Sustainable use of food processing wastes livestock feed or bio-energy

Nonhebel, S.

Published in:
EPRINTS-BOOK-TITLE

Publication date:
2005

Sustainable use of food processing wastes livestock feed or bio-energy

S.Nonhebel,
Center for Energy and Environmental Studies,
University of Groningen
Nijenborgh 4, 9747 AG Groningen.
The Netherlands
s.nonhebel@fwn.rug.nl,

Introduction

The food processing industry produces large quantities of waste products. In the Netherlands the agricultural waste-streams account for two thirds of the total industrial waste-streams. Presently these waste-streams are in use as feed for livestock. In the Netherlands about 70 % of the livestock feed originates from waste-streams generated by the food processing industry. Comparable values are found on a global scale. This livestock is more or less upgrading a waste-stream from not suitable for human consumption into a highly valued food commodity (meat). This implies that residues from food processing industry form the basis for the production of important proteins in the human diet.

In principle, these residues can also be used for other non-food purposes for instance as feedstock for bio-energy production. The amount of energy that can be obtained from these residues is substantial. It is estimated that in the Netherlands potentially 190 PJ can be obtained from these residues, on a global scale values of over 12 EJ are mentioned.

However, the use of these residues as an energy source will affect the food system, since an important source for livestock feed disappears.

This paper focuses on the question: what are the consequences of using residues for energy generation instead of using them for livestock feed. It studies the adaptations required in the food system to compensate for the loss of residues. Three different systems are recognised: the present one where residues are used for livestock feed (figure 1) and energy is obtained from energy crops (wood), and two systems were residues are used for energy generation. The loss of livestock feed is compensated for by growing extra protein crops (in combination with a change to a vegetarian lifestyle (figure 2)) or by the growing of extra feed crops (figure 3).

Figure 1

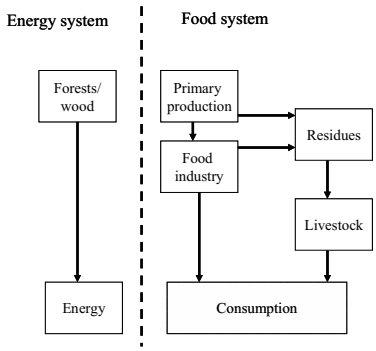


Figure 2

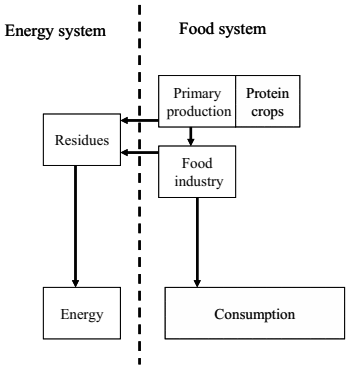
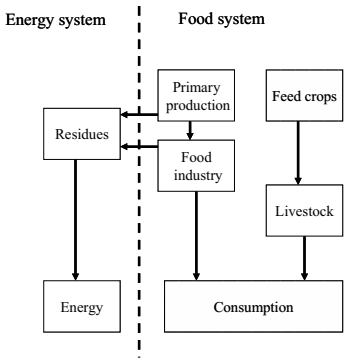


Figure 3



Figures: Schematical presentation of the three systems studied: Energy Crops system (fig 1), Vegetarian System (fig 2), Feed Crops System (fig 3)

Method

For all three systems the magnitude of the various flows is quantified through answering the following questions:

1. What is the magnitude of available residues in kg/person.
2. How much meat can be produced on basis of these residues
3. How much beans/pulses compensate for the animal protein in the menu
4. How much wheat compensates for the residues as livestock feed
5. How much energy can be gained from the residues considered
6. How much wood from biomass plantations compensates for energy in residues.
7. Finally how much acreage is needed for producing the beans, the wheat and the wood in the various systems.

Results

Table 1 shows the acreage required for the production of proteins and energy in the three systems studied. No acreage is attributed to the agricultural residues since it is assumed that they are 'unwanted' by-products of the food industry. This implies that in the Vegetarian System (fig 2) and the Feed Crops System (fig 3) no land is attributed to energy and that in the Energy Crop System (fig 1) no land is attributed to the meat production. The production of 36 kg beans in the Vegetarian System requires 120 m^2. In the Energy Crops System 80 m^2 is needed for the production of 2.2 GJ energy (121 kg wood), and the production of 120 kg wheat in the Fodder Crops System requires 170 m^2.

Table 1 Comparison of the acreage required for producing proteins {33 kg pork (on residues or 120 kg wheat as fodder) or 36 kg beans} and 2.2 GJ energy (on residues or 121 kg wood) in the three different food-energy production systems.

Energy crops (fig 1)		Vegetarian (fig 2)		Feed crops (fig 3)	
	m^2		m^2		m^2
33 kg pork	0	36 kg beans	120	120 kg wheat	170
121 kg wood	80	2.2 GJ energy	0	2.2 GJ energy	0
Total	80	Total	120	Total	170

The large differences that occur between the systems are striking. The Energy Crops System and the Fodder Crops System produce the same commodities (energy and pork) but the Fodder Crops System requires nearly 100 m^2 more to do so. The Vegetarian system also requires a larger acreage than the Energy Crops System (120 m^2). It should be noted that values mentioned concern values per person per year. 33 kg pork is over 70% of the annual meat consumption per person. And 120 m^2 seems a small amount of land but multiplying it with the number of inhabitants results is vast amounts of land needed.

Conclusion

The analysis above allows some general conclusions on use of agricultural residues for energy generation. When residues have a value as livestock feed, use of these residues as energy source results tremendous trade-offs to the food system. These trade-offs are due to the fact that loss of livestock feed need to be compensated for to maintain a healthy diet for the human population. The loss in the food system is far larger (120-170 m^2) than the gain in the energy system (80 m^2).