Farming at dairy farms (produktion på mælkelandbrug)

Process description

The present data refer to production on eight typical Danish Dairy farms in 2000, which combines dairy and (cash) crop production in a mixed farming system. Nitrogen balances for different dairy farms can be seen here. The main characteristics of the eight farms are summarized in Table 1.

Table 1: Main characteristics of the considered dairy farms.

Soil type	Loamy (clay)				Sandy			
Stocking rate	<1,4	1,4-2,3	>2,3	Organic farms	<1,4	1,4-2,3	>2,3	Organic farms
Number cows	55	55	82	62	48	67	76	84
Land area (ha)	99	50	44	88	81	65	48	99
Milk yield per cow per year	7227	7288	7053	6811	7431	7429	7125	6866
Part of cows' feed produced on farm	81%	58%	31%	70%	80%	61%	40%	68%
Winter wheat yield, ton per ha	6,7	6,8	7,8	5,9	6,5	5,5	7,9	5,0
Spring Barley yield, ton per ha	4,8	5,0	5,9	3,7	4,7	4,6	3,8	3,9

A large part of the feed for the cattle is produced on the farm as a combination of silage and grain in a crop rotation with grass clover swards. Moreover, some of the farms with lower stocking rate produce grains, rapeseed or grain legumes as cash crops. Most cows are Holstein-Friesian of high genetic potential using artificial insemination (AI). Average yearly milk yields are around 7000 kg per cow in the farms. Most cows graze in 180 days per year and thus needs conserved fodder for at least 185 days. Almost all the heifers are raised on the farm and grazed up to 200 days per year often on marginal land/permanent pasture. Bulls for fattening exist only on part of these farms mainly because of limitations on stocking rate. Most farms have stables with slatted floors (manure handled as slurry) and central milking parlors (rooms). All used water and effluents are collected in concrete slurry containers with a minimum capacity of 6 months (application to fields is only allowed from March to September). Cultivation of crops is often done using farmers own equipment while harvest of grains and silage is most often done by contractors. Equipment is usually modern and most processes automatic.

There is most often one owner and a full time hired helper, who both have a diploma and are trained in farm management. Most farmers use modern feed planning methods and regular feed analyses to adjust protein levels and minerals and all follow public regulation concerning manure N utilization and fertilization.

Data collection and treatment

Data collection:
All Danish farms are obliged to keep detailed records of purchases and sales for tax purposes and the yearly accounts are made with professional help. A representative set of these accounts, 2232, are reported by the advisors to the Danish Research Institute of Food Economics (FØI) and constitute the basic empirical input to the farm types presented here. Besides the economical data, information on the land use, livestock numbers and amounts produced are included in the data set by the advisors.
Data from other sources are used to model the technical processes: Data from the advisory services (feeding and grazing practices), the Directorate for Food, Fisheries and Agri-business, and Statistic Denmark (countrywide use of fertilizer and concentrates, partition of land use on different crops and their total yields). The Danish Institute of Agricultural Sciences (DIAS) together with FØI and Statistic Denmark is responsible for data collection.

Data treatment:
The data processing and details of the different farm types is the responsibility of DIAS and FØI. The FØI checks the account data and has divided the accounts according to the farm typology presented. DIAS to model a typical farm in terms of land use, herd size and production has used these average data from each farm type. All resource use, inputs, production and emissions is calculated using the farm level as the main unit and all the single enterprises have been described so that they fit coherently into the overall farm balances (e.g. crop production must fit the sum of homegrown feed used and exported). Thus, inputs of fertilizer, feeds and minerals are calculated to mach the livestock and cash crop production after correction for home grown feed (see also under validation).

The nutrient turnover on the farm is calculated by multiplying the physical turnover of inputs and products with N and P contents following standard procedures. Emissions of ammonia, methane and nitrous oxide (N_20) from the livestock, stables, manure storage and handling and from crop residues and soil are calculated using standard coefficients (IPCC, 2000) on the amounts of nutrients and feed dry matter (DM).

