Standardised calculation methods for animal manure and nutrients

Standard data 1990-2008

WAGENINGEN UR
For quality of life

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Statistics Netherlands

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Explanation of symbols

.	=	data not available
*	=	provisional figure
**	=	revised provisional figure
X	=	publication prohibited (confidential figure)
-	=	nil or less than half of unit concerned
-	=	(between two figures) inclusive
0 (0,0)	=	less than half of unit concerned
niets (blank)	=	not applicable
2009–2010	=	2009 to 2010 inclusive
2009/2010	=	average of 2009 up and including 2010
2009/'10	=	crop year, financial year, school year etc. beginning in 2009 and ending in 2010
1999/'00-2009/'10	=	crop year, financial year, etc. 1999/'00 to 2009/'10 inclusive

Due to rounding, some totals may not correspond to the sum of the separate figures

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Summary

Since the early 1990s, the working group on uniformity of calculations of manure and mineral data (WUM) has been identifying standard factors for manure production and nutrient excretions per animal category. The working group was established following the need for standardised data on animal manure production that could be agreed on by both producers and data users. Since 2006, the WUM has been part of the Pollutant Release and Transfer Register (PRTR), a project in which a large number of organisations collaborate to annually gather and determine emissions of pollutants to air, water and soil.

This report provides an overview of calculation methods and starting points as applied by the working group. Following a request by the PRTR in 2009, the WUM conducted a recalculation for the 1990–2006 period. This recalculation incorporated as many new insights as possible, as well as a number of corrections. The report describes only the most current starting points for the period from 1990 up to the present day. For an overview of all the revised starting points and their effects on nitrogen and phosphate excretions, we refer to CBS (2009).

Table 1 contains an overview of nutrient excretions and Table 2 shows the amounts of manure produced. Manure production and nutrient excretions show a declining trend for the 1990–2003 period. Between 2003 and 2007, production and excretions remained virtually unchanged. Production of animal manure increased again in 2008, particularly as a result of increases in livestock numbers. However, between 1990 and 2008, total manure production decreased by 18 percent. Liquid manure production decreased by 20 percent, while solid manure increased by nearly 40 percent. In 2008, around 5 percent of manure production consisted of solid manure. Nitrogen excretions declined by 29 percent and for phosphate this was 23 percent. Calculations were conducted according to the working group method.

Table 1
Nutrient excretions from Dutch livestock

	1990		1995		2000		2005		2007		2008	
	Nitrogen (N)	Phosphate (P_2O_5)	Nitrogen (N)	Phosphate (P_2O_5)	Nitrogen (N)	Phosphate (P_2O_5)	Nitrogen (N)	Phosphate (P_2O_5)	Nitrogen (N)	Phosphate (P_2O_5)	Nitrogen (N)	Phosphate (P_2O_5)
	million kg											
Cattle, excluding fattening calves	445	118	428	115	327	97	285	88	281	86	286	90
Fattening calves	6	3	9	3	13	5	12	5	14	5	14	5
Pigs	150	69	150	60	121	48	101	42	105	43	109	45
Poultry	65	33	65	29	63	32	58	27	59	27	61	28
Sheep and goats	20	5	20	4	18	5	13	4	12	4	12	4
Fur-bearing animals and rabbits	0	0	2	2	2	1	2	1	2	1	2	1
Horses and ponies	4	1	5	2	6	2	7	3	7	3	7	3
Total livestock	691	229	680	216	549	191	479	170	480	169	491	176

Table 2
Manure production by Dutch livestock

	1990		1995		2000		2005		2007		2008	
	liquid manure	solid manure	liquid manure	solid manure	liquid manure	solid manure	liquid manure	solid manure	liquid manure	solid manure	liquid manure	solid manure
	billion kg											
Cattle, excluding fattening calves	63.3	0.8	58.2	1.0	52.6	1.1	50.1	1.1	49.1	1.0	50.8	0.9
Fattening calves	2.1	–	2.5	–	3.0	–	2.9	–	2.9	–	3.0	–
Pigs	16.4	–	16.1	–	14.1	–	11.9	–	12.0	–	12.3	–
Poultry	1.5	1.0	0.9	1.2	0.5	1.6	0.1	1.3	0.1	1.4	0.1	1.4
Sheep and goats[1)]	1.6	0.3	1.5	0.3	1.4	0.3	1.3	0.4	1.3	0.5	1.2	0.5
Fur-bearing animals and rabbits	–	0.0	–	0.1	–	0.1	–	0.1	–	0.1	–	0.1
Horses and ponies[1)]	0.2	0.3	0.3	0.4	0.3	0.5	0.4	0.6	0.4	0.5	0.4	0.6
					–	–						
Total livestock	84.9	2.5	79.5	3.0	71.9	3.6	66.6	3.5	65.7	3.5	67.8	3.5

[1)] Pasture manure from sheep, horses and ponies has been calculated as liquid manure.

1. Introduction

Following the implementation of the Dutch Fertiliser Act in 1986, several institutes began to make calculations regarding animal manure. These institutes all had their own objectives and starting points. This led to a myriad of different outcomes, which hampered a general overview of developments in the production of animal manure. To end this situation, the working group on uniformity of calculations of manure and mineral data (WUM) was set up in the early 1990s with the purpose of developing a standard method of calculation that could be used for consistently calculating annual manure production and nutrient excretion.

Soon after the WUM began its work, a number of reports were published, containing the calculation method and standard data for the 1990–1992 period. In the ensuing years, developments regarding standard factors as well as total manure and nutrient excretion were published by Statistics Netherlands (CBS) (WUM, 1994a–c; Van Eerdt, 1995–1999; Van Eerdt et al., 2003; Van Bruggen, 2003–2008; CBS, 2009).

Since its establishment, the working group has consisted of members from more or less the same institutes or their successors. The current working group consists of representatives of the following institutions: Statistics Netherlands (CBS), Dutch Ministry of Economic Affairs, Agriculture and Innovation (formerly the Dutch Ministry of Agriculture, Nature and Food Quality – Directorate Knowledge and Innovation (LNV-DKI), LEI Wageningen UR, PBL Netherlands Environmental Assessment Agency, National Institute for Public Health and the Environment (RIVM) and Livestock Research Wageningen UR.

The WUM working group has been part of the Pollutant Release and Transfer Register (PRTR) since 2006. A large number or organisations collaborate within the PRTR project, with the purpose of collection and determining the emission of polluting substances to air, water and soil. The project, thus, provides emission data to support environmental policy. In 2010, coordination of the PRTR was transferred from PBL to RIVM.

The calculation methodology assumes a certain nutrient balance per animal for which the nutrient excretion is calculated from the difference between nutrient uptake from food and nutrient fixation in animal products. The consistent calculation methodology enables comparisons between years and various animal groups. However, over the years, due to new scientific insights, parameters have been revised on a regular basis. Such new insights often also affect some or all of the calculation results from former years. In 2009, to guarantee comparability between years, the Pollutant Release and Transfer Register requested a recalculation of the 1990–2006 period (CBS, 2009). This recalculation included as many of the new insights as possible, as well as a number of corrections. Following the recalculation, this methodology report was composed, describing the starting points for the period from 1990 to the present day.

Reader
Chapter 2 presents general starting points that were applied in calculations of the production of manure and nutrients, such as definitions of standard factors and animal categories. Chapters 3 to 5 describe the starting points and standard factors for nutrient excretions per animal, for grazing animals, pigs, poultry, rabbits and fur-bearing animals. Chapter 6, finally, discusses produced manure volumes.

2. General starting points of the calculation methodology

2.1 Introduction

The working group determines annual standard data on manure production and nutrient excretions per animal. These standard data represent average factors for the Netherlands as a whole. The only exception is cattle, for which calculations differentiate between two regions on the basis of the availability of raw feed materials. Furthermore, data on manure production and nutrient excretion for individual farms may show a significant deviation from the standard data, due to differences in management and rationing. This means that the use of standard data on regionally detailed levels is not without risk.

2.2 Annual update

Standard data reflect average annual manure production and nutrient excretions per animal, for particular calendar years. Nationwide manure production and nutrient excretions are calculated on the basis of standard data and animal numbers in the agricultural census. In order to monitor annual nationwide development in manure production and nutrient excretions, standard data must be determined according to a fixed calculation method for which raw data must be collected in the same way, as much as possible.

Main standard data are updated on an annual basis. Publication of new standard data depends on the availability of raw data. In the past, large variations occurred between years. In the current system, new standard data on the preceding calendar year become available every October. Certain animal categories have little or no effect on the data on nationwide manure production or nutrient excretions and, therefore, do not require annual updating of standard data. Moreover, availability of certain data, such as on manure production per animal, may be limited.

For those who use the data, it is important that new annual standard data are made available always at the same time of year. The calculation updates and their related reports are published by Statistics Netherlands (CBS).

Final data on animal numbers in the agricultural census, generally, are made available at the end of the census year. In order to provide preliminary data on manure production and nutrient excretions for the current calendar year, standard data of the preceding year are used. However, new raw data may be included in the preliminary data if developments in already available raw data should warrant such inclusion.

2.3 Nutrient excretion factors

Nutrient excretion factors are calculated annually, for each individual substance (N, P_2O_5, K_2O), on the basis of the nutrient balance per animal:
nutrient excretion = nutrient uptake from feed - nutrient fixation in animal products.

The calculation methodology is based on Coppoolse et al. (1990). The basis of the calculation of excretion factors consists of so-called technical index numbers. These are data on feed use (concentrate feed and roughage) and animal production (milk, eggs, animal growth, and numbers of animal births). In addition, data is also required on N, P and K content in feed and animal products. A distinction is made between annually updated index numbers and those that are ‘fixed’. The index numbers to be updated annually are derived as much as possible from statistics and technical administrations of the year in question. The ‘fixed’ index numbers remain steady for a number of years, as for these index numbers no annual information is available.

On a regular basis, within the framework of manure policy, studies have been conducted on average nitrogen and phosphate excretions per animal category (Van der Hoek, 1987;

Tamminga et al., 2000, 2004 and 2009; Jongbloed and Kemme, 2005, Kemme et al., 2005a and 2005b). These studies have collected large amounts of information on fixed index numbers that subsequently have been applied by the WUM. In 2000, the WUM working group ordered a revision of the fixed index numbers for grazing animals (Heeres-van der Tol, 2001).

2.4 Manure production factors

Manure production factors indicate manure production per animal per year. Manure production per animal has been defined as the amount of manure (in kg) that is present in housing storage, and includes feed residues, cleaning water and spilled drinking water. For cattle and sheep, the amount of manure that is produced in pasture is also included. All pasture manure is counted as liquid manure. Manure production factors are occasionally revised, whenever new information becomes available.

2.5 Animal categories and numbers of animals in the agricultural census

2.5.1 Demarcation of animal categories

Standard data on manure production and nutrient excretions are calculated for all animal categories in the agricultural census, with the exception of the categories ‘other poultry’ and ‘other fur-bearing animals’. These categories may contain various animal species, which prevents the determination of technical index numbers for feed use and animal production. These categories involve only very small numbers of animals.
Standard data on horses and ponies were first determined in 2006; the year in which the manure and nutrient production of professionally kept horses and ponies was included in the Fertiliser Act. For this amendment of the law, a calculation was made of nutrient excretions from horses and ponies of various weight classes (Kemme et al., 2005b). The calculation bases in this report were applied by the WUM in determining manure and nutrient excretions. In order to avoid a trend break, nutrient excretions from horses and ponies were also calculated for previous years. As index numbers for horse and pony farms are not available for the period before 2006, this was done by multiplying factors for 2006 with animal numbers in those particular years. Manure and nutrient excretions were only calculated for the number of these animals in the agricultural census; a total of around 130,000, in recent years. The actual number of horses and ponies was estimated at between 400,000 and 500,000.

The agricultural census does not include all animal species in Dutch livestock farming. A few animal species that are being kept in very small numbers are excluded, such as deer and water buffaloes. Therefore, manure production or nutrient excretions are not calculated for these animal categories. The effect of these omissions on the total manure production and nutrient excretions, however, is negligible.

Certain animal categories in the agricultural census have been combined into one category for the calculation of manure and nutrient production, in order for them to be in better agreement with the index numbers available for feed use and animal production. For example, for cattle, the age categories of ‘12 to 24 months’ and ‘24 months and over’ were combined into one category ’12 months and over’. In addition, because there were no index numbers available for feedlot and grazing cows, their category was combined with that of sucklers. The various weight classes for pigs including possible distinctions between male and female animals were combined into one category, ‘fattening pigs’. The manure and nutrient production by piglets was included in the factor per sow, and for sheep, goats, rabbits and fur-bearing animals, factors were calculated per female parent animal, which also included the share of male and young animals. .

2.5.2 Livestock numbers

Numbers of animals in the agricultural census were assumed to equal the average number of animals present in that particular year, and thus animal housing vacancies at the time of the census were assumed to equal the average vacancy situation. However, for certain animal categories, such as sheep and goats, animal numbers at the time of the census do not represent annual averages, as in spring and summer their numbers are generally greater than in winter. This has been taken into account in the calculation of excretion factors. In years with outbreaks of certain animal diseases, numbers of animals in the agricultural census may also deviate from the average, see Subsection 2.5.3.

The agricultural census is the only annual integral animal count in the Netherlands. It represents the most accurate data on Dutch livestock numbers. In the past, some research was done into the question of whether perhaps these livestock numbers could either be underestimated or overestimated (Van Eerdt and Olsthoorn, 1991; Klinker, 2004; Hubeek and De Hoop, 2004).
The study by Van Eerdt and Olsthoorn showed that numbers of cattle and poultry were in good agreement with data from other sources. The number of pigs in the agricultural census appeared to be overestimated, though. Klinker (2004) compared poultry numbers in the agricultural census with the number of animals based on the nutrient accounting system (MINAS) for the 1998–2002 period. This showed substantial differences in animal numbers, with those in the agricultural census being structurally higher (8–10 percent). This structural difference was also seen for other animal species, albeit to a lesser degree. No clear explanation was found for these differences. However, differences in reference dates and animal categorisation were found between the agricultural census and the MINAS system. The Agricultural Economics Research Institute (LEI, part of Wageningen UR) has also reported on this difference in relation to the evaluation of the Fertiliser Act (Hubeek and De Hoop, 2004).

Poultry stocks in the 2002–2004 period, according to the agricultural census, were structurally higher than those registered by the quality system for chickens (KIP), of the Dutch Product Board for Poultry and Eggs (PPE). Data from the KIP system were used to obtain insight into poultry stock numbers around the time of the outbreak of the avian flu. In this case, measuring methods also differed, which makes it difficult to draw any conclusions. However, data on the numbers of animals that were culled and bought up indicated that animal numbers at the farms involved, according to the agricultural census were structurally higher than the actual numbers of animals culled and bought up. A possible explanation for any overestimation of poultry stocks in the agricultural census could be that, in certain cases, animal housing capacities woud be entered instead of animals present. In addition, in cases of vacancies at the time of the census, perhaps housing capacity or numbers of animals normally present during production rounds would be entered. Vacancies between production rounds are insufficiently apparent from the data, causing an overestimation of the average numbers of animals present.

In 2007, CBS conducted a study into the differences between cattle stocks in the agricultural census and those based on the I&R system (Identification and Registration of animals). The purpose of the I&R system is to limit animal disease outbreaks and to guarantee food safety. This system obliges each farmer to report any changes in livestock numbers within three days. Differences between the agricultural census and the I&R system for total cattle stocks remained limited to 0.3 percent, although larger differences were found for the various age classes (Kuipers, 2007).

2.5.3 Outbreaks of animal diseases

In 1997, 2001 and 2003, animal numbers at the time of the census were not representative of the average numbers of animals present, due to the respective outbreaks of swine fever, foot-and-mouth disease and avian flu. Factors of manure production and nutrient excretions for 1997 were adjusted in such a way that they did not represent average animals present, but animals counted in the agricultural census (Sector 4.5).
For the outbreak of foot-and-mouth disease in 2001 and the avian flu in 2003, animal numbers in the agricultural census were adjusted with data on culls, so that numbers would correspond with the average numbers of animals present. Numbers of culled cattle,

pigs, sheep and goats in 2001 were divided according to the number of foot-and-mouth outbreaks proportionally over the affected municipalities (LNV, 2001). The reduced livestock size was calculated on the basis of the number of culls and the duration of transport bans (B&A group, 2002; De Bont and Wisman, 2001).
Between March and mid-May of 2003, 25 million heads of poultry were culled and 4 million were bought up for welfare reasons. Average poultry stocks per region were estimated, based on data on numbers of animals culled and bought up, vacancy duration, and the situation following the repopulation of animal housing. Vacancy duration and the situation following repopulation were based on preliminary results from the agricultural census of 2004 and literature data (Pluimveehouderij 11-10-2003, AgriHolland 15-08-2003). Estimated average poultry stock size was validated on national level according to product data on poultry meat and eggs of 2002 and 2003.

2.5.4 Adjustments to agricultural census results

Some results from the agricultural census of 2000 up to the present day may have been adjusted since their first publication on the CBS website. For example, because of a retrospective adjustment to the boundaries of farms (except for those that manage nature areas only). Publicised animal numbers, therefore, may deviate slightly from those in Tables 2.1 to 2.4, which were taken as a basis for calculating manure and nutrient excretions. Differences in animal numbers are very small and their influence on results deemed negligible.

Table 2.1
Numbers of cattle

	Cattle on dairy farms					Cattle in meat production						
	female young stock 12 months and under	male young stock 12 months and under	female young stock 12 months and over[1]	bulls 12 months and over[1]	dairy cows	white meat calves	pink meat calves	female young stock 12 months and under	beef bulls 12 months and under	female young stock 12 months and over[1]	beef bulls 12 months and over[1]	suckler, feedlot and grazing cows
	x 1,000											
1990	753	53	880	43	1,878	602		53	255	99	190	120
1991	761	59	908	48	1,852	622		66	275	122	211	139
1992	720	54	893	48	1,775	638		61	244	128	213	146
1993	687	50	836	41	1,747	656		63	233	129	198	156
1994	687	48	803	41	1,698	690		63	227	121	192	146
1995	696	44	808	42	1,708	584	86	57	188	115	181	146
1996	703	57	805	46	1,665	577	100	56	148	97	151	146
1997	651	47	822	40	1,591	603	101	48	137	76	151	145
1998	616	42	757	36	1,611	610	101	42	115	70	138	145
1999	597	38	714	36	1,588	634	118	46	97	64	121	153
2000	563	37	699	37	1,504	637	146	41	83	62	98	163
2001[2]	553	88	666	38	1,539	557	151	43	77	61	95	160
2002	529	45	648	46	1,485	561	152	39	63	58	80	150
2003	504	31	617	31	1,478	560	172	38	60	60	64	143
2004	509	32	598	26	1,470	577	188	39	62	57	62	145
2005	500	34	590	31	1,433	625	204	43	66	58	62	151
2006	488	32	580	25	1,420	622	222	41	55	58	60	143
2007	510	32	564	24	1,413	598	262	45	55	57	59	144
2008	532	34	589	23	1,466	627	272	43	54	63	61	127

[1] In this category the age classes 12 to 24 months and 24 months and over, taken from the agricultural census, were combined into one.
[2] Including corrections for culled animals as a result of the foot-and-mouth disease crisis.

Table 2.2
Numbers of sheep, goats, horses and ponies

	Ewes[1)]	Dairy goats 12 months and over[1)]	Horses	Ponies
	x 1,000			
1990	790	37	50	20
1991	859	44	55	21
1992	876	38	62	24
1993	875	35	65	27
1994	794	38	68	29
1995	771	43	70	30
1996	785	55	73	33
1997	719	61	75	37
1998	694	71	77	37
1999	716	86	77	39
2000	680	98	79	39
2001[2)]	646	116	77	42
2002	588	143	79	42
2003	592	158	83	43
2004	612	168	85	43
2005	647	172	88	45
2006	648	177	83	44
2007	645	189	86	48
2008	583	208	93	51

[1)] Lambs, young animals and males have not been included in this table, as the calculation of their manure and nutrient excretions were included in the excretion data on female parents.
[2)] Including corrections for culled animals as a result of the foot-and-mouth disease crisis.

Table 2.3
Numbers of pigs[1)]

	Fattening pigs	Young pigs 20–50 kg	Gilts > 50 kg	Farrowing, barren and nursing sows	Young boars > 50 kg	Stud boars
	x 1,000					
1990	7,025	160	225	1,272	14	28
1991	7,041	163	233	1,273	14	27
1992	7,145	161	238	1,308	13	26
1993	7,526	158	235	1,335	13	25
1994	7,271	147	221	1,294	11	22
1995	7,124	142	215	1,287	11	21
1996	7,095	159	217	1,292	9	22
1997	7,433	156	238	1,318	19	30
1998	6,591	142	279	1,294	19	26
1999	6,774	142	202	1,171	7	32
2000	6,505	133	207	1,129	7	35
2001[2)]	6,216	128	185	1,072	7	15
2002	5,591	111	171	1,007	7	16
2003	5,367	113	176	950	5	15
2004	5,383	104	172	954	6	10
2005	5,504	104	170	946	6	17
2006	5,476	103	170	946	6	9
2007	5,559	107	178	966	4	10
2008	5,839	109	122	978	4	8

[1)] Piglet numbers were not included in this table as the calculation of their manure and nutrient excretions were included in those of the sows.
[2)] Including corrections for culled animals as a result of the foot-and-mouth disease crisis.

