keywords: Green manure, animal manure, organic farming, alley cropping, feed conversion