Direct energy use is determined by the use of a model that attaches diesel use to field operations following Dalgaard et al. (2000).

Technical scope

The Inventory includes all processes on the farm necessary for the cultivation and preservation of crops and home-produced fodder (e.g. soil preparation, sowing, fertilizing/manuring, plant protection, harvesting, making silage and transport of crops).
Feeding and milking of cattle and calfs, feeding of other livestock and handling of bi-products such as manure and straw, use of electricity for milk cooling, ventilation and light is also included. To some of the processes are attached imports of e.g. feeds and fertilizers.
Resource use and emissions related to the production of fertilizer, imported feeds, minerals and electricity are handled as external processes described separately.
Use of medicine is not considered and pesticide use is not includet in the first version.
Resource use and emissions related to the construction and maintenance of buildings and machinery used on the farm is not included.
Most dairy farm types produce small amounts of other items than milk and meat, e.g. bread wheat. All inputs, resource uses and emissions related to these secondary enterprises have been included in the inventory. Only technical allocations have been made between enterprises within the farm and only when resources used could be clearly divided between the enterprises. To account for the part of resource use and externalities related to e.g. meat and cash crop production on the dairy farm the method of system enlargement is recommended.

This method has been used in the Simapro database developed from this inventory to define the resource use and emissions attached to milk production per se. Systems enlargement has also been used to account for the exported manure from farm types with high stocking rate. Thus, the difference in fertilizer use and emissions on the manure receiving farm type (modeled asbefore and after manure import) has been allocated to the manure selling farm type.

Representativity

The dataset of 2239 accounts used is statistically representative of the Danish farming sector (59000 farms in total) following a method developed over several decades for yearly economical analysis of Danish farms (FØI) and for reporting to other bodies like the EU Farm Accountancy Data Network. In order to secure representativity within the established typology only farm types that could be described by at least 14 accounts from the sample were allowed for the basic products. Moreover, a given farm could be included in only one type depending on the main enterprise. The data represent only one year (2000), but the large number of farms allows for some generalizations of the input-output relationships.
The present dairy farm types are based on 8 sub samples. Together they represent all Danish dairy farms with a maximum of 10% of Gross Margin from pig production. The total milk production on these types account for 85% of the total milk produced in Denmark. The farms have been divided into groups in order to represent dairy production on sandy and loamy soil types respectively and with different stocking rates (number of standard livestock units per hectare). Two separate types represent organic dairy farms. Farms with low or medium stocking rates usually produce 1-3 secondary products, which may differ from farm to farm. The resulting farm type thus represents an average of these secondary enterprises, but the number of small enterprises is not typical for a single farm.

Included dairy farm types:

Soil type	Loamy (clay)				Sandy			
Stocking rate	<1,4	1,4-2,3	>2,3	Organic farms	<1,4	1,4-2,3	>2,3	Organic farms
Number of accounts	23	32	14	24	83	182	16	127
Pct of total Danish milk production	4	7	3	1	15	43	4	9

What do the different types represent?
There are important differences between the dairy farm types. The farms on clay soils tend to feed more imported feeds and crop residues because cash cop production is relatively more competitive than on sandy soils. The sandy soil dairy farms usually include two-year grass-clover leys in the rotation. The farms with high stocking rate sell part of their manure production. Organic farms produce most feed themselves and use no pesticides, fertilizer or imported manure. The average size of organic farms is above the average size of farms in the conventional groups.
The farm type, Sandy with 1,4-2,3 LU per ha is considered the marginal farmthat is, the farm type most likely to expand production in the future.