Table 2.4
Numbers of poultry, rabbits and fur-bearing animals

	Poultry									Rabbits and fur-bearing animals[1]		
	broilers	parent animals of broilers, 18 weeks and under	parent animals of broilers, 18 weeks and over	laying hens 18 weeks and under	laying hens 18 weeks and over	meat ducks	meat turkeys	turkeys in the production of hatching eggs 7 months and under[2]	turkeys in the production of hatching eggs 7 months and over[2]	rabbits	minks	foxes
	x 1,000											
1990	41,172	2,882	4,390	11,121	33,199	1,086	1,003	29	20	41		
1991	41,639	3,088	4,360	10,955	33,554	1,152	1,185	31	20	105	544	10
1992	46,525	3,007	4,837	11,851	33,138	1,036	1,310	30	24	105	563	8
1993	45,781	3,004	4,901	10,054	32,180	844	1,257	46	20	89	466	7
1994	43,056	3,166	4,812	10,430	30,438	756	1,253	18	24	74	476	7
1995	43,827	3,065	4,507	8,890	29,272	869	1,176	14	17	64	456	7
1996	44,142	2,688	5,032	9,785	29,794	861	1,206	27	17	61	485	7
1997	44,987	3,090	4,952	10,389	29,688	906	1,218	103	36	64	525	7
1998	48,537	3,483	5,238	10,586	30,849	970	1,462	21	18	61	566	8
1999	53,247	3,255	5,804	11,043	31,418	1,077	1,387			55	576	5
2000	50,937	3,644	5,398	11,463	32,573	958	1,544			52	585	4
2001	50,127	2,933	4,548	10,888	31,838	867	1,523			49	611	5
2002	54,660	2,554	4,949	10,186	28,703	852	1,451			50	617	5
2003[3]	39,319	2,329	3,724	6,898	20,558	655	796			45	613	4
2004	44,262	2,235	3,651	8,449	27,219	723	1,238			49	632	3
2005	44,496	2,192	3,597	10,787	31,842	1,031	1,245			48	692	5
2006	41,914	2,853	3,993	10,963	32,060	1,043	1,140			41	694	4
2007	43,352	2,809	4,260	10,040	32,299	1,134	1,232			49	803	5
2008	44,358	2,386	4,863	11,508	33,586	1,064	1,044			41	849	0

[1] Parent animals.
[2] Since 1999, turkeys in hatching egg production have been added to the numbers of meat turkeys.
[3] Including corrections for culled animals as a result of the bird flu.

3. Nutrient excretion from cattle, sheep, goats, horses and ponies

3.1 Categorisation of animals

Calculations of excretion factors for N, P and K were carried out for the following animal categories in the agricultural census:
- Female young stock of 12 months and under, in dairy and meat production;
- Male young stock of 12 months and under, on dairy farms;
- Female young stock of 12 months and over, in dairy and meat production;
- Male young stock of 12 to 24 months, on dairy farms, and stud bulls of 24 months and over;
- Dairy cows and pregnant cows;
- Suckler, feedlot and grazing cows;
- White-meat calves. Since 1995, a distinction has been made between white-meat and pink-meat calves. Up to 1994, all meat calves were considered as white-meat calves (see also Subsection 3.4.3);
- Pink-meat calves (from 1995 onwards);
- Male young stock of 12 months and under, in meat production;
- Male young stock of 12 months and over, in meat production;
- Ewes (including lambs and male animals);
- Dairy goats (including kids and bucks);
- Horses;
- Ponies.

For sheep and goats, the assumption that their numbers in the agricultural census would have equalled the average number of animals present, was incorrect. More animals are present during spring and summer than in winter, as most animals are born in the spring and animals that are not kept for breeding are removed during the grazing season. In the calculation of excretion factors per ewe and dairy goat this has been accounted for by using index numbers for numbers of lambs and kids and feed use (Subsections 3.4.6 and 3.4.7) The excretion factors for ewes and dairy goats include lambs, kids, young stock and males.

3.2 Feed use and composition

Cattle, sheep, goats, horses and ponies generally eat raw feed materials, supplemented with concentrate feed in the form of compound feed – except for cattle. Cattle are fed concentrate feed that for around 90 percent consists of compound feed and for 10 percent of raw feed materials, such as soy chaff. In addition, they are fed moist concentrate feed that consists mainly of waste products from the food industry, with a lower dry weight content than compound feed. Increasingly, specialised compound feeds are being used, such as protein-rich or low-protein feeds, low-phosphorus feeds, supplements to moist concentrate feeds or raw feed materials, separate vitamins and minerals. The concentrate feed in the tables includes raw feed materials and nutrient compounds.

For feed uptake, certain losses have been factored in: 2 percent for concentrate feeds, 3 percent for moist concentrate feeds, and 5 percent for preserved raw feeds. Therefore, feed uptake data include these losses, under the assumption that feed losses end up in manure. Losses during harvest of fodder and during grazing largely remain on the land and therefore have been left aside, as have preservation losses of ensiled products. Feed content always refers to the product as it is consumed by the animal.

Table 3.1
Feed use of grazing animals

	Cattle, sheep and goats[1]									Horses and ponies		
	roughage				concentrate feed					roughage		concentrate feed
	grass silage	grass hay	maize silage	meadow grass	standard feed[2]	protein-rich feed[2][3]	beef-bull feed	artificial milk	moist concentrate	grass hay	meadow grass	
	million kg dry weight				*million kg*				*million kg dry weight*			*million kg*
1990	4,308	380	2,471	5,362	3,339	600	349	417	441			
1991	4,616	489	2,174	5,737	3,314	598	358	425	484			
1992	4,080	393	2,150	6,421	3,470	507	371	437	454			
1993	4,540	290	2,388	5,544	3,228	536	359	448	539			
1994	4,307	360	2,684	5,036	3,259	588	353	465	487			
1995	3,851	408	2,510	5,045	3,434	730	401	416	546			
1996	3,954	339	2,325	4,929	3,434	762	343	407	414			
1997	3,588	380	2,479	4,888	3,278	656	326	413	623			
1998	4,345	240	3,206	3,604	2,959	789	321	447	523			
1999	4,147	294	2,650	4,437	2,799	689	312	460	457			
2000	4,263	393	2,790	3,794	2,864	522	304	471	601			
2001	4,090	318	2,613	4,120	2,938	442	300	444	435			
2002	3,885	168	2,850	3,940	2,968	355	287	416	435			
2003	4,697	427	2,737	3,131	2,898	399	276	418	455			
2004	4,326	374	2,875	3,307	2,908	380	248	393	402			
2005	3,778	583	2,845	3,598	2,754	324	263	425	417			
2006	3,829	321	2,992	3,743	2,713	307	266	430	418	111	121	47
2007	4,339	227	2,936	3,653	2,692	309	295	416	391	116	126	49
2008	4,715	108	3,078	3,311	2,648	690	304	436	410	125	136	53

[1] Including feed losses.
[2] Including supplement feeds and raw material for cattle feed singularly compounded.
[3] Protein-based feeds and other protein feed of intestinally digestible protein (DVE 120 and more).

3.2.1 Raw feed materials

Roughage is grown within the Netherlands and mainly consists of grass silage, hay, maize silage and meadow grass. The amounts of used grass silage and hay were derived from harvest yields and stock mutations, based on the CBS study into grassland use. From 2008 onwards, reference dates for stocks have been shifted to 31 December, and uses have since been calculated per calendar year. Up to 2008, uses were calculated from housing season to housing season. The use of maize silage was calculated from the amounts harvested (CBS), minus preservation losses. For the years up to 2006, 8 percent in preservation losses were assumed. From 2007 onwards, this has been lowered to 5 percent. For the 1990–1997 period, all harvested maize silage has been assumed to have been used as feed in the subsequent housing and grazing periods. Since 1998, uses have been corrected according to stock mutations, based on information derived from the Farm Accountancy Data Network (BIN) of the LEI Wageningen UR (*Bedrijven Informatie Net* (BIN)). From 2006 onwards, fermented maize silage has also been taken into account.

Meadow grass production was calculated on the basis of remaining feed requirements by grazers, after all other feeds consumed were subtracted. Thus, meadow grass production was calculated as a remnant category containing all inaccuracies. In order to check the plausibility of the figures on grass product use, gross grassland production data were determined and compared against annual production amounts in the Dutch handbook for dairy farmers (*Handboek Melkveehouderij*). The calculated amounts of grassland production appeared to be in reasonable keeping with values in this handbook. Gross grassland production was calculated by adding feed production losses and preservation losses to the use of grassland products. For this calculation, the difference between gross and net yields was assumed to be 20 percent, i.e. 20 percent production and preservation losses and 20 percent grazing losses.
The composition of the used silage feed was derived mainly from yield data on the preceding year.

For its calculations of standard factors for dairy cows, including their young stock, the WUM working group distinguishes two regions – south-eastern Netherlands and north-western Netherlands – as there are large differences between the feed ratios on sandy soils and peat and clay meadows. Such a distinction is not necessary for other animal categories. In the north-western region, the share of maize silage in rations is relatively small, and in the south-eastern region it is relatively large. Since 2007, the Dutch provinces of Drenthe and Zeeland have been included in the south-eastern region, based on the share of maize silage in raw feed rations. Although Drenthe and Zeeland, based on these shares, could have been included in this region also in the years preceding 2007, this was not done for recalculations over the 1990–2006 period because of a lack of standard data. On a national level, the adjusted regional division hardly affects the results The current regional division is as follows:

– Region north-west: Groningen, Friesland, Utrecht, North Holland and South Holland;
– Region south-east: Drenthe, Overijssel, Flevoland, Gelderland, Zeeland, North Brabant and Limburg.

Table 3.2 shows data on the gross roughage production. Although there are considerable fluctuations in the annual production of meadow grass and preserved grass, the table shows that since 1990 meadow grass production per hectare has been decreasing in favour of preserved grass. This was caused in part by an increase in the use of preserved grass (maize silage, grass silage and hay) during grazing periods, an increase in the housing periods for cattle, and a more limited use of autumn grass. Maize silage yields per hectare, in the 1990s, have increased from barely 12 tonnes of dry weight per hectare to between 14 and 15 tonnes.

Roughage composition was based on data from the BLGG laboratory on soil and crop research in Oosterbeek (*Bedrijfslaboratorium voor Grond- en Gewasonderzoek* (BLGG)). In this laboratory, feed and nutrient content are determined from a large number of samples of silage feeds and fresh grass. For hay, feed values were kept at a set level, as the share of hay in rations was relatively small.
Tables 3.3 and 3.4 show feed compositions. For preserved feeds, the composition in the years between 1990 and 2003 relates to harvests in each preceding year. From 2004 onwards, feed use and composition have no longer been based on financial years but on calendar years. From that year, compositions of harvested roughage have been factored in for the year of calculation. These calculations assume that the roughage consumed in the housing period from mid-October to 31 December was harvested in that same year.

Following the study into fixed N excretions (Tamminga et al., 2000), from 1999 onwards, shifts in types of farming have been taken into account, from suckler farming as a by-product of dairy farming towards specialised suckler farming which uses increasing amounts of low fertilised managed grass. The nutrient content in rations of animals kept in extensive farming systems was derived from Heeres-van der Tol (2002). For rations of animals in intensive farming systems, we used data on content from the BLGG laboratory. From 2003 onwards, the N content in low-fertilised meadow grass has been assumed to be 20 percent lower than that of regular meadow grass. The N content in grass silage from extensively managed grassland was set at 10 percent below that of regular meadow grass (Tamminga et al., 2004). Extensively managed grassland also has a lower VEM value (VEM=feed unit milk). VEM values are calculated based on the relation between VEM and N content. P content was set at the same level of that of regularly fertilised grassland.
From 2008 onwards, a lower P content has been being taken into account for grassland products from low-fertilised grassland. This correction amounts to half the correction applied for N content. Thus, the P content in grass silage from low-fertilised grassland was set at 5 percent below that of regular grass silage. For fresh grass from low-fertilised grassland, the P content was set at 10 percent below that of regular fresh grass. (Tamminga et al., 2009).

Variations in nutrient content between years were due to certain weather and growth circumstances (temperature and moisture) and to differences in fertilisation.

Table 3.2
Roughage production

	South and east Netherlands				North and west Netherlands				The Netherlands			
	grassland production[1]	of which		maize silage	grassland production[1]	of which		maize silage	grassland production[1]	of which		maize silage
		grass silage and hay	meadow grass			grass silage and hay	meadow grass			grass silage and hay	meadow grass	
	kg dry weight per hectare[2]											
1990	12,223	5,522	6,701	11,600	10,966	5,385	5,581	12,200	11,563	5,450	6,113	11,700
1991	12,577	5,201	7,376	11,700	11,417	5,436	5,981	10,600	11,966	5,325	6,641	11,600
1992	13,538	5,258	8,280	11,900	12,670	5,774	6,896	12,300	13,080	5,530	7,550	11,900
1993	13,132	5,678	7,454	12,900	11,210	5,531	5,679	11,900	12,115	5,600	6,515	12,800
1994	11,067	4,607	6,460	11,800	10,353	4,779	5,574	12,600	10,690	4,698	5,992	11,900
1995	11,136	4,652	6,484	11,400	10,613	5,016	5,597	12,300	10,860	4,844	6,016	11,500
1996	11,119	4,323	6,796	12,300	9,419	4,391	5,028	11,400	10,215	4,359	5,856	12,100
1997	11,926	5,570	6,356	15,000	10,908	5,348	5,560	15,000	11,380	5,451	5,929	15,000
1998	10,025	5,757	4,268	13,000	10,066	5,615	4,451	13,300	10,047	5,681	4,366	13,100
1999	11,433	5,368	6,065	14,900	10,053	5,121	4,932	15,000	10,681	5,233	5,448	15,000
2000	10,720	5,864	4,856	13,800	9,962	5,420	4,542	14,000	10,310	5,624	4,686	13,800
2001	10,910	5,622	5,288	14,400	10,357	5,255	5,102	14,200	10,609	5,422	5,187	14,300
2002	10,971	6,211	4,760	14,100	10,763	5,697	5,065	14,300	10,858	5,932	4,926	14,200
2003	9,248	5,531	3,717	14,300	9,160	4,973	4,187	14,700	9,200	5,228	3,972	14,400
2004	10,519	6,485	4,033	14,100	10,594	6,246	4,348	14,200	10,560	6,356	4,204	14,100
2005	11,051	6,180	4,871	14,200	10,206	5,848	4,358	14,700	10,584	5,997	4,588	14,400
2006	10,310	5,697	4,614	14,300	10,326	5,286	5,041	14,500	10,319	5,474	4,845	14,400
2007	10,812	6,428	4,384	15,000	11,056	5,829	5,227	15,000	10,924	6,153	4,771	15,000
2008	10,649	6,314	4,334	16,300	10,936	6,487	4,449	15,600	10,781	6,394	4,387	16,100

[1] Gross production, including losses from grazing and conservation.
[2] Calculated grassland production for consumption by cattle, sheep and goats, according to the agricultural census. From 2006 onwards also including consumption by horses and ponies.

Table 3.3
Nutrient content in roughage for cattle, sheep and goats

	Period	Grass silage and hay						Meadow grass						Maize silage		
		standard fertilisation			low fertilisation[1]			standard fertilisation			low fertilisation[2]			N	P	K
		N	P	K	N	P	K	N	P	K	N	P	K			
		g/kg dry weight														
1990	year	30.4	3.6	28.2				42.9	4.3	35.9				13.8	2.5	14.9
1991	year	31.7	3.9	32.0				42.1	3.9	38.0				13.1	2.5	14.9
1992	year	30.2	3.7	32.1				40.3	4.0	35.8				13.1	1.7	14.1
1993	year	31.2	3.9	33.0				41.1	4.5	39.8				13.3	1.9	12.5
1994	year	33.4	4.1	37.8				41.4	4.2	37.7				12.6	2.1	13.0
1995	year	31.4	4.0	34.5				41.3	4.0	36.7				13.1	1.9	14.2
1996	year	30.4	3.7	33.5				44.5	3.6	38.0				12.8	1.8	14.2
1997	year	35.1	3.6	36.1				42.8	4.2	37.3				12.6	1.9	13.0
1998	year	33.2	4.1	35.9				41.6	4.3	37.6				11.8	1.8	12.7
1999	year	31.6	4.3	35.6	27.6	4.1	34.1	36.0	4.3	36.9	33.6	4.2	35.4	12.2	1.9	12.2
2000	year	31.3	4.0	32.6	27.5	3.9	32.8	37.1	4.5	37.0	34.2	4.3	35.5	12.2	2.0	12.0
2001	year	31.4	4.4	34.8	27.5	4.1	33.8	36.6	4.3	35.9	34.0	4.2	34.9	12.6	2.1	11.2
2002	year	29.9	4.0	32.6	26.9	3.9	32.8	36.2	4.4	37.2	33.8	4.3	35.6	12.6	2.1	12.1
2003	year	29.1	4.2	34.2	26.4	4.2	34.2	36.0	4.1	36.2	28.8	4.1	36.2	13.1	2.1	12.5
2004	housing period	28.5	3.9	33.4	25.6	3.9	33.4							12.4	1.9	11.8
2004	grazing period	27.7	3.8	32.7				33.0	4.1	35.1	26.4	4.1	35.1	12.5	1.9	11.8
2005	housing period	28.8	3.9	33.6	25.7	3.9	33.6							12.2	2.0	11.9
2005	grazing period	29.6	4.0	34.0				33.3	4.2	36.0	26.6	4.2	36.0	12.2	2.0	11.8
2006	housing period	28.4	3.9	32.9	25.4	3.9	32.9							12.5	2.1	12.0
2006	grazing period	27.8	3.9	33.3				32.0	4.1	36.0	25.6	4.1	36.0	12.0	2.0	12.0
2007	housing period	28.9	3.9	33.1	25.9	3.9	33.1							12.7	2.2	11.6
2007	grazing period	29.5	3.9	33.1				30.6	4.1	34.0	24.4	4.1	34.0	13.3	2.2	12.0
2008	housing period	28.0	4.1	33.0	25.1	3.8	32.7							11.9	2.1	11.0
2008	grazing period	28.0	4.0	33.0				32.3	4.3	35.0	25.9	3.9	35.0	11.7	2.1	11.0

[1] Since 1999 applied for suckler, feedlot and grazing cows, and since 2004 for sheep.
[2] Since 1999 applied for suckler, feedlot and grazing cows. Since 2003 for female young stock of 12 months and over, and since 2004 for sheep.

Table 3.4
Nutrient content in roughage for horses and ponies

	Average quality hay			Good quality hay			Grass seed straw			Meadow grass		
	N	P	K	N	P	K	N	P	K	N	P	K
	g/kg dry weight											
2006	19.2	3.0	25.0	25.6	3.0	25.0	13.3	1.6	18.9	29.1	4.1	30.9
2007	17.0	4.2	34.1	25.7	4.2	34.1	11.2	1.7	18.4	29.1	4.1	30.4
2008	15.2	2.7	18.5	20.1	2.9	19.3	11.2	1.7	18.4	29.1	4.1	30.4

3.2.2 Concentrate feeds

The term 'concentrate feed' refers to compound feed, raw feed materials, moist concentrate feeds, and artificial milk (powder). To date, data on the availability of concentrate feeds only exist on national level.

1990–1998
Calculations of concentrate feed use by cattle were based on data from the annual statistics on feeds (LEI-DLO). These annual statistics provide an overview per financial year of the total available resources for compound feed production and raw feeds. The share of beef bull feeds and protein-rich feeds was calculated according to the share of these feeds in products sold by cooperative firms that were members of De Schothorst, the Dutch foundation for livestock feeds (*Stichting CLO-instituut De Schothorst*. These cooperations produce around 50 percent of the compound feed. Average nutrient content in compound feeds for cattle, including raw feed materials, were calculated from the amount of base ingredients from which compound feeds are made and the nutrient content per base ingredient.
The nutrient content in these base ingredients was derived from tables on livestock feeds by the CVB (part of the Dutch Product Board Animal Feed). The composition of cattle compound feed was separated into standard feed and protein-rich feed for dairy cattle and beef bull feed, by calibration based on product sales and results from analyses of these compound feeds. The use of phosphorus-rich nutrient mixtures has been taken into account in data from 1993 onwards.

In the course of the 1990s, data on available concentrate feeds became less reliable, partly due to a decline in quality of CBS data on international trade. In its statistics, the CBS registers international trade with countries outside Europe, but provides less detail on trade within Europe. Since the abolishment of the EU inner borders, on 1 January 1993, the CBS switched from full observation based on customs documentation, to a system of sample surveys. Therefore, data on export of (imported) base materials to EU countries may be underestimated, which would cause an overestimation of nationally available base ingredients for concentrate feeds. An important indication of this situation is the fact that amounts of available base materials were found to have increased (between 1999 and 2001), while animal numbers declined. As a result of the decline in animal numbers, annual use of compound feeds has also declined (compound feed survey PDV). If this were to be explained by the presumption that differences between available base materials and amounts of compound feed are consumed in raw feed, this would lead to an unlikely large amount of raw feed materials.

1999 – the present
From 1999 onwards, it was decided that data on the composition of compound feeds would no longer be based on available amounts of concentrate feeds, but on the composition of compound feeds used by livestock farms, which - due to the nutrient accounting system (MINAS) – must document the application of nutrients. Since 1998, feed suppliers must report to the Dutch National Service for the Implementation of Regulations (*Dienst Regelingen*) of the Ministry of Agriculture, on the annual amounts and composition of compound feeds delivered to these livestock farms. Up to 2003, the calibration method for separating compound feeds was applied. After 2003, this was no longer possible, due to the lack of standard data, such as from compound feed surveys,

detailed overviews from the cooperations that produce compound feed, and analyses of the various types of compound feeds. When using data on feed supplies, the supply of P-rich nutrient mixtures to dairy cows no longer has to be taken into account, separately. These feed data currently are included in data on feed supplies.

Since 2006, compound feed suppliers are no longer obliged to report to the *Dienst Regelingen* on deliveries of compound feeds for grazing animals. Therefore, calculated nutrient uptake for the cattle categories can no longer be calibrated on the basis of registered feed deliveries. In 2006 and 2007, the nutrient uptake per animal category in dairy farming was calculated from estimations on use in relation to total cattle compound feed production, whereas feed composition was calculated according to feed value prices from Livestock Research Wageningen UR.
In 2008, data became available from LEI on compound feed sales in terms of amounts of intestinally digestible protein (DVE). These data were subsequently grouped according to DVE classes that would be in keeping with the categorisation used in feed value pricing to determine nutrient content. For rations of beef cattle categories, fixed amounts of starter feed and finishing feed were used. The composition of starter and finishing feeds is occasionally obtained from a number of compound feed producers. .

Data on the use of raw feed materials, since 2002, have been obtained from the BIN database (*Bedrijven Informatienet*) of the LEI Wageningen UR.

Sales of moist concentrate feeds are mapped annually by the OPNV (discussion group of moist livestock feed producers '*Overleggroep Producenten Natte Veevoeders'* (OPNV)). Since 2004, in the composition of moist concentrate feeds, a distinction has been made between the moist concentrate feed for calves in pink-meat production and beef bulls, and moist concentrate feed for other cattle (Kemme et al., 2005a). Kemme et al. determined that calves in pink-meat production and beef bulls receive by-products with on average a lower nutrient content. This means that dairy cows receive by-products with on average a higher nutrient content. For data on sales of moist concentrate feeds for cattle, a certain amount of losses from preservation have been taken into account (CBS, 2009 p.8).

The composition of compound feeds and moist concentrate feeds is shown in Tables 3.5 to 3.7. The composition of milk and artificial milk is presented in Table 3.9.

Table 3.5
Nutrient content in concentrate feeds for dairy and breeding cattle[1)]

	Protein-rich concentrate feed[2)]			Standard concentrate feed[2)]			Moist concentrate feed[2)]		
	N	P	K	N	P	K	N	P	K
	g/kg						*g/kg dry weight*		
1990	38.4	6.5	14.4	26.2	4.8	14.4	28.5	2.8	8.0
1991	39.1	6.5	15.4	27.2	4.8	15.4	27.5	3.0	8.4
1992	41.4	6.8	15.4	27.8	4.8	15.4	26.9	3.6	9.7
1993	42.3	6.8	15.9	28.5	4.9	15.9	22.7	3.3	13.2
1994	43.5	6.5	17.8	27.1	4.9	15.2	26.2	3.1	9.4
1995	44.2	6.2	17.1	29.4	5.1	15.0	21.5	3.0	10.9
1996	39.5	5.6	16.7	28.2	4.7	14.8	25.1	3.7	8.4
1997	37.7	6.0	16.8	26.6	4.7	14.0	20.4	2.8	9.4
1998	36.5	5.5	16.4	27.4	4.5	13.6	23.0	3.3	9.2
1999	35.7	5.3	15.1	28.1	4.9	12.8	22.9	3.3	6.6
2000	36.2	5.8	15.4	28.2	5.0	12.9	20.8	3.1	10.7
2001	36.4	5.4	16.3	27.0	4.8	12.9	23.5	3.7	7.1
2002	39.6	5.6	17.4	27.8	4.9	14.6	21.7	3.4	8.4
2003	38.4	5.7	17.0	27.9	4.9	14.5	21.3	3.1	8.4
2004	38.7	5.7	15.8	28.3	4.9	14.2	23.0	3.0	9.0
2005	38.9	6.0	16.3	28.5	5.0	15.0	25.3	3.4	10.9
2006	38.5	5.8	16.3	28.6	4.9	14.7	27.5	3.7	9.9
2007	38.3	5.5	15.6	27.9	4.5	12.9	28.3	4.0	8.2
2008	39.2	5.6	14.8	26.5	4.3	12.0	28.1	4.2	9.1

1) Including suckler, feedlot and grazing cows.
2) Including supplementary feeds and singular compounded concentrate sources.

Table 3.6
Nutrient content in concentrate feeds for beef cattle[1)]

	Fattening calves, pink meat						Beef bulls						Moist concentrate feed		
	starting feed			finishing feed			starting feed			finishing feed			N	P	K
	N	P	K	N	P	K	N	P	K	N	P	K			
	g/kg												*g/kg dry weight*		
1990							34.3	6.0	14.4				28.5	2.8	8.0
1991							35.6	6.0	15.4				27.5	3.0	8.4
1992							35.7	6.8	15.4				26.9	3.6	9.7
1993							36.8	6.6	15.9				22.7	3.3	13.2
1994							32.5	6.3	14.4				26.2	3.1	9.4
1995	34.1	6.3	15.1	26.4	5.0	14.4	34.1	6.3	15.1				21.5	3.0	10.9
1996	33.4	5.9	15.8	26.4	5.0	14.4	33.4	5.9	15.8				25.1	3.7	8.4
1997	33.0	6.1	15.4	26.4	5.0	14.4	33.0	6.1	15.4				20.4	2.8	9.4
1998	32.3	5.5	14.0	29.0	5.0	13.8	36.0	5.5	18.5	29.0	5.0	17.3	23.0	3.3	9.2
1999	32.3	5.5	14.0	29.0	5.0	13.8	36.0	5.5	18.5	29.0	5.0	17.3	22.9	3.3	6.6
2000	32.3	5.5	14.0	29.0	5.0	13.8	36.0	5.5	18.5	29.0	5.0	17.3	20.8	3.1	10.7
2001	32.3	5.5	14.0	29.0	5.0	13.8	36.0	5.5	18.5	29.0	5.0	17.3	23.5	3.7	7.1
2002	32.8	5.1	15.6	28.8	4.7	13.7	33.8	5.4	15.6	28.5	5.2	13.7	21.7	3.4	8.4
2003	32.8	5.1	15.1	28.8	4.7	13.2	33.8	5.4	15.3	28.5	5.2	13.2	21.3	3.1	8.4
2004	32.5	5.5	14.7	29.8	5.1	14.1	34.3	5.5	14.9	33.5	5.6	14.1	16.7	3.4	8.6
2005	32.5	5.5	15.8	29.9	5.0	16.5	34.3	5.5	16.1	32.2	5.8	16.5	17.4	3.4	9.0
2006	32.5	5.5	15.5	29.2	5.2	14.5	34.3	5.5	15.9	32.2	5.8	14.5	17.4	3.4	9.0
2007	32.5	5.5	14.0	30.9	5.1	12.5	33.2	5.1	14.4	28.9	5.3	13.0	17.2	3.4	9.0
2008	32.5	5.5	13.1	30.6	4.9	12.5	33.6	5.2	13.4	29.3	5.1	12.7	17.2	3.4	9.0

[1)] Excluding suckler, feedlot and grazing cows.

Table 3.7
Nutrient content in concentrate feeds for horses and ponies

	Standard feed			High energy sport feed			Stud feed		
	N	P	K	N	P	K	N	P	K
	g/kg								
2006–2008	17.9	5.1	7.0	17.7	5.2	7.5	24.2	6.6	11.5

3.3 Nutrient content in animals and animal products

The level of nutrient fixation in animals depends on production levels of meat, milk and eggs, and on nutrient content per kilogram of product. Data on animal production were derived from statistical data, whenever possible. Data on cow milk production is the only parameter that is updated on an annual basis. Data on live weights of grazing animals are updated only occasionally. New data on N, P and K content in grazing animals only rarely become available.
Table 3.8 presents the nutrient content in animals and animal products, except cow milk. The cow milk composition is included in Table 3.9. Nutrient content that is derived from outside sources, often, was based on other and mostly older research material. For example, the nutrient content referred to in Coppoolse et al. (1990) had been based on reports by Jongbloed et al. from 1984 and 1985.

In the beginning of the time series (see footnotes Table 3.8), the N and K content for all cattle categories and the P content in fattening calves were based on Coppoolse et al. (1990). For P fixation in older cattle, the P content was taken from the calculations of phosphate production standards of 1987 (Van der Hoek, 1987). These data seem reliable as they were corrected for the contents of the gastrointestinal tract. The content data in Coppoolse et al. were based on live weight minus gastrointestinal contents. From 1999 onwards, the nitrogen content for various animal categories also was updated, taking the contents of the gastrointestinal tract into account (Tamminga et al., 2000; Heeres-van der Tol, 2001). The content of both N and P for various categories of grazing animals was last updated in 2004 (Kemme et al., 2005a).

From 1 January 2006 onwards, the manure production by horses and ponies has also been subject to the Fertiliser Act. In this context, their N and P content was published by Kemme et al. (2005b). The Potassium content was set to equal that of cattle.

Fixation of nutrients per animal was calculated as finishing weight x nutrient content per animal at its finishing weight, minus starting weight x nutrient content at its starting weight. Data on live weights are provided in the following section on nutrient excretions per animal category.

Table 3.8
Nutrient content in cattle, sheep, goats, horses and ponies, and animal products

	Status	N	P	K
		g/kg live weight		
Calves	birth	29.44[1]	8.00[1]	2.05[1]
Female young stock, 12 months				
1990–1998	12 months	25.60[1]	7.40[2]	2.00[1]
1999–2008	12 months	24.10[3]	7.40[2]	2.00[1]
Female young stock, 24 months and over				
1990–1998	26 months	25.60[1]	7.40[2]	2.00[1]
1999–2008	26 months	23.10[3]	7.40[2]	2.00[1]
Dairy cows				
1990–1998	calved	25.28[1]	7.40[2]	2.00[1]
1999–2008	calved	22.50[3]	7.40[2]	2.00[1]
Stud bulls				
1990–2008	12 months	25.60[1]	7.40[2]	2.00[1]
1990–2008	> 24 months	25.28[1]	7.40[2]	2.00[1]
Fattening calves, white meat				
1990–1997	6 months	30.24[1]	7.60[1]	1.91[1]
1998–2008	6 months	27.30[4]	5.90[4]	1.67[4]
Fattening calves, pink meat				
1995–1997	8 months	28.96[5]	7.60[1]	1.91[1]
1998–2003	8 months	26.40[4]	5.60[4]	1.69[4]
2004–2008	8 months	26.40[4]	6.85[7]	1.69[4]
Beef bulls, starting weight	birth	29.44[1]	8.00[1]	2.05[1]
Beef bulls, 12 months	12 months	28.48[5]	7.50[5]	1.91[1]
Beef bulls, finishing weight	16 months	27.04[1]	7.40[2]	1.91[1]
Suckler, feedlot and grazing cows				
1990–1998	calved	25.28[1]	7.40[2]	2.00[1]
1999–2008	calved	22.50[3]	7.40[2]	2.00[1]
Sheep, ewes				
1990–2003	adult animal	25.00[6]	6.00[6]	1.70[6]
2004–2008	adult animal	25.00[6]	7.80[7]	1.70[6]
Sheep, slaughter lambs				
1990–2003	birth	25.00[6]	6.00[6]	1.70[6]
2004–2008	weaning age	26.20[7]	5.20[7]	1.70[6]
Goats, dairy goats				
1990–2003	adult animal	24.00[6]	6.00[6]	1.70[6]
2004–2008	adult animal	24.00[6]	7.90[7]	1.70[6]
Goats, slaughter kids				
1990–2003	birth	24.00[6]	6.00[6]	1.70[6]
2004–2008	weaning age	24.00[6]	6.30[7]	1.70[6]
Horses and ponies	adult animal	29.90[8]	7.50[8]	2.00[1]
Cow milk[9]				
Goat milk				
1990–1997		5.00[6]	0.90[6]	2.00[6]
1998–2003		5.33[4]	0.90[6]	2.00[6]
2004–2008		5.03[7]	1.12[7]	2.00[6]
Wool				
1990–1994		122.0[6]	0.11[6]	0.30[6]
1995–2008		122.0[6]	0.11[6]	1.45

1) Coppoolse et al., 1990.
2) Van der Hoek, 1987.
3) Tamminga et al., 2000.
4) Heeres-van der Tol. 2001.
5) Derived from the content in beef bulls at starting and finishing weights.
6) IKC, 1993.
7) Kemme et al., 2005a.
8) Kemme et al., 2005b.
9) Updated annually, see Table 3.9, N content is milk protein (g/kg)/6.38.

Table 3.9
Nutrient content in dairy products

	Artificial milk (fattening calves, white meat)			Artificial milk (fattening calves, pink meat, and beef bulls)			Whole milk[1)]		
	N	P	K	N	P	K	N	P	K
	g/kg powder						*g/l*		
1990	32.1	6.8	14.7	32.1	6.8	14.7	5.38	0.90	1.60
1991	32.1	6.8	14.7	32.1	6.8	14.7	5.43	0.90	1.60
1992	32.1	6.8	14.7	32.1	6.8	14.7	5.42	0.90	1.60
1993	32.1	6.8	14.7	32.1	6.8	14.7	5.42	0.90	1.60
1994	32.1	6.8	14.7	32.1	6.8	14.7	5.42	0.90	1.60
1995	32.8	6.9	16.7	32.8	6.9	16.7	5.44	0.90	1.60
1996	32.6	6.5	16.7	32.6	6.5	16.7	5.45	0.90	1.60
1997	30.9	6.6	16.7	30.9	6.6	16.7	5.44	0.90	1.60
1998	31.0	6.8	17.0	31.0	6.8	17.0	5.42	0.90	1.60
1999	30.1	6.5	17.0	30.1	6.5	17.0	5.41	0.90	1.60
2000	31.4	6.1	17.0	31.4	6.1	17.0	5.42	0.90	1.60
2001	31.4	6.1	17.0	31.4	6.1	17.0	5.43	0.90	1.60
2002	31.4	6.1	17.0	31.4	6.1	17.0	5.42	0.90	1.60
2003	31.4	6.1	17.0	31.4	6.1	17.0	5.43	0.97	1.60
2004	30.3	6.0	17.0	34.0	7.0	17.3	5.45	0.97	1.60
2005	30.4	6.0	17.0	34.0	7.0	17.3	5.47	0.97	1.60
2006	30.0	6.1	17.0	34.0	7.0	17.3	5.45	0.97	1.60
2007	29.7	5.9	17.0	34.0	7.0	17.3	5.45	0.97	1.60
2008	29.4	5.6	17.0	34.0	7.0	17.3	5.49	0.97	1.60

Source: CBS statistics on milk supply and dairy production; Coppoolse, 1990; IKC, 1993a; Heeres-van der Tol, 2001; Tamminga et al., 2004; Kemme et al., 2005a.

[1)] N content milk protein (g/kg)/6.38.

3.4 Nutrient excretions per animal category

Excretion factors originally were calculated per financial year (from May to May), as the main data on feed uses were registered according to this time line. In order to calculate excretion factors per financial year, variables that became available per calendar year were converted to variables per financial year by averaging the data for two consecutive calendar years. For example, nutrient excretions for 1990 were calculated by multiplying nutrient excretions per animal in the 1989–1990 financial year with the animal numbers in the 1990 agricultural census. In the course of time, more and more data became available per calendar year, thus enabling the calculation of nutrient excretions per calendar year.

A distinction was made between housing and grazing periods for animals that would spend part of the year in pastures. Excretion factors were calculated for both types of periods. Some of the manure from dairy cows would end up in housing storage, depending on the grazing system applied (Table 3.14). This distinction is important for the calculation of transported and processed manure surpluses and for the calculation of ammonia emissions. Therefore, excretions from dairy cows in grazing periods were divided into amounts in pasture and in storage.

In the calculation of feed rations per animal category, no distinction was made between grass silage and hay, as the share of hay was relatively low. The nutrient content data under ‘grass silage and hay’ refer to weighted averages of the nutrient content in grass silage and hay.

For the calculations, standard data were not rounded off. Thus, calculations based on the rounded off standard data as provided in the tables may lead to slightly deviating results.

3.4.1 Dairy cows

The feed nutrient content and nutritional values are updated, annually, for most categories of cattle, sheep and goats. In addition, for dairy cows also the composition of feed rations and nutrient fixation in animal products are updated.

Index numbers
The following data are required for the calculation of nutrient excretions:
– Milk production;
– Animal growth;
– Number of calves produced;
– Nutrient content in the animal and its products;
– Feed uptake and composition.

Milk production per cow was calculated from data on total milk production and the number of dairy cows. For the 1990–1999 period, milk production was based on CBS dairy statistics. These statistics contain data on the amount of milk supplied to dairy factories per calendar year. This concerns around 95 percent of the total milk production. Also available are data on the fat and protein content of this milk. The remaining 5 percent was estimated in consultation with the Dutch Dairy Board. This relates to milk consumed by fattening calves, for private consumption, cheese production and supply to foreign dairy factories. From 2000 onwards, milk production data have been based on preliminary data from the Dutch Dairy Board, including additional estimations of dairy production not supplied to dairy factories. Final data on milk production were not available in time for calculating the excretion factors. Differences between preliminary and final data in most cases will only be marginal.
The average milk production per cow was calculated from the data on national milk production per calendar year and the number of cows in the agricultural census. Milk production increased from 6,000 kg/cow in 1990 to 800 kg/cow in 2008.

The WUM study began by comparing data from various sources of milk production data, such as from the CRV (Dutch cooperative on cattle improvement, formerly the NRS), the DELAR (collective data on Dutch cattle farming) and the LEI (Agricultural Economics Research Institute LEI, part of Wageningen UR). The general conclusion was that the CBS dairy statistics provided the most accurate data on national milk production. Table 3.10 provides standard data on milk production, weight, age and number of calves.

The share of annually replaced dairy cows was calculated from 1/(age at transport – age at first calving). Results were subsequently compared with the share calculated from the productive lifespan of removed cows (CRV, formerly NRS) and the number of slaughtered cows (CBS). For determining annual replacement percentages, the differences between the various results of these calculations were taken into account.

Feed uptake
Feed uptake over the 1990–2008 period was calculated using the formula for VEM[1)] requirements, as determined by Tamminga et al. (2004) (CBS, 2009). The VEM coverage according to this formula was set at 102 percent.
Cattle feed predominately consists of grassland products, maize silage and concentrate feeds. The size of the share of maize silage has a large influence on excretion factors due to low N and P content. The availability of maize silage in the south-eastern region is relatively large.
The feed use of cattle (excluding dairy cows), sheep and goats was calculated on the basis of fixed index numbers on feed use per animal. The uptake of preserved raw feed and concentrate feed by dairy cows was calculated by deducting the uptake by other grazers from the total amount of available feed.

Feed uptake by dairy cows was distributed over annual housing and grazing periods, based on the following:
– Of the available concentrate feed, 40 percent was provided during grazing periods and 60 percent during housing periods. This apportionment was based on DELAR data, and confirmed by actual practice data over the 1999–2005 period from farms participating in a collaboration of 16 dairy farmers and the Wageningen University;
– South-eastern region: The available amount of grass silage and hay was divided between housing and grazing periods. After deduction of the provided amount of concentrate feed during housing periods, the remaining feed requirement in the housing periods represented the consumed amount of maize silage. Any remaining maize silage would be used in the following grazing season.