Validation

The representativity of the farm accounts has been checked using standard methodology at FØI. The resource use and production on the farms have been validated at two levels: Internal

coherence within each farm type and overall coherence between the sum of farm types and national level input use and production.
On the farm level the quantification of each type has been validated primarily by checking the coherence between land use, crop yields and livestock production (e.g. the feed needed for the herd matches the home-produced feed plus imported feeds less sold cash crops and the sum of homegrown feeds and sold crops fits the land use).
At a higher hierarchical level the land use has been validated by comparing the sum of each crop acreage over all types with national statistics for the same year, e.g. checking that the total wheat area and total wheat yield does not differ more than a few % from the national statistics.
Likewise, the total estimated use of inputs like diesel, fertilizer and concentrated feeds across all farm types have been checked against statistical information on national level. In case of differences that could not be ascribed to an error in a specific type, a general correction factor was multiplied into all types for the relevant input item.

Inputs and outputs

Inputs and outputs associated with production processes at eight different types of diary farms. Data are provided per farm per year.

	Soil type	Loamy (clay)				Sandy			
	Stocking rate	<1,4	1,4-2,3	>2,3	Organic farms	<1,4	1,4-2,3	>2,3	Organic farms
Products									
Bread wheat	ton	76,3	17,2	34,0	26,7	36,7	12,1	8,4	8,3
Wheat	ton	21,8	0	0	0	7,7	0	0	0
Oat	ton	2,4	0	0	0	2,0	0	0	0
Mixed crops	ton	0	0	0	0	4,3	0	0	0
Rye	ton	18,8	0	0	0	9,3	0	0	0
Rape seed	ton	8,1	1,3	0,0	0,0	6,2	1,1	0,0	0,0
Grass seed	ton	0,7	0,0	0,0	0,8	0,7	0,0	0,0	0,0
Peas	ton	6,8	0,0	0,0	2,2	2,7	0,0	0,0	0,0
Potatoes	ton	11,3	0,0	6,3	0	11,8	0,0	0,0	0,0
Sugar beet	ton	13,6	7,0	239,0	18,0	17,1	0,0	44,9	0,0
Milk-ECM	ton	399,7	397,9	575,5	424,3	355,2	499,3	538,0	583,2
Grower pig (30 kg)	ton	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Beef meat	ton	25,1	15,4	20,3	16,3	19,9	20,6	23,9	17,8
Pork meat	ton	0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Manure	ton	0,0	0,0	2,6	0,0	0,0	0,0	2,0	0,0
Materials/fuels									
Spring barley	ton	0,0	64,9	217,2	98,2	0	91,9	210,5	144,3
Soy meal	ton	59,0	70,4	336,2	0	49,2	77,2	125,3	0
Rape seed meal	ton	0	0	0	22,0	0	0	0	35,2
Lubricant Oil	liter	1463	831	720	1093	1164	1068	955	1249
Manure	kg N	602	0	0	1692	625	0	0	2002
Fertilizer , Calcium ammonium nitrate	kg N	10689	4486	2096	0	8806	6602	3580	0
Fertilizer P	kg P	1016	554	430	0	872	909	758	0
Fertilizer K	kg K	2735	872	0	0	2873	2549	534	8725
P, Mineral Feed	kg P	0	124		135	105	137	332	189

Electricity/heat									
Electricity Denmark	kWh	46190	30003	44258	39399	34929	42162	45563	55129
Heating	MJ	545	933	57	199	606	690	515	549
Traction	MJ	515111	292549	326952	384807	409783	376043	336181	439502
Emissions to air									
Methane	kg CH4	10017	9107	12097	10673	9205	12316	13640	14395
Ammonia	kg NH3	3277	2704	3796	2438	2919	3426	3733	3324
N2O	Kg N2O	942	669	619	579	866	920	817	882
Emissions to water									
Nitrate	kg NO3	29775	19978	18970	2449	30490	31112	28324	14522
Phosphate	kg P	66	73	851	6	94	113	139	39
Emissions to soil									
Carbon	kg C								
Non material emissions									
Arable land use	ha a	99	50	44	88	81	65	48	102

Location in database: Processing/agriculture/Farming on...

Administrative information

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