1 VEM = feed unit milk (Voeder Eenheid Melk)

Table 3.10
Index numbers dairy cows

	Milk production				Average weight			Calves per adult cow[1]	Age at first calf	Age at transport	Annual replacement
	milk region north-west	milk region south-east	fat	protein	at first calf	at transport	calf				
	kg/cow		*%*		*kg*			*number*	*year*		*share*
1990	6,003	6,003	4.37	3.46	520	600	43	2	2.2	4.6	0.42
1991	6,007	6,007	4.43	3.47	520	600	43	2	2.2	4.6	0.42
1992	6,136	6,136	4.41	3.45	520	600	43	2	2.2	4.6	0.42
1993	6,325	6,325	4.41	3.45	520	600	43	2	2.2	4.6	0.42
1994	6,443	6,443	4.42	3.46	520	600	43	2	2.2	4.6	0.42
1995	6,596	6,596	4.40	3.48	520	600	43	2	2.2	4.6	0.42
1996	6,626	6,626	4.44	3.48	520	600	43	2	2.2	4.6	0.42
1997	6,803	6,803	4.41	3.46	520	600	43	2	2.2	4.6	0.42
1998	6,810	6,810	4.40	3.46	530	600	43	2	2.2	5.25	0.32
1999	7,034	7,034	4.32	3.44	530	600	43	2	2.2	5.25	0.32
2000	7,416	7,416	4.38	3.47	530	600	43	2	2.2	5.25	0.32
2001	7,127	7,127	4.44	3.46	530	600	43	2	2.2	5.25	0.32
2002	7,187	7,187	4.43	3.46	530	600	43	2	2.2	5.25	0.32
2003	7,494	7,494	4.40	3.47	525	600	44	2.25	2.2	5.67	0.30
2004	7,415	7,415	4.42	3.48	525	600	44	2.25	2.2	5.67	0.30
2005	7,568	7,568	4.39	3.49	525	600	44	2.25	2.2	5.67	0.30
2006	7,744	7,744	4.39	3.48	525	600	44	2.25	2.2	5.67	0.30
2007	7,728	7,988	4.41	3.48	525	600	44	2.5	2.2	5.83	0.30
2008	7,748	8,054	4.37	3.50	525	600	44	2.5	2.2	5.92	0.27

Source: see text.

[1] First calves are calculated as retention in heifers.

Table 3.11
Feed uptake by dairy cows, per animal[1]

	Housing period							Grazing period						
	number of days	VEM requirement	standard concentrate feed[2]	protein rich concentrate feed[2]	moist concentrate feed	maize silage	grass silage and hay	number of days	VEM requirement	standard concentrate feed[2]	moist concentrate feed	maize silage	grass silage and hay	fresh grass
South-east Netherlands		*kVEM*	*kg*		*kg dry weight*				*kVEM*	*kg*	*kg dry weight*			
1990	175	2,541	562	515	90	860	851	190	2,859	718	60	549	95	1,631
1991	175	2,557	551	521	63	804	992	190	2,876	715	42	351	110	1,792
1992	175	2,576	678	444	37	1,118	679	190	2,897	748	24	99	75	2,095
1993	175	2,615	606	483	66	1,038	788	190	2,939	726	44	377	88	1,844
1994	175	2,653	608	541	65	1,008	854	190	2,981	766	44	779	95	1,506
1995	175	2,678	616	661	115	970	684	190	3,008	851	77	530	121	1,578
1996	175	2,708	631	668	71	1,049	633	190	3,040	866	47	329	112	1,758
1997	175	2,733	634	619	163	1,071	581	190	3,068	835	109	576	194	1,529
1998	185	2,890	523	736	141	979	896	180	2,907	726	81	1,333	299	714
1999	185	2,912	540	636	123	1,155	836	180	2,929	678	71	626	209	1,486
2000	200	3,228	755	517	209	1,156	936	165	2,750	583	96	871	312	1,044
2001	200	3,255	861	430	142	1,244	942	165	2,773	592	65	672	404	1,218
2002	200	3,228	919	352	147	1,446	715	165	2,751	583	67	746	477	1,080
2003	200	3,271	896	413	165	1,023	1,196	165	2,786	600	76	1,136	797	488
2004	190	3,130	878	396	135	972	1,156	175	2,975	681	72	1,212	622	705
2005	190	3,165	802	312	132	1,296	1,001	175	3,008	743	88	905	429	1,082
2006	200	3,379	811	294	131	1,414	1,137	165	2,875	737	87	905	487	933
2007	190	3,280	829	295	115	1,113	1,335	175	3,114	750	77	1,101	572	920
2008	195	3,371	582	624	117	1,319	1,128	170	3,029	804	78	858	608	991
North-west Netherlands														
1990	175	2,541	1,000	77	90	211	1,497	190	2,859	718	60	70	281	1,887
1991	175	2,557	995	78	63	173	1,661	190	2,876	715	42	58	149	2,015
1992	160	2,355	1,042	80	37	219	1,384	205	3,125	748	24	0	13	2,469
1993	175	2,615	1,002	87	66	256	1,627	190	2,939	726	44	85	320	1,910
1994	175	2,653	1,049	100	65	330	1,544	190	2,981	766	44	110	293	1,897
1995	175	2,678	1,129	148	115	335	1,385	190	3,008	851	77	112	101	1,956
1996	175	2,708	1,108	192	71	395	1,330	190	3,040	866	47	132	402	1,694
1997	175	2,733	1,110	144	163	382	1,321	190	3,068	835	109	127	69	2,028
1998	195	3,046	1,126	202	148	635	1,388	170	2,746	658	73	212	495	1,453
1999	185	2,912	1,046	193	129	541	1,448	180	2,929	614	64	180	480	1,734
2000	200	3,228	1,139	133	209	523	1,650	165	2,750	583	96	282	415	1,506
2001	200	3,255	1,155	136	142	606	1,652	165	2,773	592	65	151	231	1,844
2002	200	3,228	1,163	108	147	674	1,542	165	2,751	583	67	225	131	1,852
2003	200	3,271	1,193	116	165	606	1,662	165	2,786	600	76	326	815	1,227
2004	190	3,130	1,160	114	135	629	1,536	175	2,975	681	72	339	770	1,396
2005	190	3,165	977	137	132	628	1,721	175	3,008	743	88	338	604	1,462
2006	190	3,210	970	136	131	695	1,713	175	3,050	737	87	374	276	1,798
2007	190	3,210	1,012	112	115	548	1,880	175	3,050	750	77	295	304	1,892
2008	190	3,203	948	258	117	585	1,732	175	3,043	804	78	315	535	1,604

[1] Including feed losses of 2% of concetrate feed, 3% of moist concentrate feed and 5% of preserved roughage.
[2] Including singular compounded concentrate sources.

– North-western region: The available amount of grass silage was divided between housing and grazing periods. After deduction of the provided amount of concentrate feed during housing periods, the remaining feed requirement in the housing periods represented the consumed amount of grass silage. Any remaining grass silage would be used in the following grazing season.

The above distribution of raw feed over housing and grazing periods was conducted on the basis of expert judgements, taking into account the total amount of concentrate feed and raw feed available. In both regions, the remaining feed requirement would be met through the uptake of meadow grass. In the calculations of this remaining feed requirement, feed losses were also taken into account.
The uptake of meadow grass, therefore, is calculated as a remnant category. In order to double check this calculation, gross grass production per hectare was calculated for each calendar year and compared against that of previous years (Table 3.2).

The amount of moist concentrate feed used by dairy cows was calculated by deducting the feed that was used by pink meat calves and beef bulls from the total amount of available moist concentrate feed.
As for dry concentrate feed, also for moist concentrate feed 60 percent was attributed to the housing period.

Table 3.12
Nutrient uptake and fixation by dairy cows

	Nutrient uptake						Nutrient fixation					
	housing period			grazing period			housing period			grazing period		
	N	P	K	N	P	K	N	P	K	N	P	K
	kg/animal											
South-east Netherlands												
1990	74.8	11.5	53.1	101.0	12.3	80.2	16.3	2.8	4.7	17.7	3.1	5.1
1991	79.1	12.1	60.7	104.1	11.9	88.2	16.5	2.8	4.7	17.9	3.1	5.1
1992	73.4	10.8	55.2	109.4	12.5	90.6	16.7	2.9	4.7	18.1	3.1	5.1
1993	77.6	11.9	57.2	105.3	13.2	93.1	17.1	2.9	4.8	18.5	3.2	5.3
1994	82.9	12.6	64.9	97.2	12.3	82.6	17.5	3.0	5.0	19.0	3.3	5.4
1995	84.0	12.5	59.2	102.6	12.5	83.2	17.8	3.1	5.1	19.4	3.3	5.5
1996	78.6	11.6	57.2	111.5	11.7	88.4	18.2	3.1	5.1	19.7	3.4	5.6
1997	77.4	11.5	55.7	103.9	12.5	84.2	18.4	3.2	5.2	20.0	3.4	5.7
1998	85.8	12.5	65.1	77.1	10.3	65.1	19.4	3.3	5.6	18.9	3.2	5.4
1999	81.2	12.2	61.2	88.4	12.0	79.1	19.6	3.4	5.7	19.1	3.3	5.5
2000	87.7	13.5	64.3	77.5	10.9	67.8	22.1	3.8	6.4	18.2	3.1	5.3
2001	87.5	13.7	65.9	83.2	11.5	73.4	22.3	3.8	6.4	18.4	3.1	5.3
2002	82.3	12.8	61.6	80.4	11.3	73.8	21.9	3.7	6.3	18.1	3.1	5.2
2003	92.6	14.4	75.0	74.0	10.9	68.4	22.5	4.1	6.5	18.6	3.4	5.4
2004	88.3	13.4	70.0	76.6	11.1	69.7	21.7	3.9	6.2	20.0	3.6	5.7
2005	83.0	12.8	67.6	83.2	12.1	76.3	22.2	4.0	6.4	20.4	3.7	5.9
2006	88.1	13.5	72.4	77.7	11.5	72.4	23.8	4.3	6.8	19.7	3.6	5.6
2007	90.4	13.4	73.4	82.8	12.1	73.7	23.4	4.2	6.7	21.5	3.9	6.2
2008	90.5	13.8	69.0	82.6	12.3	74.5	24.3	4.4	6.9	21.2	3.8	6.0
North-west Netherlands												
1990	80.1	11.4	61.6	111.0	12.9	87.5	16.3	2.8	4.7	17.7	3.1	5.1
1991	86.8	12.4	72.7	110.9	12.1	93.6	16.5	2.8	4.7	17.9	3.1	5.1
1992	77.9	11.2	65.2	121.3	13.6	100.6	15.2	2.6	4.3	19.5	3.4	5.5
1993	87.9	12.7	75.1	111.3	13.8	99.8	17.1	2.9	4.8	18.5	3.2	5.3
1994	90.2	13.1	81.0	111.6	13.3	96.1	17.5	3.0	5.0	19.0	3.3	5.4
1995	90.1	13.3	73.3	112.1	13.0	90.5	17.8	3.1	5.1	19.4	3.3	5.5
1996	86.1	12.4	70.3	114.9	12.1	92.9	18.2	3.1	5.1	19.7	3.4	5.6
1997	89.4	12.2	72.2	115.3	13.3	92.5	18.4	3.2	5.2	20.0	3.4	5.7
1998	95.3	13.7	77.9	99.1	11.9	84.7	20.4	3.5	5.9	17.8	3.0	5.1
1999	91.5	13.8	75.4	98.5	13.1	91.6	19.6	3.4	5.7	19.1	3.3	5.5
2000	99.2	14.8	79.0	90.7	12.2	81.2	22.1	3.8	6.4	18.2	3.1	5.3
2001	98.9	15.3	82.5	94.1	12.3	84.0	22.3	3.8	6.4	18.4	3.1	5.3
2002	94.4	14.3	78.5	91.5	12.2	85.0	21.9	3.7	6.3	18.1	3.1	5.2
2003	97.6	15.3	85.0	90.5	12.3	85.7	22.5	4.1	6.5	18.6	3.4	5.4
2004	91.9	13.9	78.2	92.6	12.8	88.5	21.7	3.9	6.2	20.0	3.6	5.7
2005	93.7	14.1	83.6	94.1	13.2	89.3	22.2	4.0	6.4	20.4	3.7	5.9
2006	93.9	14.2	82.5	93.2	13.1	90.1	22.6	4.1	6.5	20.9	3.8	6.0
2007	97.1	14.1	84.3	93.9	13.3	88.2	22.6	4.1	6.5	20.8	3.8	6.0
2008	94.0	14.3	79.9	94.0	13.5	87.6	22.8	4.1	6.5	21.0	3.8	6.0

In the calculations, the total amount of available protein-rich concentrate feed for dairy cattle was attributed to diary cows. The distribution over the south-eastern and north-western regions was determined by the amounts of maize silage used, assuming that a large use would be accompanied by a high intake of protein-rich concentrate feed, to compensate for the low-protein content of maize silage. Feed uptake data are provided in Table 3.11.

Table 3.13
Nutrient excretion from dairy cows

	Housing period			Grazing period						Full year		
	N	P_2O_5	K_2O	during housing			in pasture			N	P_2O_5	K_2O
				N	P_2O_5	K_2O	N	P_2O_5	K_2O			
	kg/animal											
South-east Netherlands												
1990	58.4	19.8	58.3	33.3	8.5	36.2	49.9	12.7	54.4	141.6	41.0	148.9
1991	62.6	21.2	67.5	34.5	8.0	40.1	51.7	12.0	60.1	148.8	41.2	167.7
1992	56.7	18.2	60.8	36.5	8.6	41.2	54.8	12.9	61.8	148.0	39.7	163.8
1993	60.5	20.6	63.0	34.7	9.2	42.4	52.0	13.7	63.5	147.2	43.5	168.9
1994	65.5	22.0	72.2	31.3	8.3	37.2	47.0	12.5	55.8	143.8	42.8	165.2
1995	66.2	21.6	65.2	33.3	8.4	37.5	49.9	12.6	56.2	149.4	42.6	158.9
1996	60.5	19.5	62.7	36.7	7.6	39.9	55.0	11.5	59.9	152.2	38.6	162.5
1997	59.0	19.2	60.9	33.6	8.3	37.9	50.4	12.5	56.8	143.0	40.0	155.6
1998	66.4	21.1	71.7	23.3	6.5	28.8	35.0	9.7	43.2	124.7	37.3	143.7
1999	61.6	20.3	66.9	27.7	8.0	35.5	41.6	12.0	53.2	130.9	40.3	155.6
2000	65.6	22.2	69.8	23.7	7.1	30.1	35.6	10.7	45.2	124.9	40.0	145.1
2001	65.1	22.7	71.6	25.9	7.7	32.8	38.9	11.5	49.3	129.9	41.9	153.7
2002	60.3	20.8	66.6	37.4	11.3	49.6	24.9	7.5	33.1	122.6	39.6	149.3
2003	70.0	23.6	82.6	33.2	10.3	45.6	22.2	6.9	30.4	125.4	40.8	158.6
2004	66.6	21.5	76.9	33.9	10.3	46.3	22.6	6.8	30.8	123.1	38.6	154.0
2005	60.8	20.2	73.8	37.6	11.5	51.0	25.1	7.7	34.0	123.5	39.4	158.8
2006	64.2	21.1	79.0	36.3	11.3	50.3	21.7	6.8	30.1	122.2	39.2	159.4
2007	67.0	21.0	80.3	41.3	12.7	54.9	20.0	6.1	26.5	128.3	39.8	161.7
2008	66.2	21.6	74.8	35.7	11.3	48.0	25.7	8.1	34.5	127.6	41.0	157.3
North-west Netherlands												
1990	63.8	19.6	68.6	37.3	9.0	39.8	55.9	13.5	59.6	157.0	42.1	168.0
1991	70.3	21.9	82.0	37.2	8.3	42.7	55.8	12.4	64.0	163.3	42.6	188.7
1992	62.7	19.7	73.3	40.7	9.4	45.8	61.1	14.1	68.7	164.5	43.2	187.8
1993	70.8	22.5	84.6	37.1	9.7	45.6	55.7	14.5	68.3	163.6	46.7	198.5
1994	72.7	23.2	91.7	37.1	9.2	43.7	55.6	13.8	65.6	165.4	46.2	201.0
1995	72.3	23.5	82.2	37.1	8.9	41.0	55.6	13.4	61.4	165.0	45.8	184.6
1996	68.0	21.2	78.6	38.1	8.0	42.1	57.1	12.0	63.2	163.2	41.2	183.9
1997	71.0	20.6	80.7	38.1	9.0	41.9	57.2	13.5	62.8	166.3	43.1	185.4
1998	74.8	23.3	86.8	32.5	8.1	38.4	48.8	12.2	57.6	156.1	43.6	182.8
1999	71.9	24.0	84.0	31.8	9.0	41.5	47.6	13.5	62.2	151.3	46.5	187.7
2000	77.1	25.2	87.6	29.0	8.3	36.6	43.5	12.5	54.9	149.6	46.0	179.1
2001	76.6	26.4	91.6	30.3	8.4	38.0	45.4	12.7	56.9	152.3	47.5	186.5
2002	72.5	24.2	86.9	36.7	10.5	48.0	36.7	10.5	48.0	145.9	45.2	182.9
2003	75.0	25.5	94.6	36.0	10.2	48.4	36.0	10.2	48.4	147.0	45.9	191.4
2004	70.2	22.9	86.7	36.3	10.5	49.9	36.3	10.5	49.9	142.8	43.9	186.5
2005	71.5	23.1	93.1	36.8	10.9	50.3	36.8	10.9	50.3	145.1	44.9	193.7
2006	71.3	23.0	91.5	36.1	10.7	50.6	36.2	10.7	50.8	143.6	44.4	192.9
2007	74.5	23.0	93.8	39.6	11.8	53.7	33.5	10.0	45.4	147.6	44.8	192.9
2008	71.2	23.4	88.4	33.9	10.3	45.6	39.1	11.9	52.7	144.2	45.6	186.7
Netherlands, average												
1990	60.8	19.7	63.0	35.1	8.7	37.8	52.6	13.1	56.8	148.5	41.5	157.6
1991	66.1	21.5	74.1	35.7	8.1	41.3	53.6	12.2	61.9	155.4	41.8	177.3
1992	59.4	18.9	66.4	38.4	9.0	43.3	57.6	13.4	64.9	155.4	41.3	174.6
1993	65.1	21.5	72.7	35.8	9.4	43.8	53.7	14.1	65.7	154.6	45.0	182.2
1994	68.8	22.5	81.0	33.9	8.7	40.1	50.9	13.1	60.2	153.6	44.3	181.3
1995	69.0	22.5	72.9	35.0	8.6	39.1	52.5	13.0	58.6	156.5	44.1	170.6
1996	63.9	20.3	69.9	37.3	7.8	40.9	56.0	11.7	61.4	157.2	39.8	172.2
1997	64.5	19.8	69.9	35.6	8.6	39.7	53.5	13.0	59.5	153.6	41.4	169.1
1998	70.2	22.1	78.6	27.5	7.2	33.2	41.3	10.8	49.8	139.0	40.1	161.6
1999	66.4	22.0	74.8	29.6	8.5	38.3	44.4	12.7	57.4	140.4	43.2	170.5
2000	71.0	23.6	78.1	26.2	7.7	33.1	39.3	11.5	49.7	136.5	42.8	160.9
2001	70.6	24.5	81.1	28.0	8.0	35.3	42.0	12.1	52.9	140.6	44.6	169.3
2002	66.2	22.4	76.4	37.1	10.9	48.8	30.6	8.9	40.3	133.9	42.2	165.5
2003	72.4	24.5	88.4	34.6	10.3	47.0	28.9	8.5	39.1	135.9	43.3	174.5
2004	68.4	22.2	81.7	35.1	10.4	48.1	29.3	8.6	40.1	132.8	41.2	169.9
2005	66.0	21.6	83.2	37.2	11.2	50.7	30.8	9.3	42.0	134.0	42.1	175.9
2006	67.7	22.0	85.1	36.2	11.0	50.4	28.8	8.7	40.3	132.7	41.7	175.8
2007	70.2	21.8	86.0	40.6	12.3	54.4	25.7	7.7	34.4	136.5	41.8	174.8
2008	68.3	22.4	80.5	34.9	10.9	47.0	31.3	9.7	42.1	134.5	43.0	169.6

NB P_2O_5 excretion is calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion is calculated according to: (K uptake – K fixation) * 47/39.

Nutrient excretion

Table 3.12 shows uptake and fixation data for housing and grazing periods, and Table 3.13 presents data on excretions. For the grazing periods, excretions were divided over housing and grazing times. This distinction is important for the calculation of gaseous nitrogen losses, including ammonia. Ammonia emissions are far higher from manure which is produced inside animal housing than from that produced in pastures.

The amount of manure that ends up inside animal housing during grazing periods depends on the number of hours a day that animals spend indoors. Under unlimited grazing, 15 percent of excretions occur during indoor milking (taking around four hours a day).

Under limited grazing, amounts excreted inside animal housing depend on the number of hours spent in pastures. The number of grazing hours under limited grazing was changed, for the years from 2006 onwards, from 10 to 8 hours a day, based on CBS research. Under regimes of 10 grazing hours, 60 percent of excretions occur inside animal housing, and for 8 grazing hours this is 67 percent. All manure from animals in full-time housing is produced indoors.

In the early 1990s, it was determined that there was no significant difference between regions in the share of indoor excretions during grazing periods. Both regions were assumed to have 40 percent indoor excretions during grazing periods. Based on the results from incidental research by CBS, this percentage remained unchanged up to and including 2001. Data from LEI on 2002, however, showed that the nutrient accounting system Minas had caused a shift towards more hours spent inside animal housing. On the basis of LEI data, the amount of stored pasture manure was set at 60 percent for the south-eastern region and at 50 percent for the north-western region. These percentages remained stable over the 2003–2005 period. Since 2006, CBS has been inventorying the situation of grazing dairy cattle, on an annual basis. Seeing the increasing numbers of farms from which data have become available, the WUM decided to use the CBS results in this study. It was also decided that calculated shares of stored pasture manure would no longer be rounded-off. Table 3.14 presents the shares of manure that end up inside animal housing during grazing periods.

Table 3.14
Grazing dairy cows

	Full-time pasturing		Part-time pasturing		Full-time housing		Total		
	cows	stored manure	cows	stored manure	cows	stored manure	cows	stored manure	applied in calculation
	%								
South-east Netherlands									
1990[1)]	42	15	52	60	6	100	100	44	40
2002	15	15	66	60	19	100	100	61	60
2003	19	15	68	60	14	100	101	58	60
2004	23	15	58	60	19	100	100	58	60
2005	25	15	61	60	15	100	100	55	60
2006	25	15	49	67	26	100	100	63	63
2007	15	15	60	67	25	100	100	67	67
2008	31	15	46	67	23	100	100	58	58
North-west Netherlands									
1990[1)]	55	15	41	60	4	100	100	37	40
2002	35	15	50	60	15	100	100	50	50
2003	36	15	49	60	15	100	100	50	50
2004	40	15	44	60	16	100	100	48	50
2005	43	15	42	60	15	100	100	46	50
2006	43	15	41	67	16	100	100	50	50
2007	33	15	53	67	13	100	100	54	54
2008	50	15	33	67	17	100	100	46	46

Source: see text.

1) Results were applied for the 1990–2001 period.

3.4.2 Female young stock, male young stock for breeding and stud bulls

Index numbers

Index numbers on female young stock were based on young stock in dairy farming (Table 3.15). No separate index numbers were derived for female young stock in meat production. For the number of calves born per cow, the fixation for the first calf is counted under heifers (young stock of 12 months and over).

Tamminga et al. (2004) calculated no separate excretion factors for male young stock for breeding and breeding bulls, because of the limited size of this category and their relatively small contribution to the total nutrient excretion. Since 1990, the WUM does calculate standard factors for these categories. The largest share of male young stock of up to 12 months old is located at specialised breeding farms. After 12 months, these animals weigh 80 kilograms more than the female young stock and are fed on winter rations that contain relatively few proteins (CBS, 2009). The index numbers for breeding bulls of 12 months and over were taken from the fixed data that were determined on phosphate excretions (Van der Hoek, 1987). The weight of these animals increases until they are 3.5 years old, after which their weight remains steady. Index numbers for male young stock in dairy farming and breeding bulls have not been revised since 1990.

Feed uptake

VEM requirements and VEM coverage for female young stock in dairy farming, for the entire 1990–2008 time series, were based on the assumptions in Tamminga et al. (2004). Female young stock of up to 12 months old (Table 3.16) were assumed to obtain 10 percent of their energy during grazing periods from concentrate feed. During housing periods this was 20 percent to 25 percent, depending on the share of maize silage in their rations. Animals of 12 months and over (Table 3.17) would receive part of their energy requirement from concentrate feed only during housing periods. In grazing periods, this energy requirement would fully be obtained from meadow grass uptake. Up to 2006, the annual share of concentrate feed during housing periods was 15 percent in the south-eastern region and 10 percent in the north-western region (IKC, 1993a).

From 2007 onwards, the share of concentrate feed in rations of young stock of 12 months and over has been revised, based on information from a number of compound feed producers. These animals, generally, did not receive any concentrate feed, except for one to two kilograms during the last few weeks before calving. Shares of concentrate feed during housing periods in both regions, therefore, was reduced to 15 percent of the energy requirement. This concentrate feed was assumed to have been of a standard composition. In the north-western region, raw feed during housing periods consisted of grass silage, while in the south-east also maize silage was provided during these periods.

Heeres-van der Tol (2001) estimated that around 35 percent of female young stock of less than 12 months old would be raised on cow milk. Because all of the available artificial milk was fully used by meat calves and beef bulls, calculations assume that young stock received milk products in the form of whole milk. Calculations up to 1998 assumed 59 kg of powder, which equals 354 litres of whole milk. From 1999 onwards, calculations were based on 35 kg of powder or 200 litres of cow milk during the first 8 weeks (4 litres a day, gradually reduced to zero over the last 2 weeks of this period) (Heeres-van der Tol, 2001). For young stock, moist concentrate feed or nutrient supplements were not taken into account, as this type of feed generally was not supplied and there was no related quantitative information available.

Tamminga et al. (2000) assumed a lower N content in meadow grass for young stock older than 12 months, and a lower N content in the grass silage fed to sheep. This distinction between raw feed qualities for the various animal categories first was not applied in calculations of excretion factors, due to a lack of monitoring data. However, after the publication of follow-up studies into fixed N and P excretions from cattle (Tamminga et al., 2004) and various other categories of grazers (Kemme et al., 2005a), it was decided also to assume a lesser quality of raw feed for young stock of 12 months and over (from 2003 onwards) and for sheep (from 2004 onwards). An important agreement in favour of this course of action is the fact that the limited number of analyses of fresh grass mostly refer to more intensive farming, which causes the data on the average N content of meadow grass to be less representative. Though the effect on excretion factors would only be limited, because the VEM value of this raw feed would be lower, and therefore larger amounts of this feed must be eaten to meet feed requirements. The N content of meadow grass for young stock older than 12 months was set at 20 percent below the average BLGG value (Tamminga et al., 2004). This reduction was partly based on the practice whereby young stock often were grazed on terrain that had first been grazed by adult animals, which means that their grass intake would have had a lower N content. In addition, the share of grass from extensively managed grassland in young stock rations is expected to increase in the future. The VEM value of this grass is based on the relation between VEM (feed unit milk) and N content.

The length of the grazing period in 1990, in the south-eastern and north-western regions, was derived from the 1992 CBS research into grazing systems. Results from this research were applied to the years up to and including 2002. Research into grazing of young stock up to 12 months old, over the 2003–2007 period, did not take into account the numbers of calves that had not been offered any grazing time. This caused the average grazing period to be overestimated, which in turn caused the distribution of excretions over housing and grazing periods to deviate from the situation in actual practice. The CBS study on grassland use in 2008 adjusted its research questions in such a way that information became available on those numbers of calves that were not offered any grazing time. These numbers appeared to have increased substantially, over the years, which on average led to data representing considerably shorter periods of grazing. These data are being applied from 2008 onwards. The time span of housing and grazing periods for young stock up to 12 months of age is provided in Table 3.16, and Table 3.17 shows the data for young stock of 12 months and over.

Feed requirements by male young stock of up to 12 months old (Table 3.18) were estimated at an annual 1,650 kVEM per animal (Tamminga et al., 2000). Whole-milk intake was equal to that of female young stock. Furthermore, Tamminga et al. assumed 275 kg in concentrate feed, 400 kg dry weight of meadow grass, with the remaining feed requirement being equally divided over grass silage, hay and maize silage. The WUM calculations combined grass silage and hay, because of the limited use of hay. WUM rations consist of the same amount of whole milk as those of female young stock, 275 kg of concentrate feed, 575 kg dry weight in maize silage, 575 kg dry weight in grass silage plus hay, and meadow grass for the remainder. Fresh grass intake, over the 2003–2008 period, was slightly overestimated, because VEM coverage for whole milk was not taken into account. Feed requirements by male young stock of 12 to 24 months and breeding bulls were set at an annual 2,740 kVEM per animal (Table 3.18). Ten per cent of the protein requirement was met by concentrate feed, with the remainder consisting of grass silage. Male young stock as well as breeding bulls were assumed to have spent all of the year inside animal housing.

Nutrient uptake and fixation in female young stock of up to 12 months old are shown, per region, in Table 3.19. Table 3.20 shows excretions per region, and Table 3.21 shows Dutch averages. Table 3.21 also distinguishes between young stock in dairy farming and young stock in meat production. Although regional excretion factors for both types of young stock are similar, nationwide averages may differ. This is due to regional differences in ratios between numbers of animals in dairy farming and meat production.

Table 3.15
Index numbers for young stock on dairy farms and stud bulls

	Female young stock				Male young stock		Stud bulls			
	birth weight	weight at 12 months	weight at calving	age at calving[1)]	birth weight	weight at 12 months	weight at 12 months	finishing weight	age at transport	annual growth
	kg			*year*	*kg*				*year*	*kg*
1990	43	310	520	2.2	43	390	400	1,100	4.75	187
1991	43	310	520	2.2	43	390	400	1,100	4.75	187
1992	43	310	520	2.2	43	390	400	1,100	4.75	187
1993	43	310	520	2.2	43	390	400	1,100	4.75	187
1994	43	310	520	2.2	43	390	400	1,100	4.75	187
1995	43	310	520	2.2	43	390	400	1,100	4.75	187
1996	43	310	520	2.2	43	390	400	1,100	4.75	187
1997	43	310	520	2.2	43	390	400	1,100	4.75	187
1998	43	320	530	2.2	43	400	400	1,100	4.75	187
1999	43	320	530	2.2	43	400	400	1,100	4.75	187
2000	43	320	530	2.2	43	400	400	1,100	4.75	187
2001	43	320	530	2.2	43	400	400	1,100	4.75	187
2002	43	320	530	2.2	43	400	400	1,100	4.75	187
2003	44	320	525	2.2	44	400	400	1,100	4.75	187
2004	44	320	525	2.2	44	400	400	1,100	4.75	187
2005	44	320	525	2.2	44	400	400	1,100	4.75	187
2006	44	320	525	2.2	44	400	400	1,100	4.75	187
2007	44	320	525	2.2	44	400	400	1,100	4.75	187
2008	44	320	525	2.2	44	400	400	1,100	4.75	187

Source: see text.

[1)] First calves are calculated as retention in heifers.

Nutrient uptake and fixation in female young stock of 12 months and over are shown in Table 3.22. Table 3.23 provides excretions per region, while Tables 3.24 and 3.25 show excretion averages for the Netherlands, distinguishing between young stock of 12 to 24 months and young stock of 24 months and over (Table 3.25).
Both tables also distinguish between young stock in dairy farming and in meat production. Although regional excretion factors for young stock up to 12 months old in dairy farming and meat production are similar, nationwide averages may differ. This is due to regional differences in ratios between numbers of animals in dairy farming and meat production.
Table 3.26 contains data on uptake, fixation and excretions for male young stock and breeding bulls.

Table 3.16
Feed uptake by female young stock, 12 months and under[1)]

	Female young stock, 12 months and under									
	housing period						grazing period			
	number of days	VEM requirement	whole milk	standard concentrate feed[2)]	maize silage	grass silage and hay	number of days	VEM requirement	standard concentrate feed[2)]	fresh grass
		kVEM	*kg*		*kg dry weight*			*kVEM*	*kg*	*kg dry weight*
South-east Netherlands										
1990	275	1,050	354	285	202	603	90	385	42	355
1991	275	1,050	354	285	199	632	90	385	42	348
1992	275	1,050	354	285	198	652	90	385	42	356
1993	275	1,050	354	285	197	634	90	385	42	350
1994	275	1,050	354	285	208	634	90	385	42	345
1995	275	1,050	354	285	197	651	90	385	42	344
1996	275	1,050	354	285	196	627	90	385	42	335
1997	275	1,050	354	285	195	629	90	385	42	347
1998	275	1,050	354	285	192	645	90	385	42	340
1999	275	1,050	200	285	203	686	90	385	42	342
2000	275	1,050	200	285	196	663	90	385	42	345
2001	275	1,050	200	285	198	662	90	385	42	349
2002	275	1,050	200	285	202	649	90	385	42	350
2003	235	900	200	244	170	570	130	555	60	511
2004	235	900	200	244	171	568	130	555	60	515
2005	235	900	200	244	171	554	130	555	60	513
2006	235	900	200	244	171	554	130	555	60	522
2007	255	975	200	265	183	611	110	470	51	455
2008	310	1,185	200	322	228	749	55	235	26	227
North-west Netherlands										
1990	265	1,015	354	220		833	100	425	46	392
1991	265	1,015	354	220		872	100	425	46	384
1992	265	1,015	354	220		900	100	425	46	393
1993	265	1,015	354	220		876	100	425	46	386
1994	265	1,015	354	220		875	100	425	46	381
1995	265	1,015	354	220		899	100	425	46	379
1996	265	1,015	354	220		865	100	425	46	370
1997	265	1,015	354	220		868	100	425	46	383
1998	265	1,015	354	220		890	100	425	46	375
1999	265	1,015	200	220		946	100	425	46	378
2000	265	1,015	200	220		913	100	425	46	381
2001	265	1,015	200	220		912	100	425	46	385
2002	265	1,015	200	220		894	100	425	46	386
2003	225	860	200	187		776	140	595	65	548
2004	225	860	200	187		774	140	595	65	552
2005	225	860	200	187		754	140	595	65	550
2006	225	860	200	187		754	140	595	65	560
2007	235	900	200	195		802	130	555	60	537
2008	300	1,145	200	249		1,031	65	275	30	266

[1)] Including feed losses of 2% of concentrate feed and 5% of preserved roughage.
[2)] Including supplementary feeds and singular compounded concentrate sources.

Table 3.17
Feed uptake by female young stock, 12 months and over[1)]

	Female young stock, 12 months and over							
	housing period					grazing period		
	number of days	VEM requirement	standard concentrate feed[2)]	maize silage	grass silage and hay	number of days	VEM requirement	fresh grass
		kVEM	*kg*	*kg dry weight*			*kVEM*	*kg dry weight*
South-east Netherlands								
1990	205	1,385	226	138	1,238	160	1,225	1,256
1991	205	1,385	226	136	1,296	160	1,225	1,231
1992	205	1,385	226	136	1,338	160	1,225	1,259
1993	205	1,385	226	135	1,302	160	1,225	1,236
1994	205	1,385	226	142	1,301	160	1,225	1,221
1995	205	1,385	226	135	1,337	160	1,225	1,215
1996	205	1,385	226	134	1,286	160	1,225	1,186
1997	205	1,385	226	134	1,291	160	1,225	1,227
1998	205	1,385	226	132	1,323	160	1,225	1,201
1999	205	1,385	226	130	1,326	160	1,225	1,210
2000	205	1,385	226	126	1,280	160	1,225	1,219
2001	205	1,385	226	128	1,278	160	1,225	1,232
2002	205	1,385	226	130	1,254	160	1,225	1,237
2003	205	1,385	226	129	1,301	160	1,225	1,361
2004	205	1,385	226	130	1,297	160	1,225	1,346
2005	205	1,385	226	130	1,265	160	1,225	1,332
2006	195	1,315	214	123	1,201	170	1,300	1,429
2007	205	1,385	75	143	1,429	160	1,225	1,384
2008	220	1,485	81	154	1,522	145	1,110	1,247
North-west Netherlands								
1990	205	1,385	150		1,456	160	1,225	1,256
1991	205	1,385	150		1,525	160	1,225	1,231
1992	205	1,385	150		1,574	160	1,225	1,259
1993	205	1,385	150		1,532	160	1,225	1,236
1994	205	1,385	150		1,530	160	1,225	1,221
1995	205	1,385	150		1,573	160	1,225	1,215
1996	205	1,385	150		1,513	160	1,225	1,186
1997	205	1,385	150		1,518	160	1,225	1,227
1998	205	1,385	150		1,556	160	1,225	1,201
1999	205	1,385	150		1,560	160	1,225	1,210
2000	205	1,385	150		1,506	160	1,225	1,219
2001	205	1,385	150		1,504	160	1,225	1,232
2002	205	1,385	150		1,475	160	1,225	1,237
2003	205	1,385	150		1,531	160	1,225	1,361
2004	205	1,385	150		1,526	160	1,225	1,346
2005	205	1,385	150		1,488	160	1,225	1,332
2006	195	1,315	143		1,412	170	1,300	1,429
2007	195	1,315	71		1,508	170	1,300	1,469
2008	235	1,590	86		1,811	130	995	1,118

1) Including feed losses of 2% of concentrate feed and 5% of preserved roughage.
2) Including supplementary feeds and singular compounded concentrate sources.

Table 3.18
Feed uptake by male young stock and stud bulls[1)]

	Male young stock of 12 months and under						Male young stock of 12 to 24 months, and stud bulls of 24 months and over		
	VEM requirement	whole milk	standard concentrate feed[2)]	maize silage	grass silage and hay	fresh grass	VEM requirement	standard concentrate feed[2)]	grass silage and hay
	kVEM	*kg*		*kg dry weight*			*kVEM*	*kg*	*kg dry weight*
1990	1,650	354	275	575	575	323	2,740	297	2,880
1991	1,650	354	275	575	575	331	2,740	297	3,017
1992	1,650	354	275	575	575	353	2,740	297	3,113
1993	1,650	354	275	575	575	331	2,740	297	3,030
1994	1,650	354	275	575	575	352	2,740	297	3,028
1995	1,650	354	275	575	575	336	2,740	297	3,111
1996	1,650	354	275	575	575	309	2,740	297	2,993
1997	1,650	354	275	575	575	320	2,740	297	3,004
1998	1,650	354	275	575	575	316	2,740	297	3,079
1999	1,650	200	275	575	575	358	2,740	297	3,085
2000	1,650	200	275	575	575	327	2,740	297	2,979
2001	1,650	200	275	575	575	336	2,740	297	2,975
2002	1,650	200	275	575	575	337	2,740	297	2,918
2003	1,650	200	275	575	575	357	2,740	297	3,029
2004	1,650	200	275	575	575	418	2,740	297	3,018
2005	1,650	200	275	575	575	405	2,740	297	2,943
2006	1,650	200	275	575	575	412	2,740	297	2,943
2007	1,650	200	275	575	575	420	2,740	297	2,977
2008	1,650	200	275	575	575	420	2,740	297	2,956

[1)] Including feed losses of 2% of concentrate feed and 5% of conserved roughage.
[2)] Including singular compounded concentrate sources.

Table 3.19
Nutrient uptake and fixation by female young stock, 12 months and under

	Nutrient uptake						Nutrient fixation					
	housing period			grazing period			housing period			grazing period		
	N	P	K	N	P	K	N	P	K	N	P	K
	kg/animal											
South-east Netherlands												
1990	30.5	4.3	24.7	16.3	1.7	13.3	5.0	1.5	0.4	1.6	0.5	0.1
1991	32.3	4.7	28.1	15.8	1.6	13.9	5.0	1.5	0.4	1.6	0.5	0.1
1992	32.1	4.5	28.7	15.5	1.6	13.4	5.0	1.5	0.4	1.6	0.5	0.1
1993	32.4	4.6	28.5	15.6	1.8	14.6	5.0	1.5	0.4	1.6	0.5	0.1
1994	33.4	4.8	31.6	15.4	1.7	13.6	5.0	1.5	0.4	1.6	0.5	0.1
1995	33.4	4.7	30.1	15.4	1.6	13.3	5.0	1.5	0.4	1.6	0.5	0.1
1996	31.6	4.4	28.6	16.1	1.4	13.4	5.0	1.5	0.4	1.6	0.5	0.1
1997	34.0	4.3	29.8	16.0	1.7	13.5	5.0	1.5	0.4	1.6	0.5	0.1
1998	33.4	4.6	30.0	15.3	1.7	13.4	5.2	1.5	0.4	1.7	0.5	0.1
1999	33.2	4.9	30.9	13.5	1.7	13.2	4.9	1.5	0.4	1.6	0.5	0.1
2000	32.2	4.7	28.0	14.0	1.8	13.3	4.9	1.5	0.4	1.6	0.5	0.1
2001	32.0	4.9	29.3	13.9	1.7	13.1	4.9	1.5	0.4	1.6	0.5	0.1
2002	31.0	4.6	28.1	13.8	1.7	13.6	4.9	1.5	0.4	1.6	0.5	0.1
2003	26.7	4.1	25.5	20.1	2.4	19.4	4.1	1.3	0.4	2.3	0.7	0.2
2004	26.3	3.9	24.8	18.7	2.4	18.9	4.1	1.3	0.4	2.3	0.7	0.2
2005	26.1	3.9	24.6	18.8	2.5	19.4	4.1	1.3	0.4	2.3	0.7	0.2
2006	25.9	3.9	24.2	18.4	2.4	19.7	4.1	1.3	0.4	2.3	0.7	0.2
2007	28.5	4.2	26.1	15.3	2.1	16.1	4.5	1.4	0.4	1.9	0.6	0.2
2008	33.3	5.1	31.4	8.0	1.1	8.3	5.4	1.7	0.5	1.0	0.3	0.1
North-west Netherlands												
1990	33.0	4.3	27.2	18.0	1.9	14.7	4.8	1.4	0.4	1.8	0.5	0.1
1991	35.6	4.8	31.8	17.4	1.7	15.3	4.8	1.4	0.4	1.8	0.5	0.1
1992	35.2	4.7	32.9	17.1	1.8	14.8	4.8	1.4	0.4	1.8	0.5	0.1
1993	35.5	4.8	33.0	17.2	2.0	16.1	4.8	1.4	0.4	1.8	0.5	0.1
1994	37.1	5.0	37.0	17.0	1.8	15.1	4.8	1.4	0.4	1.8	0.5	0.1
1995	36.7	5.0	34.9	17.0	1.8	14.6	4.8	1.4	0.4	1.8	0.5	0.1
1996	34.4	4.6	32.8	17.8	1.5	14.7	4.8	1.4	0.4	1.8	0.5	0.1
1997	38.2	4.5	35.0	17.6	1.8	14.9	4.8	1.4	0.4	1.8	0.5	0.1
1998	37.5	5.0	35.5	16.9	1.8	14.7	5.0	1.5	0.4	1.9	0.6	0.2
1999	37.1	5.3	36.9	14.9	1.9	14.5	4.7	1.5	0.4	1.8	0.6	0.2
2000	35.8	4.9	32.9	15.4	1.9	14.7	4.7	1.5	0.4	1.8	0.6	0.2
2001	35.6	5.2	34.9	15.3	1.9	14.4	4.7	1.5	0.4	1.8	0.6	0.2
2002	33.9	4.8	32.7	15.3	1.9	15.0	4.7	1.5	0.4	1.8	0.6	0.2
2003	28.9	4.4	29.5	21.5	2.6	20.8	4.0	1.2	0.3	2.5	0.8	0.2
2004	28.4	4.1	28.8	20.1	2.6	20.3	4.0	1.2	0.3	2.5	0.8	0.2
2005	28.1	4.1	28.5	20.2	2.6	20.8	4.0	1.2	0.3	2.5	0.8	0.2
2006	27.9	4.1	27.9	19.8	2.6	21.1	4.0	1.2	0.3	2.5	0.8	0.2
2007	29.7	4.2	29.4	18.1	2.5	19.0	4.1	1.3	0.4	2.3	0.7	0.2
2008	36.6	5.5	37.3	9.4	1.3	9.7	5.3	1.7	0.5	1.1	0.4	0.1

Table 3.20
Nutrient excretion from female young stock, 12 months and under, per region

	Housing period			Grazing period			Full year		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	kg/animal								
South-east Netherlands									
1990	25.4	6.6	29.3	14.7	2.9	15.9	40.1	9.5	45.2
1991	27.3	7.3	33.4	14.1	2.5	16.6	41.4	9.8	50.0
1992	27.1	6.8	34.1	13.9	2.6	16.0	41.0	9.4	50.1
1993	27.4	7.1	33.8	13.9	3.0	17.4	41.3	10.1	51.2
1994	28.4	7.5	37.6	13.8	2.7	16.3	42.2	10.2	53.9
1995	28.3	7.5	35.8	13.8	2.5	15.8	42.1	10.0	51.6
1996	26.5	6.6	33.9	14.4	2.1	15.9	40.9	8.7	49.8
1997	29.0	6.5	35.4	14.3	2.7	16.1	43.3	9.2	51.5
1998	28.2	7.1	35.7	13.6	2.6	15.9	41.8	9.7	51.6
1999	28.4	7.8	36.7	11.9	2.7	15.7	40.3	10.5	52.4
2000	27.4	7.2	33.2	12.4	2.9	15.9	39.8	10.1	49.1
2001	27.2	7.7	34.8	12.3	2.8	15.6	39.5	10.5	50.4
2002	26.1	7.0	33.3	12.2	2.9	16.3	38.3	9.9	49.6
2003	22.6	6.5	30.3	17.8	3.8	23.1	40.4	10.3	53.4
2004	22.2	6.0	29.4	16.4	3.9	22.6	38.6	9.9	52.0
2005	22.0	6.0	29.2	16.5	4.0	23.1	38.5	10.0	52.3
2006	21.8	6.0	28.7	16.1	3.9	23.5	37.9	9.9	52.2
2007	24.0	6.3	31.0	13.4	3.4	19.2	37.4	9.7	50.2
2008	27.9	7.8	37.3	7.1	1.8	9.9	35.0	9.6	47.2
North-west Netherlands									
1990	28.1	6.7	32.4	16.2	3.1	17.6	44.3	9.8	50.0
1991	30.7	7.7	37.9	15.6	2.7	18.3	46.3	10.4	56.2
1992	30.4	7.6	39.1	15.3	2.9	17.6	45.7	10.5	56.7
1993	30.7	7.9	39.3	15.4	3.3	19.2	46.1	11.2	58.5
1994	32.3	8.2	44.1	15.2	3.0	18.0	47.5	11.2	62.1
1995	31.8	8.3	41.6	15.2	2.8	17.4	47.0	11.1	59.0
1996	29.6	7.3	39.0	15.9	2.3	17.6	45.5	9.6	56.6
1997	33.4	7.1	41.7	15.8	3.0	17.8	49.2	10.1	59.5
1998	32.5	8.1	42.3	15.0	2.9	17.6	47.5	11.0	59.9
1999	32.4	8.8	43.9	13.1	3.0	17.3	45.5	11.8	61.2
2000	31.1	7.9	39.2	13.7	3.2	17.5	44.8	11.1	56.7
2001	31.0	8.6	41.6	13.6	3.0	17.2	44.6	11.6	58.8
2002	29.3	7.6	38.9	13.5	3.1	17.9	42.8	10.7	56.8
2003	24.9	7.1	35.2	19.1	4.1	24.8	44.0	11.2	60.0
2004	24.5	6.6	34.3	17.6	4.1	24.2	42.1	10.7	58.5
2005	24.2	6.5	33.9	17.7	4.3	24.8	41.9	10.8	58.7
2006	23.9	6.4	33.2	17.3	4.2	25.2	41.2	10.6	58.4
2007	25.6	6.6	35.0	15.8	4.0	22.7	41.4	10.6	57.7
2008	31.3	8.8	44.4	8.2	2.1	11.5	39.5	10.9	55.9

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

Table 3.21
Nutrient excretion from female young stock, 12 months and under, for the Netherlands as a whole

	Housing period			Grazing period			Full year		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	kg/animal								
Female young stock, 12 months and under, for dairy farming									
1990	26.5	6.6	30.6	15.3	3.0	16.6	41.8	9.6	47.2
1991	28.7	7.5	35.2	14.7	2.6	17.3	43.4	10.1	52.5
1992	28.4	7.1	36.1	14.5	2.7	16.7	42.9	9.8	52.8
1993	28.7	7.4	36.0	14.5	3.1	18.1	43.2	10.5	54.1
1994	30.0	7.8	40.3	14.4	2.8	17.0	44.4	10.6	57.3
1995	29.8	7.8	38.2	14.4	2.6	16.5	44.2	10.4	54.7
1996	27.8	6.9	36.0	15.0	2.2	16.6	42.8	9.1	52.6
1997	30.9	6.8	38.1	14.9	2.8	16.8	45.8	9.6	54.9
1998	30.1	7.5	38.5	14.2	2.7	16.6	44.3	10.2	55.1
1999	30.1	8.2	39.8	12.4	2.8	16.4	42.5	11.0	56.2
2000	29.0	7.5	35.9	13.0	3.0	16.6	42.0	10.5	52.5
2001	28.9	8.1	37.8	12.9	2.9	16.3	41.8	11.0	54.1
2002	27.6	7.3	35.8	12.8	3.0	17.0	40.4	10.3	52.8
2003	23.7	6.8	32.5	18.4	3.9	23.9	42.1	10.7	56.4
2004	23.2	6.3	31.6	16.9	4.0	23.3	40.1	10.3	54.9
2005	23.0	6.2	31.3	17.0	4.1	23.9	40.0	10.3	55.2
2006	22.8	6.2	30.8	16.6	4.0	24.3	39.4	10.2	55.1
2007	24.6	6.4	32.5	14.3	3.6	20.5	38.9	10.0	53.0
2008	29.2	8.2	40.1	7.5	1.9	10.5	36.7	10.1	50.6
Female young stock, 12 months and under, for meat production									
1990	26.2	6.6	30.3	15.2	3.0	16.5	41.4	9.6	46.8
1991	28.4	7.4	34.9	14.6	2.6	17.2	43.0	10.0	52.1
1992	28.2	7.0	35.8	14.4	2.7	16.6	42.6	9.7	52.4
1993	28.5	7.3	35.7	14.4	3.1	18.0	42.9	10.4	53.7
1994	29.7	7.7	39.8	14.3	2.8	16.9	44.0	10.5	56.7
1995	29.4	7.7	37.7	14.3	2.6	16.3	43.7	10.3	54.0
1996	27.5	6.8	35.6	14.9	2.2	16.5	42.4	9.0	52.1
1997	30.4	6.7	37.5	14.8	2.8	16.7	45.2	9.5	54.2
1998	29.6	7.4	37.9	14.1	2.7	16.5	43.7	10.1	54.4
1999	29.7	8.1	39.0	12.3	2.8	16.2	42.0	10.9	55.2
2000	28.6	7.4	35.2	12.8	3.0	16.4	41.4	10.4	51.6
2001	28.5	8.0	37.1	12.7	2.9	16.1	41.2	10.9	53.2
2002	27.2	7.2	35.3	12.7	3.0	16.9	39.9	10.2	52.2
2003	23.4	6.7	32.0	18.3	3.9	23.7	41.7	10.6	55.7
2004	23.0	6.2	31.2	16.8	4.0	23.2	39.8	10.2	54.4
2005	22.8	6.2	30.9	16.9	4.1	23.7	39.7	10.3	54.6
2006	22.5	6.1	30.3	16.5	4.0	24.1	39.0	10.1	54.4
2007	24.4	6.4	32.0	14.0	3.6	20.1	38.4	10.0	52.1
2008	28.8	8.1	39.1	7.4	1.9	10.3	36.2	10.0	49.4

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

Table 3.22
Nutrient uptake and fixation by female young stock, 12 months and over

	Nutrient uptake						Nutrient fixation					
	housing period			grazing period			housing period			grazing period		
	N	P	K	N	P	K	N	P	K	N	P	K
	kg/animal											
South-east Netherlands												
1990	45.4	5.8	40.2	53.9	5.4	45.1	3.5	1.0	0.3	2.7	0.8	0.2
1991	49.1	6.5	46.9	51.8	4.8	46.8	3.5	1.0	0.3	2.7	0.8	0.2
1992	48.5	6.3	48.4	50.7	5.0	45.1	3.5	1.0	0.3	2.7	0.8	0.2
1993	48.8	6.5	48.2	50.8	5.6	49.2	3.5	1.0	0.3	2.7	0.8	0.2
1994	51.4	6.7	54.5	50.5	5.1	46.0	3.5	1.0	0.3	2.7	0.8	0.2
1995	50.5	6.7	51.4	50.2	4.9	44.6	3.5	1.0	0.3	2.7	0.8	0.2
1996	47.2	6.1	48.3	52.8	4.3	45.1	3.5	1.0	0.3	2.7	0.8	0.2
1997	53.0	6.0	51.5	52.5	5.2	45.8	3.5	1.0	0.3	2.7	0.8	0.2
1998	51.7	6.7	52.2	50.0	5.2	45.2	3.5	1.0	0.3	2.7	0.8	0.2
1999	49.8	7.1	51.7	43.6	5.2	44.6	3.0	1.0	0.3	2.3	0.8	0.2
2000	47.9	6.5	46.2	45.2	5.5	45.1	3.0	1.0	0.3	2.3	0.8	0.2
2001	47.8	7.0	48.9	45.1	5.3	44.2	3.0	1.0	0.3	2.3	0.8	0.2
2002	45.4	6.3	45.7	44.8	5.4	46.0	3.0	1.0	0.3	2.3	0.8	0.2
2003	45.9	6.8	49.3	39.2	5.6	49.3	2.9	1.0	0.3	2.3	0.8	0.2
2004	45.0	6.4	48.1	35.5	5.5	47.2	2.9	1.0	0.3	2.3	0.8	0.2
2005	44.5	6.3	47.4	35.4	5.6	48.0	2.9	1.0	0.3	2.3	0.8	0.2
2006	41.8	6.0	44.1	36.6	5.9	51.4	2.8	0.9	0.2	2.4	0.8	0.2
2007	45.2	6.2	49.9	33.8	5.7	47.1	2.9	1.0	0.3	2.3	0.8	0.2
2008	46.6	6.9	52.9	32.3	4.8	43.6	3.2	1.0	0.3	2.1	0.7	0.2
North-west Netherlands												
1990	48.1	5.9	43.2	53.9	5.4	45.1	3.5	1.0	0.3	2.7	0.8	0.2
1991	52.5	6.7	51.1	51.8	4.8	46.8	3.5	1.0	0.3	2.7	0.8	0.2
1992	51.7	6.6	52.9	50.7	5.0	45.1	3.5	1.0	0.3	2.7	0.8	0.2
1993	52.0	6.8	52.9	50.8	5.6	49.2	3.5	1.0	0.3	2.7	0.8	0.2
1994	55.1	7.0	60.2	50.5	5.1	46.0	3.5	1.0	0.3	2.7	0.8	0.2
1995	53.9	7.0	56.5	50.2	4.9	44.6	3.5	1.0	0.3	2.7	0.8	0.2
1996	50.3	6.4	52.9	52.8	4.3	45.1	3.5	1.0	0.3	2.7	0.8	0.2
1997	57.2	6.2	56.9	52.5	5.2	45.8	3.5	1.0	0.3	2.7	0.8	0.2
1998	55.8	7.1	57.9	50.0	5.2	45.2	3.5	1.0	0.3	2.7	0.8	0.2
1999	53.5	7.5	57.5	43.6	5.2	44.6	3.0	1.0	0.3	2.3	0.8	0.2
2000	51.3	6.8	51.0	45.2	5.5	45.1	3.0	1.0	0.3	2.3	0.8	0.2
2001	51.2	7.3	54.3	45.1	5.3	44.2	3.0	1.0	0.3	2.3	0.8	0.2
2002	48.3	6.6	50.2	44.8	5.4	46.0	3.0	1.0	0.3	2.3	0.8	0.2
2003	48.7	7.2	54.5	39.2	5.6	49.3	2.9	1.0	0.3	2.3	0.8	0.2
2004	47.7	6.7	53.1	35.5	5.5	47.2	2.9	1.0	0.3	2.3	0.8	0.2
2005	47.1	6.6	52.2	35.4	5.6	48.0	2.9	1.0	0.3	2.3	0.8	0.2
2006	44.2	6.2	48.6	36.6	5.9	51.4	2.8	0.9	0.2	2.4	0.8	0.2
2007	45.6	6.2	50.8	35.8	6.0	49.9	2.8	0.9	0.2	2.4	0.8	0.2
2008	53.0	7.8	60.8	29.0	4.3	39.1	3.4	1.1	0.3	1.9	0.6	0.2

Table 3.23
Nutrient excretion from female young stock, 12 months and over, per region

	Housing period			Grazing period			Full year		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	kg/animal								
South-east Netherlands									
1990	42.0	11.1	48.2	51.2	10.6	54.1	93.2	21.7	102.3
1991	45.6	12.6	56.2	49.1	9.2	56.1	94.7	21.8	112.3
1992	45.0	12.2	58.0	48.0	9.8	54.1	93.0	22.0	112.1
1993	45.4	12.6	57.8	48.1	11.0	59.0	93.5	23.6	116.8
1994	47.9	13.2	65.4	47.8	10.0	55.2	95.7	23.2	120.6
1995	47.0	13.2	61.7	47.5	9.4	53.5	94.5	22.6	115.2
1996	43.7	11.7	57.9	50.1	8.0	54.1	93.8	19.7	112.0
1997	49.5	11.5	61.8	49.8	10.0	54.9	99.3	21.5	116.7
1998	48.3	13.1	62.6	47.3	10.0	54.2	95.6	23.1	116.8
1999	46.8	13.9	62.0	41.2	10.1	53.6	88.0	24.0	115.6
2000	44.9	12.6	55.3	42.9	10.8	54.1	87.8	23.4	109.4
2001	44.8	13.7	58.6	42.8	10.4	53.1	87.6	24.1	111.7
2002	42.4	12.3	54.8	42.4	10.7	55.2	84.8	23.0	110.0
2003	42.9	13.4	59.1	36.9	11.0	59.1	79.8	24.4	118.2
2004	42.0	12.5	57.6	33.2	10.9	56.7	75.2	23.4	114.3
2005	41.5	12.2	56.9	33.1	11.1	57.5	74.6	23.3	114.4
2006	39.0	11.6	52.9	34.1	11.6	61.7	73.1	23.2	114.6
2007	42.3	12.0	59.9	31.5	11.2	56.5	73.8	23.2	116.4
2008	43.4	13.4	63.4	30.2	9.5	52.4	73.6	22.9	115.8
North-west Netherlands									
1990	44.7	11.2	51.8	51.2	10.6	54.1	95.9	21.8	105.9
1991	49.0	13.0	61.2	49.1	9.2	56.1	98.1	22.2	117.3
1992	48.2	12.8	63.4	48.0	9.8	54.1	96.2	22.6	117.5
1993	48.6	13.2	63.5	48.1	11.0	59.0	96.7	24.2	122.5
1994	51.7	13.8	72.2	47.8	10.0	55.2	99.5	23.8	127.4
1995	50.4	13.9	67.8	47.5	9.4	53.5	97.9	23.3	121.3
1996	46.8	12.3	63.4	50.1	8.0	54.1	96.9	20.3	117.5
1997	53.7	12.0	68.3	49.8	10.0	54.9	103.5	22.0	123.2
1998	52.4	14.0	69.5	47.3	10.0	54.2	99.7	24.0	123.7
1999	50.5	14.8	69.0	41.2	10.1	53.6	91.7	24.9	122.6
2000	48.3	13.3	61.2	42.9	10.8	54.1	91.2	24.1	115.3
2001	48.2	14.5	65.1	42.8	10.4	53.1	91.0	24.9	118.2
2002	45.3	12.8	60.2	42.4	10.7	55.2	87.7	23.5	115.4
2003	45.8	14.1	65.3	36.9	11.0	59.1	82.7	25.1	124.4
2004	44.8	13.1	63.7	33.2	10.9	56.7	78.0	24.0	120.4
2005	44.2	12.8	62.6	33.1	11.1	57.5	77.3	23.9	120.1
2006	41.4	12.1	58.2	34.1	11.6	61.7	75.5	23.7	119.9
2007	42.8	12.1	61.0	33.4	11.9	59.9	76.2	24.0	120.9
2008	49.6	15.3	72.9	27.1	8.5	47.0	76.7	23.8	119.9

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

Table 3.24
Nutrient excretion from female young stock, 12 to 24 months, for the Netherlands as a whole

	Housing period			Grazing period			Full year		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	kg/animal								
Female young stock, 12 to 24 months, for dairy farming									
1990	43.1	11.1	49.7	51.2	10.6	54.1	94.3	21.7	103.8
1991	47.0	12.8	58.3	49.1	9.2	56.1	96.1	22.0	114.4
1992	46.3	12.4	60.2	48.0	9.8	54.1	94.3	22.2	114.3
1993	46.7	12.8	60.2	48.1	11.0	59.0	94.8	23.8	119.2
1994	49.5	13.5	68.2	47.8	10.0	55.2	97.3	23.5	123.4
1995	48.4	13.5	64.3	47.5	9.4	53.5	95.9	22.9	117.8
1996	45.0	12.0	60.2	50.1	8.0	54.1	95.1	20.0	114.3
1997	51.3	11.7	64.6	49.8	10.0	54.9	101.1	21.7	119.5
1998	50.1	13.5	65.6	47.3	10.0	54.2	97.4	23.5	119.8
1999	48.4	14.3	65.0	41.2	10.1	53.6	89.6	24.4	118.6
2000	46.4	12.9	57.9	42.9	10.8	54.1	89.3	23.7	112.0
2001	46.3	14.1	61.5	42.8	10.4	53.1	89.1	24.5	114.6
2002	43.7	12.5	57.2	42.4	10.7	55.2	86.1	23.2	112.4
2003	44.2	13.7	61.9	36.9	11.0	59.1	81.1	24.7	121.0
2004	43.3	12.8	60.4	33.2	10.9	56.7	76.5	23.7	117.1
2005	42.7	12.5	59.5	33.1	11.1	57.5	75.8	23.6	117.0
2006	40.1	11.8	55.3	34.1	11.6	61.7	74.2	23.4	117.0
2007	42.5	12.0	60.3	32.2	11.5	57.8	74.7	23.5	118.1
2008	45.8	14.1	67.1	29.0	9.1	50.3	74.8	23.2	117.4
Female young stock, 12 to 24 months, for meat production									
1990	43.0	11.1	49.5	51.2	10.6	54.1	94.2	21.7	103.6
1991	46.8	12.7	58.0	49.1	9.2	56.1	95.9	21.9	114.1
1992	46.2	12.4	60.0	48.0	9.8	54.1	94.2	22.2	114.1
1993	46.6	12.8	59.9	48.1	11.0	59.0	94.7	23.8	118.9
1994	49.3	13.4	67.9	47.8	10.0	55.2	97.1	23.4	123.1
1995	48.2	13.5	63.9	47.5	9.4	53.5	95.7	22.9	117.4
1996	44.8	11.9	59.8	50.1	8.0	54.1	94.9	19.9	113.9
1997	50.9	11.7	64.0	49.8	10.0	54.9	100.7	21.7	118.9
1998	49.7	13.4	64.9	47.3	10.0	54.2	97.0	23.4	119.1
1999	48.0	14.2	64.3	41.2	10.1	53.6	89.2	24.3	117.9
2000	46.0	12.8	57.2	42.9	10.8	54.1	88.9	23.6	111.3
2001	45.9	14.0	60.8	42.8	10.4	53.1	88.7	24.4	113.9
2002	43.4	12.5	56.7	42.4	10.7	55.2	85.8	23.2	111.9
2003	43.9	13.6	61.3	36.9	11.0	59.1	80.8	24.6	120.4
2004	43.0	12.7	59.7	33.2	10.9	56.7	76.2	23.6	116.4
2005	42.4	12.4	58.9	33.1	11.1	57.5	75.5	23.5	116.4
2006	39.8	11.8	54.7	34.1	11.6	61.7	73.9	23.4	116.4
2007	42.4	12.0	60.2	32.0	11.4	57.4	74.4	23.4	117.6
2008	45.0	13.9	65.8	29.4	9.2	51.0	74.4	23.1	116.8

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

Table 3.25
Nutrient excretion from female young stock, 24 months and over, for the Netherlands as a whole

	Housing period			Grazing period			Full year		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	kg/animal								
Female young stock, 24 months and over, for dairy farming									
1990	43.0	11.1	49.5	51.2	10.6	54.1	94.2	21.7	103.6
1991	46.9	12.8	58.1	49.1	9.2	56.1	96.0	22.0	114.2
1992	46.3	12.4	60.1	48.0	9.8	54.1	94.3	22.2	114.2
1993	46.6	12.8	60.0	48.1	11.0	59.0	94.7	23.8	119.0
1994	49.4	13.4	68.0	47.8	10.0	55.2	97.2	23.4	123.2
1995	48.4	13.5	64.1	47.5	9.4	53.5	95.9	22.9	117.6
1996	45.0	11.9	60.1	50.1	8.0	54.1	95.1	19.9	114.2
1997	51.2	11.7	64.5	49.8	10.0	54.9	101.0	21.7	119.4
1998	50.0	13.5	65.5	47.3	10.0	54.2	97.3	23.5	119.7
1999	48.3	14.3	64.9	41.2	10.1	53.6	89.5	24.4	118.5
2000	46.3	12.9	57.8	42.9	10.8	54.1	89.2	23.7	111.9
2001	46.3	14.0	61.4	42.8	10.4	53.1	89.1	24.4	114.5
2002	43.7	12.5	57.2	42.4	10.7	55.2	86.1	23.2	112.4
2003	44.2	13.7	61.8	36.9	11.0	59.1	81.1	24.7	120.9
2004	43.3	12.8	60.4	33.2	10.9	56.7	76.5	23.7	117.1
2005	42.7	12.5	59.5	33.1	11.1	57.5	75.8	23.6	117.0
2006	40.1	11.8	55.3	34.1	11.6	61.7	74.2	23.4	117.0
2007	42.5	12.0	60.3	32.2	11.5	57.8	74.7	23.5	118.1
2008	45.8	14.1	67.1	29.0	9.1	50.3	74.8	23.2	117.4
Female young stock, 24 months and over, for meat production									
1990	43.1	11.1	49.7	51.2	10.6	54.1	94.3	21.7	103.8
1991	47.0	12.8	58.3	49.1	9.2	56.1	96.1	22.0	114.4
1992	46.4	12.5	60.3	48.0	9.8	54.1	94.4	22.3	114.4
1993	46.7	12.9	60.2	48.1	11.0	59.0	94.8	23.9	119.2
1994	49.4	13.4	68.1	47.8	10.0	55.2	97.2	23.4	123.3
1995	48.4	13.5	64.2	47.5	9.4	53.5	95.9	22.9	117.7
1996	45.0	11.9	60.2	50.1	8.0	54.1	95.1	19.9	114.3
1997	51.1	11.7	64.2	49.8	10.0	54.9	100.9	21.7	119.1
1998	49.7	13.4	65.0	47.3	10.0	54.2	97.0	23.4	119.2
1999	48.1	14.2	64.4	41.2	10.1	53.6	89.3	24.3	118.0
2000	46.1	12.8	57.3	42.9	10.8	54.1	89.0	23.6	111.4
2001	45.9	14.0	60.7	42.8	10.4	53.1	88.7	24.4	113.8
2002	43.3	12.5	56.5	42.4	10.7	55.2	85.7	23.2	111.7
2003	43.9	13.6	61.3	36.9	11.0	59.1	80.8	24.6	120.4
2004	43.0	12.7	59.8	33.2	10.9	56.7	76.2	23.6	116.5
2005	42.5	12.4	59.0	33.1	11.1	57.5	75.6	23.5	116.5
2006	39.9	11.8	54.9	34.1	11.6	61.7	74.0	23.4	116.6
2007	42.4	12.0	60.2	32.0	11.4	57.3	74.4	23.4	117.5
2008	44.9	13.9	65.7	29.4	9.3	51.1	74.3	23.2	116.8

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

Table 3.26
Nutrient uptake, fixation and excretion by male young stock of 12 months and under, and stud bulls of 12 months and over

	Male young stock of 12 months and under									Stud bulls of 12 months and over								
	uptake			fixation			excretion			uptake			fixation			excretion		
	N	P	K	N	P	K	N	P_2O_5	K_2O	N	P	K	N	P	K	N	P_2O_5	K_2O
	kg/animal																	
1990	48.4	6.5	40.9	8.7	2.5	0.7	39.6	9.1	48.5	95.2	11.7	85.5	4.7	1.4	0.4	90.6	23.5	102.6
1991	49.1	6.6	44.3	8.7	2.5	0.7	40.4	9.3	52.6	103.8	13.2	101.0	4.7	1.4	0.4	99.1	27.1	121.3
1992	48.7	6.2	44.0	8.7	2.5	0.7	40.0	8.3	52.2	102.3	13.0	104.5	4.7	1.4	0.4	97.6	26.7	125.5
1993	48.9	6.5	44.3	8.7	2.5	0.7	40.2	9.1	52.5	102.9	13.4	104.7	4.7	1.4	0.4	98.2	27.5	125.7
1994	50.4	6.7	47.2	8.7	2.5	0.7	41.7	9.6	56.1	109.1	13.9	119.1	4.7	1.4	0.4	104.5	28.7	143.0
1995	49.5	6.5	45.0	8.7	2.5	0.7	40.8	9.0	53.4	106.6	13.9	111.8	4.7	1.4	0.4	101.9	28.8	134.2
1996	48.3	5.9	43.8	8.7	2.5	0.7	39.6	7.7	51.9	99.4	12.6	104.6	4.7	1.4	0.4	94.7	25.6	125.6
1997	50.3	6.1	44.6	8.7	2.5	0.7	41.6	8.2	52.9	113.2	12.3	112.7	4.7	1.4	0.4	108.5	25.0	135.3
1998	48.5	6.3	44.1	9.0	2.6	0.7	39.5	8.5	52.3	110.5	14.1	114.6	4.7	1.4	0.4	105.8	29.1	137.6
1999	46.9	6.6	44.6	9.0	2.6	0.7	37.9	9.2	52.8	105.7	14.7	113.8	4.7	1.4	0.4	101.0	30.6	136.7
2000	46.0	6.5	41.6	9.0	2.6	0.7	37.0	8.8	49.3	101.5	13.4	100.9	4.7	1.4	0.4	96.8	27.6	121.2
2001	46.1	6.7	42.4	9.0	2.6	0.7	37.1	9.3	50.2	101.3	14.5	107.5	4.7	1.4	0.4	96.6	30.0	129.1
2002	45.4	6.5	42.6	9.0	2.6	0.7	36.4	8.9	50.4	95.5	13.0	99.4	4.7	1.4	0.4	90.8	26.6	119.3
2003	45.9	6.6	44.1	8.9	2.6	0.7	36.9	9.2	52.2	96.4	14.2	107.8	4.7	1.4	0.4	91.7	29.2	129.5
2004	46.2	6.6	44.9	8.9	2.6	0.7	37.2	9.2	53.2	94.4	13.2	105.0	4.7	1.4	0.4	89.7	27.1	126.1
2005	46.0	6.7	45.2	8.9	2.6	0.7	37.0	9.3	53.6	93.2	13.0	103.3	4.7	1.4	0.4	88.5	26.5	124.1
2006	45.7	6.7	45.0	8.9	2.6	0.7	36.7	9.3	53.4	92.1	12.9	101.2	4.7	1.4	0.4	87.4	26.5	121.5
2007	45.5	6.6	43.9	8.9	2.6	0.7	36.6	9.2	52.0	94.3	12.9	102.4	4.7	1.4	0.4	89.6	26.5	122.9
2008	44.9	6.7	43.6	8.9	2.6	0.7	35.9	9.4	51.7	90.6	13.4	101.1	4.7	1.4	0.4	86.0	27.5	121.4

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

3.4.3 Fattening calves

Index numbers
Up to 1994, the agricultural census did not differentiate between white-meat calves and pink-meat calves. All meat calves in this period were considered to be white meat. Index numbers are shown in Table 3.27. The share of pink-meat calves in 1995 was 13 percent.

Feed uptake fattening calves, white meat
Feed uptake over the 1990–1997 period was calculated on the basis of data on feed conversion and growth (IKC, 1992a). Data on feed types were based on inventory data from milk powder producers as well as on practical data. On the basis of this information, the average nutrient content in artificial milk for meat calves was calculated.

From 1998 onwards, index numbers have been revised (Heeres-van der Tol, 2001). From 1 January 1998, farmers were obliged to provide their calves with raw feed (*Kalverbesluit 1998* (Dutch decree on calves)). This caused the use of artificial milk to decline in favour of raw feed. In addition to maize silage, also straw pellets, crushed barley and 'raw feed mix' were provided, as well as artificial milk. Around 10 percent of calves were fed 10 kg of crushed barley; 40 percent received around 110 kg of maize silage; and around 50 percent received a raw feed mix that consisted of straw pellets and barley. These mixes are assumed to have consisted of 50 percent straw pellets and 50 percent crushed barley. This would amount to 12.5 kg of straw pellets and 12.5 kg of barley (gross intake per feeding).
Based on a follow-up study (Heeres-van der Tol, 2002), certain index numbers were revised in 2002: 50 percent of calves received maize silage and 50 percent were fed on a mix of barley straw and crushed barley (50/50). Feed consisting solely of barley was not used. Raw feed converted to amounts per calf consisted of: 17.5 kg dry weight of maize silage and 17.5 kg dry weight of barley–straw mix. Artificial milk intake remained at 340 kg per feeding. Data on feed uptake since 2004 were been based on data from the Dutch handbooks on Quantitative Livestock Farming Information (*Kwantitatieve Informatie Veehouderij* (KWIN-V)).

Feed uptake fattening calves, pink meat
Rations in 1995 were based on information from the Information and Knowledge Centre (IKC) (Van Vliet, 1996). In 1999, the fattening period was expanded by 14 days to 246 days, which caused calves to increase in weight. When fattening periods are expanded, concentrate feed shares can be reduced. Here, an average of 65 percent in concentrate

Table 3.27
Index numbers for fattening calves

	Fattening calves, white meat				Fattening calves, pink meat			
	birth weight	finishing weight	production period	growth	birth weight	finishing weight	production period	growth
	kg		*days*	*g/day*	*kg*		*days*	*g/day*
1990	43	230	186	1,005				
1991	43	230	186	1,005				
1992	43	230	186	1,005				
1993	43	230	186	1,005				
1994	43	230	186	1,005				
1995	43	230	186	1,005	43	310	225	1,187
1996	43	230	186	1,005	43	310	225	1,187
1997	43	230	186	1,005	43	310	225	1,187
1998	43	258	186	1,156	43	325	238	1,185
1999	43	245	172	1,174	43	336	246	1,191
2000	43	245	172	1,174	43	336	246	1,191
2001	43	245	172	1,174	43	336	246	1,191
2002	43	245	172	1,174	43	336	246	1,191
2003	44	245	172	1,169	44	336	246	1,187
2004	44	237	178	1,084	44	345	260	1,158
2005	44	237	178	1,084	44	345	260	1,158
2006	44	237	178	1,084	44	345	260	1,158
2007	44	237	178	1,084	44	345	260	1,158
2008	44	237	178	1,084	44	345	260	1,158

Sources: see text.

feed on dry weight basis was assumed. The share of moist concentrate feed (wet byproducts) in total rations was 10 percent for calves from the age of 16 weeks onwards (Heeres-van der Tol, 2001).

In 2002, basic assumptions were revised once more. During the first 13 weeks (0–3 months), rations were now believed to consist of 40 kg starting milk together with a mix of maize silage and starting feed, in a dry weight ratio of 35:65. At 13 weeks feed would be adjusted to finishing pellets and at 16 weeks 12.5 percent of the concentrate feed would be replaced with a mixture of wet by-products. Rations at this time would consist of 35 percent maize silage and 52.5 percent finishing pellets in dry weight, and 12.5 percent in wet by-products (Heeres-van der Tol, 2002).

Table 3.28
Feed uptake by fattening calves, per animal[1)]

	Fattening calves, white meat			Fattening calves, pink meat				
	artificial milk	concentrate feed[2)]	maize silage	artificial milk	moist concentrate feed	starting feed	finishing feed	maize silage
	kg		*kg dry weight*	*kg*	*kg dry weight*	*kg*		*kg dry weight*
1990	679	–	–					
1991	679	–	–					
1992	679	–	–					
1993	679	–	–					
1994	679	–	–					
1995	679	–	37	73	227	365	592	462
1996	679	–	37	73	227	365	592	462
1997	679	–	36	73	227	365	592	462
1998	717	26	30	69	221	337	560	394
1999	722	28	32	59	159	153	849	872
2000	722	28	32	59	159	153	849	872
2001	722	28	31	59	159	153	849	872
2002	722	43	37	52	159	153	849	574
2003	722	43	37	52	159	153	849	574
2004	656	–	103	49	332	142	599	673
2005	656	–	103	49	332	142	599	673
2006	666	–	144	49	332	142	599	673
2007	666	–	144	49	332	142	599	673
2008	666	–	144	49	332	142	599	673

1) Including feed losses of 2% of concentrate feed, 3% of moist concentrate feed and 5% of preserved roughage.
2) Concentrate feed consists of mixtures of straw pellets and/or crushed barley.

Table 3.29
Nutrient uptake, fixation and excretion by fattening calves

	Fattening calves, white meat									Fattening calves, pink meat								
	uptake			fixation			excretion			uptake			fixation			excretion		
	N	P	K	N	P	K	N	P_2O_5	K_2O	N	P	K	N	P	K	N	P_2O_5	K_2O
	kg/animal																	
1990	21.8	4.6	10.0	11.2	2.8	0.7	10.6	4.3	11.2									
1991	21.8	4.6	10.0	11.2	2.8	0.7	10.6	4.3	11.2									
1992	21.8	4.6	10.0	11.2	2.8	0.7	10.6	4.3	11.2									
1993	21.8	4.6	10.0	11.2	2.8	0.7	10.6	4.3	11.2									
1994	21.8	4.6	10.0	11.2	2.8	0.7	10.6	4.3	11.2									
1995	22.7	4.8	11.9	11.2	2.8	0.7	11.6	4.6	13.5	41.4	7.3	24.3	12.5	3.3	0.8	28.9	9.3	28.3
1996	22.6	4.5	11.9	11.2	2.8	0.7	11.4	4.0	13.5	41.8	7.3	24.0	12.5	3.3	0.8	29.3	9.1	27.9
1997	21.4	4.5	11.8	11.2	2.8	0.7	10.3	4.1	13.4	40.4	7.2	23.5	12.5	3.3	0.8	27.9	9.0	27.3
1998	22.9	5.0	12.8	11.3	2.3	0.7	11.6	6.1	14.6	39.0	6.6	20.7	11.2	2.3	0.7	27.8	9.8	24.0
1999	22.4	4.8	12.9	11.5	2.3	0.7	10.9	5.7	14.7	45.6	7.7	26.5	11.3	2.3	0.7	34.3	12.3	31.1
2000	23.4	4.5	12.9	11.5	2.3	0.7	11.9	5.0	14.7	45.4	7.7	27.0	11.3	2.3	0.7	34.1	12.4	31.7
2001	23.4	4.5	12.9	11.5	2.3	0.7	11.9	5.0	14.7	46.1	7.9	25.8	11.3	2.3	0.7	34.9	12.8	30.2
2002	23.6	4.6	13.1	11.5	2.3	0.7	12.1	5.1	15.0	41.8	6.8	23.2	11.3	2.3	0.7	30.5	10.4	27.1
2003	23.6	4.6	13.1	11.4	2.3	0.7	12.2	5.2	15.0	42.0	6.8	22.9	11.2	2.3	0.7	30.8	10.3	26.8
2004	21.2	4.1	12.4	10.6	2.1	0.6	10.5	4.6	14.1	38.0	6.6	22.2	11.0	2.8	0.7	27.1	8.7	25.9
2005	21.2	4.1	12.4	10.6	2.1	0.6	10.6	4.6	14.2	38.2	6.6	24.0	11.0	2.8	0.7	27.2	8.6	28.0
2006	21.8	4.4	13.1	10.6	2.1	0.6	11.2	5.1	15.0	38.0	6.8	22.8	11.0	2.8	0.7	27.0	9.0	26.6
2007	21.6	4.2	13.0	10.6	2.1	0.6	11.0	4.8	14.9	39.0	6.8	21.1	11.0	2.8	0.7	28.1	9.0	24.6
2008	21.3	4.0	12.9	10.6	2.1	0.6	10.7	4.3	14.8	38.3	6.6	20.6	11.0	2.8	0.7	27.4	8.6	24.0

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

From 2004 onwards, the fattening period was adjusted to 260 days (37 weeks) and finishing weight was increased from 336 to 345 kilograms (Kemme et al., 2005a). The study by Kemme et al. determined the initial weight at 46 kilograms, with the amount of artificial milk (starting milk) reduced to 30 kilograms for the first three months. These values related to calves that would be supplied to fattening farms at the age of 10 days. However, calculations of excretion factors assumed a birth weight of 44 kilograms and also included the starting milk during the first 10 days (around 5 kg). The amount of starting feed was less than was first assumed, as the animals were found to be able to take in concentrate feed and maize silage at an earlier age. The share of by-products was raised substantially. The N content in these by-products would be lower than average, as they mostly consisted of corn gluten feed, shredded potatoes and CCM (corn cob mix). Kemme et al. (2005a) set annual rations of moist concentrate feed, including CCM, in combinations of corn gluten feed - shredded potatoes - CCM, at a ratio of 66:133:133, or 1:2:2. The N content of this combination would be lower than the average content in moist concentrate feed.

3.4.4 Beef bulls

Beef bulls are considered to be male young stock bred for meat production (including oxen) of up to 12 months old, and those aged 12 to 24 months, as well as bulls of 24 months and older.

Index numbers
Up to 1997, index numbers were set by the LEI beef bull administration. The farms included in this administration were mostly specialised in beef bulls. Fattening periods at these farms generally would be shorter and growth per day higher. Nutrient excretions were calculated separately for animals up to 12 months old and those aged 12 months and over. Technical index numbers were divided according to age category, based on feeding standards (Van Vliet et al., 1994). The LEI beef bull administration was terminated in 1997.

In 1998, basic assumptions were adjusted according to Heeres-van der Tol (2001). In that report, the finishing weight for animals was set to 640 kilograms, at an age of 17 months. This finishing weight was in agreement with the finishing weight according to the LEI beef bull administration of 1994/1995 of 637 kilograms. Growth was likely to have been slightly higher than the 1070 g/day in the LEI calculations, as the share of luxury meat breeds presumably had increased since then. Growth is also likely to have been somewhat more efficient in later years.

From 2004 onwards, the basic assumptions in Kemme et al. (2005a) have been used. This study distinguishes between the period of 0 to 3 months, for which assumptions were set to those for pink-meat calves of the same age, and a period from 3 months old to finishing at 16 months and over, depending on breed. Kemme et al. distinguished between crossbred bulls (dairy breed x meat breed) and pure-bred beef bulls. Pure-bred beef bulls are finished after a suckling period of 6 to 7 months. As annual excretion levels of these animals are generally higher, but also because rations vary greatly, in actual practice, cross-bred bulls and pure-bred beef bulls were combined by Kemme et al. into one category of meat cattle of 3 months and over in red-meat production. Fixed excretions were set according to the average excretion levels of cross-bred bulls and pure-bred beef bulls. In the calculation of excretion factors, for practical reasons, an artificially mixed category was assumed. This had no effect of excretion data.

Feed uptake
The agricultural businesses included in the LEI administration were mostly located in the south of the country. In this region, raw feed uptake would consist largely of maize silage. It was assumed that in the north-western region also grass silage would have been included in the rations. This was not taken into account in the calculation of excretion factors. However, this is expected to have had only a small effect on the data, as the vast majority of beef bulls were bred in the south-eastern region. Therefore, for practical reasons, a national ration for beef bulls was set. This ration is divided into age groups of between 0 and 6 months, 7 and 12 months, and 13 months and over.

Bulls of luxury meat breeds are sometimes imported as sucklers (grass-fed calves) at ages of 6 to 7 months. Initial raising, thus, would occur abroad and feed uptake for this

period was excluded. These imported animals are also not included in the agricultural census. Therefore, per animal counted, feed use should be higher, as this increases with age. However, due to a lack of data on the share of luxury breeds or their import, beef bull rations have not been corrected accordingly.

Heeres-van der Tol (2006) used the basic assumptions in Kemme et al. (2005a) to create two age trajectories that would agree with the classifications in the agricultural census: 0 to 12 months and 12 months to finishing weight. In this classification, the distinction between cross-bred bulls and pure-bred beef bulls was maintained. In the age bracket of 12 months and over, the pure-bred beef bulls appeared to have been fed on starting feed. This followed the actual practice in which fewer kilos of concentrate feed were provided and additional low-protein by-products were included in the rations (e.g. CCM). To ensure sufficient protein within the rations, the protein content of compound feed was increase to match that of starting feed. These basic assumptions have been applied from 2004 onwards.

Table 3.30
Index numbers for beef bulls

	Starting weight	Weight at 12 months	Finishing weight cross-breeds	Finishing weight beef bulls	Age finishing weight cross-breeds	Age finishing weight beef bulls
	kg				*days*	
1990	53	450	577	577	479	479
1991	55	450	584	584	482	482
1992	53	450	588	588	480	480
1993	55	461	609	609	491	491
1994	55	450	618	618	522	522
1995	55	450	637	637	544	544
1996	52	450	610	610	515	515
1997	52	455	619	619	520	520
1998	53	465	640	640	540	540
1999	50	465	640	640	540	540
2000	50	465	640	640	540	540
2001	50	465	640	640	540	540
2002	50	465	640	640	540	540
2003	50	465	640	640	540	540
2004	44	450	625	700	519	581
2005	44	450	625	700	519	581
2006	44	450	625	700	519	581
2007	44	450	625	700	519	581
2008	44	450	625	700	519	581

Sources: see text.

Table 3.31
Feed uptake by beef bulls, per animal[1)]

	Beef bulls, 12 months and under					Beef bulls, 12 months and over			
	artificial milk	moist concentrate	starting feed	finishing feed	maize silage	moist concentrate	starting feed	finishing feed	maize silage
	kg	*kg dry weight*	*kg*		*kg dry weight*		*kg*		*kg dry weight*
1990	41	142	624	–	969	682	1,076	–	1,822
1991	37	238	594	–	933	1,114	998	–	1,710
1992	34	271	597	–	840	1,289	1,019	–	1,565
1993	36	248	580	–	842	1,396	1,075	–	1,695
1994	34	232	679	–	980	1,258	1,009	–	1,174
1995	30	125	679	–	1,059	936	956	–	1,603
1996	34	175	641	–	997	998	881	–	1,411
1997	34	181	653	–	1,045	871	907	–	1,601
1998	35	198	220	441	1,074	838	–	1,020	1,500
1999	35	198	220	441	1,054	838	–	1,020	1,487
2000	35	198	220	441	1,020	838	–	1,020	1,439
2001	35	198	220	441	981	838	–	1,020	1,455
2002	35	198	220	441	999	838	–	1,020	1,481
2003	35	198	220	441	994	838	–	1,020	1,475
2004	35	–	671	–	1,169	562	452	633	1,730
2005	35	–	671	–	1,171	562	452	633	1,733
2006	35	–	671	–	1,170	562	452	633	1,731
2007	35	–	671	–	1,150	562	452	633	1,701
2008	35	–	671	–	1,159	562	452	633	1,715

[1)] Including feed losses of 2% of concentrate feed, 3% of moist concentrate feed and 5% for preserved roughage.

Table 3.32
Nutrient uptake, fixation and excretion by beef bulls

	Beef bulls, 12 months and under									Beef bulls, 12 months and over								
	uptake			fixation			excretion			uptake			fixation			excretion		
	N	P	K	N	P	K	N	P_2O_5	K_2O	N	P	K	N	P	K	N	P_2O_5	K_2O
	kg/animal																	
1990	40.1	6.8	25.2	11.3	3.0	0.8	28.9	8.9	29.4	81.5	12.9	48.1	8.9	2.9	0.8	72.6	23.0	57.0
1991	41.1	6.9	25.6	11.2	2.9	0.7	29.9	9.0	29.9	88.6	13.6	50.2	9.3	3.0	0.8	79.3	24.4	59.5
1992	40.7	6.7	24.2	11.3	3.0	0.8	29.4	8.6	28.2	91.6	14.2	50.3	9.8	3.1	0.8	81.8	25.5	59.6
1993	39.3	6.5	23.5	11.5	3.0	0.8	27.8	8.0	27.5	93.8	14.9	56.7	9.7	3.0	0.8	84.1	27.2	67.4
1994	41.6	7.3	25.2	11.2	2.9	0.7	30.4	10.0	29.5	80.5	12.7	41.6	9.1	2.8	0.7	71.5	22.8	49.3
1995	40.7	6.9	27.2	11.2	2.9	0.7	29.5	9.0	31.8	73.7	11.9	47.4	9.0	2.7	0.7	64.7	20.9	56.2
1996	39.7	6.4	26.3	11.3	3.0	0.8	28.4	8.0	30.8	72.5	11.4	42.3	9.0	2.8	0.7	63.6	19.8	50.1
1997	39.5	6.7	25.9	11.4	3.0	0.8	28.0	8.5	30.3	67.9	11.0	43.0	8.9	2.8	0.7	59.0	18.9	50.9
1998	39.5	6.2	27.8	11.7	3.1	0.8	27.3	7.3	32.5	66.6	10.6	44.4	8.5	2.6	0.7	58.1	18.2	52.7
1999	39.2	6.3	26.5	11.8	3.1	0.8	27.4	7.4	30.9	66.9	10.7	41.3	8.5	2.6	0.7	58.4	18.5	49.0
2000	38.4	6.3	26.7	11.8	3.1	0.8	26.6	7.3	31.2	64.6	10.6	43.9	8.5	2.6	0.7	56.1	18.3	52.0
2001	38.8	6.4	24.7	11.8	3.1	0.8	27.1	7.6	28.8	67.6	11.3	39.9	8.5	2.6	0.7	59.1	19.8	47.2
2002	38.0	6.5	23.8	11.8	3.1	0.8	26.2	7.7	27.8	65.9	11.3	38.9	8.5	2.6	0.7	57.4	19.8	46.1
2003	38.3	6.4	23.9	11.8	3.1	0.8	26.6	7.6	27.8	66.2	11.0	38.9	8.5	2.6	0.7	57.8	19.2	46.1
2004	38.7	6.2	24.4	11.5	3.0	0.8	27.2	7.3	28.5	67.5	11.3	40.9	10.0	3.0	0.8	57.5	19.0	48.3
2005	38.5	6.3	25.3	11.5	3.0	0.8	27.0	7.5	29.6	66.8	11.5	43.4	10.0	3.0	0.8	56.8	19.5	51.3
2006	38.8	6.4	25.3	11.5	3.0	0.8	27.3	7.7	29.6	67.3	11.7	42.2	10.0	3.0	0.8	57.3	19.8	49.9
2007	38.1	6.2	23.6	11.5	3.0	0.8	26.6	7.2	27.6	64.6	11.3	39.6	10.0	3.0	0.8	54.5	18.9	46.7
2008	37.5	6.1	22.3	11.5	3.0	0.8	26.0	7.1	26.0	63.8	11.0	38.0	10.0	3.0	0.8	53.8	18.4	44.9

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

3.4.5 Suckler, feedlot and grazing cows

Index numbers

Suckler cows are female parents of beef bulls, which suckle their calf until around the age of 7 months, after which the calf is finished. Original index numbers originate from the IKC (1992a).

In 1998, annual replacements were revised as a result of a slightly older weaning age (Heeres-van der Tol, 2001). From 1999 onwards, around 50 percent of suckler cows were estimated to have been extensively farmed. Milk production per cow was set at 1,700 kilograms for extensively farmed animals (Heeres-van der Tol, 2002). There were few technical data available from actual practice against which the index numbers could be verified.

From 2003 onwards, in calculations of VEM requirements of these animals, the same insights were used as those used in calculations of VEM requirements of dairy cows (Tamminga et al., 2004). In addition, all suckler, feedlot and grazing cows were assumed to have been farmed extensively. According to the agricultural census of 2003, the share of suckler, feedlot and grazing cows on greatly specialised dairy farms only amounted to 4 percent. Table 3.33 provides an overview of the index numbers.

In excretion calculations for feedlot and grazing cows, the same data were used as for suckler cows.

Feed uptake

Standard rations were originally calculated on the basis of annual energy requirements of 3,120 kVEM per cow. The use of concentrate feed was set to 320 kilograms, in addition to supplements of grass silage during housing periods. In grazing periods, feed uptake would consist fully of meadow grass.

At the revision of index numbers in 1999, a distinction was made between intensively and extensively farmed suckler cows. The supply of concentrate feed (excluding calves) was derived from the DLV administration. Differences in the use of concentrate feed were very large between farms. Those that had few bulls used an average amount of concentrate feed of around 500 kilograms per cow, varying from 273 to 760 kilograms (including calves). Concentrate feed use was set at 400 kilograms for intensively farmed animals, and at 60 kilograms for those that were farmed extensively (Heeres-van der Tol, 2001).

Since 2003, the basic assumption has been that animals mostly would be farmed extensively. This would involve a concentrate feed supply of 60 kilograms per cow (Tamminga et al., 2004). Tamminga et al. furthermore assumed that the remaining feed requirement would be met from more or less equal shares of grass silage and meadow grass. In the calculations of excretion factors, the VEM requirement during housing periods would be met in the form of concentrate feed and grass silage, and in grazing periods would consist solely of meadow grass.

Excretions from suckler cows were found to be clearly lower than from dairy cows, as the lower milk production would allow for smaller feed rations. Moreover, the N content of the feed was also lower.

Table 3.33
Index numbers for suckler, feedlot and grazing cows

	Weight at first calving	Weight at time of transport	Weight calf	No. of calves per suckler cow	Replacement per year	Milk production
	kg				*share*	*kg/year*
1990	520	650	43	3	0.25	2,000
1991	520	650	43	3	0.25	2,000
1992	520	650	43	3	0.25	2,000
1993	520	650	43	3	0.25	2,000
1994	520	650	43	3	0.25	2,000
1995	520	650	43	3	0.25	2,000
1996	520	650	43	3	0.25	2,000
1997	520	650	43	3	0.25	2,000
1998	520	650	43	3	0.27	2,000
1999	530	650	43	3	0.27	1,850
2000	530	650	43	3	0.27	1,850
2001	530	650	43	3	0.27	1,850
2002	530	650	43	3	0.27	1,850
2003	525	650	44	3	0.25	1,700
2004	525	650	44	3	0.25	1,700
2005	525	650	44	3	0.25	1,700
2006	525	650	44	3	0.25	1,700
2007	525	650	44	3	0.25	1,700
2008	525	650	44	3	0.25	1,700

Sources: see text.

Table 3.34
Feeduptake by suckler, feedlot and grazing cows[1)]

	Housing period				Grazing period		
	no. of days	VEM requirement	standard concentrate feed	grass silage and hay	no. of days	VEM requirement	fresh grass
		kVEM	*kg*	*kg dry weight*		*kVEM*	*kg dry weight*
1990	165	1,410	320	1,303	200	1,710	1,753
1991	165	1,410	320	1,365	200	1,710	1,718
1992	165	1,410	320	1,408	200	1,710	1,757
1993	165	1,410	320	1,371	200	1,710	1,725
1994	165	1,410	320	1,370	200	1,710	1,704
1995	165	1,410	320	1,408	200	1,710	1,696
1996	165	1,410	320	1,354	200	1,710	1,655
1997	165	1,410	320	1,359	200	1,710	1,713
1998	165	1,410	400	1,301	200	1,710	1,676
1999	165	1,376	230	1,522	200	1,668	1,722
2000	165	1,376	230	1,497	200	1,668	1,728
2001	165	1,379	230	1,501	200	1,672	1,741
2002	165	1,379	230	1,490	200	1,672	1,745
2003	165	1,395	60	1,651	200	1,792	1,991
2004	165	1,395	60	1,689	200	1,792	1,969
2005	165	1,395	60	1,645	200	1,792	1,947
2006	165	1,395	60	1,651	200	1,792	1,969
2007	165	1,395	60	1,647	200	1,792	2,024
2008	165	1,395	60	1,677	200	1,792	2,013

[1)] Including feed losses of 2% of concentrate feed, 3% of moist concentrate feed and 5% of preserved roughage.

Table 3.35
Nutrient uptake and fixation by suckler, feedlot and grazing cows

	Nutrient uptake						Nutrient fixation					
	housing period			grazing period			housing period			grazing period		
	N	P	K	N	P	K	N	P	K	N	P	K
	kg/animal											
1990	48.0	6.2	41.4	75.2	7.5	62.9	5.6	1.0	1.5	6.8	1.3	1.8
1991	52.0	6.9	48.6	72.3	6.7	65.3	5.7	1.0	1.5	6.9	1.3	1.8
1992	51.4	6.8	50.1	70.8	7.0	62.9	5.7	1.0	1.5	6.9	1.3	1.8
1993	51.9	7.0	50.3	70.9	7.8	68.7	5.7	1.0	1.5	6.9	1.3	1.8
1994	54.4	7.2	56.7	70.5	7.2	64.2	5.7	1.0	1.5	6.9	1.3	1.8
1995	53.7	7.3	53.4	70.0	6.8	62.2	5.7	1.0	1.5	6.9	1.3	1.8
1996	50.2	6.6	50.1	73.6	6.0	62.9	5.7	1.0	1.5	6.9	1.3	1.8
1997	56.2	6.4	53.6	73.3	7.2	63.9	5.7	1.0	1.5	6.9	1.3	1.8
1998	54.2	7.2	52.1	69.7	7.2	63.0	5.7	1.1	1.5	6.9	1.3	1.8
1999	48.5	7.3	54.9	57.9	7.3	61.0	5.3	1.0	1.4	6.3	1.2	1.7
2000	47.7	7.1	52.1	59.1	7.5	61.3	5.3	1.0	1.4	6.3	1.2	1.7
2001	47.6	7.3	53.7	59.1	7.4	60.8	5.3	1.0	1.4	6.4	1.2	1.7
2002	46.4	7.0	52.3	58.9	7.5	62.1	5.3	1.0	1.4	6.4	1.2	1.7
2003	45.3	7.2	57.3	57.3	8.2	72.1	4.9	1.0	1.3	5.9	1.2	1.6
2004	44.9	6.9	57.3	52.0	8.1	69.1	4.9	1.0	1.3	6.0	1.2	1.6
2005	44.0	6.7	56.2	51.8	8.2	70.1	4.9	1.0	1.3	6.0	1.2	1.6
2006	43.7	6.7	55.2	50.4	8.1	70.9	4.9	1.0	1.3	6.0	1.2	1.6
2007	44.3	6.7	55.3	49.4	8.3	68.8	4.9	1.0	1.3	6.0	1.2	1.6
2008	43.7	6.6	55.6	52.1	7.8	70.5	4.9	1.0	1.3	6.0	1.2	1.6

Table 3.36
Nutrient excretion from suckler, feedlot and grazing cows

	Housing period			Grazing period			Full year		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	kg/animal								
1990	42.3	11.7	48.0	68.4	14.4	73.6	110.7	26.1	121.6
1991	46.3	13.3	56.7	65.4	12.5	76.5	111.7	25.8	133.2
1992	45.7	13.2	58.6	63.9	13.2	73.6	109.6	26.4	132.2
1993	46.2	13.6	58.8	64.0	14.9	80.5	110.2	28.5	139.3
1994	48.7	14.1	66.5	63.7	13.5	75.2	112.4	27.6	141.7
1995	48.0	14.2	62.5	63.1	12.7	72.8	111.1	26.9	135.3
1996	44.5	12.7	58.5	66.7	10.8	73.6	111.2	23.5	132.1
1997	50.5	12.4	62.7	66.4	13.6	74.8	116.9	26.0	137.5
1998	48.5	14.0	61.0	62.8	13.6	73.7	111.3	27.6	134.7
1999	43.2	14.5	64.5	51.6	14.1	71.5	94.8	28.6	136.0
2000	42.4	13.9	61.1	52.7	14.5	71.8	95.1	28.4	132.9
2001	42.3	14.4	63.0	52.8	14.2	71.3	95.1	28.6	134.3
2002	41.1	13.7	61.3	52.6	14.5	72.8	93.7	28.2	134.1
2003	40.4	14.3	67.5	51.4	16.0	85.0	91.8	30.3	152.5
2004	40.0	13.5	67.5	46.0	15.8	81.4	86.0	29.3	148.9
2005	39.1	13.2	66.1	45.8	16.0	82.6	84.9	29.2	148.7
2006	38.7	13.2	65.0	44.5	15.8	83.5	83.2	29.0	148.5
2007	39.4	13.1	65.1	43.4	16.3	81.1	82.8	29.4	146.2
2008	38.7	13.0	65.4	46.2	15.1	83.0	84.9	28.1	148.4

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

3.4.6 Sheep

Index numbers

Up to 1997, technical index numbers on numbers of lambs per ewe and feed use were derived from the LEI agricultural administration of sheep farming. Variations between years appeared to be very small. Other technical index numbers were derived from the IKC. For nutrient fixation in wool, the dirty wool (including manure residue) was used in the calculations.

In 1998, index numbers were revised using data from the agricultural administrations of LEI and DLV. Because of the shift towards more fertile breeds, the number of lambs born per ewe increased to 1.9. Assuming a lamb mortality of 12.5 percent, the number of raised lambs per ewe would be 1.66. In 1997, 1.64 raised lambs per ewe were assumed, at a mortality rate of 13.5 percent. This mortality rate was found to be a little too high. For wool production, data from KWIN 98/99 were used (3.5 kg/ewe). This part of the agricultural administration was terminated shortly after revision of the index numbers.

In 2004, index numbers were revised on the basis of Kemme et al. (2005a), using the Dutch farm indicator for sheep (*BedrijfsWijzer Schapen*). This is a farm budgetary programme which can be used to calculate results for various farming systems. Assumptions deviated strongly from those in previous years, and were related to the following issues:
– Feed uptake based on the DLV administration was higher than from model calculations that use standard requirements, even after being corrected for feed losses;
– The DLV administration had an ever-declining number of participants, which possibly affected representativeness of the data;
– Pulp was no longer included, as its scale of use was unknown.

These index numbers are provided in Table 3.37.

Feed uptake
The feed use over the 1990–1997 period was calculated on the basis of kVEM uptake, registered in the LEI agricultural administration of sheep farming. Nutrient content in meadow grass, grass silage and hay were set to those used for cattle. This may have caused an overestimation of the nutrient uptake, as meadow grass for sheep contains a lower N and P content for part of the year. However, specific data were not available at this point.

Table 3.37
Index numbers for sheep

	Lambs born per ewe	Lambs reared per ewe	Birth weight	Weight lamb at time of sale	Weight adult ewe	Wool production per ewe	Wool production per lamb	Replacement ewe stock
			kg					*%*
1990	1.76	1.56	4	40	75	3.25	2	25
1991	1.76	1.56	4	40	75	3.25	2	25
1992	1.76	1.56	4	40	75	3.25	2	25
1993	1.76	1.56	4	40	75	3.25	2	25
1994	1.76	1.56	4	40	75	3.25	2	25
1995	1.76	1.56	4	40	75	3.25	2	25
1996	1.76	1.56	4	40	75	3.25	2	25
1997	1.76	1.56	4	40	75	3.25	2	25
1998	1.9	1.64	4	40	75	3.50	2	25
1999	1.9	1.66	4	40	75	3.50	2	25
2000	1.9	1.66	4	40	75	3.50	2	25
2001	1.9	1.66	4	40	75	3.50	2	25
2002	1.9	1.66	4	40	75	3.50	2	25
2003	1.9	1.66	4	40	75	3.50	2	25
2004	1.8	1.5	4.75	42	75	3		25
2005	1.8	1.5	4.75	42	75	3		25
2006	1.8	1.5	4.75	42	75	3		25
2007	1.8	1.5	4.75	42	75	3		25
2008	1.8	1.5	4.75	42	75	3		25

Sources: see text.

The revision of basic assumptions in 1998 showed that concentrate feed per ewe had increased to 95 kg/ewe (Heeres-van der Tol, 2001). Tamminga et al. (2000) assumed the slightly lower supply of concentrate feed of 85 kg/ewe, divided into 49 kilograms of sheep pellets and 21 kilograms of pulp pellets during housing periods, and 15 kilograms in grazing periods. The last data have been used in calculations of excretion factors since 1999. Raw feed use has also been based on Tamminga et al.

In 2004, feed uptake per ewe was derived from rations in the category of 'Breeding sheep, including lambs up to 25 kilograms and stud rams' and the category of 'other sheep' (all lambs over 25 kg), in the study by Kemme et al. (2005a). The distribution over housing and grazing periods was taken from previous years. This led to the assumption that sheep pellets and preserved raw feed would be provided during housing periods, and lamb pellets and meadow grass during grazing periods.
From 2004 onwards, sheep have been assumed to have been kept in extensive farming systems. The assumed N content in meadow grass and grass silage, therefore, was lowered. Also, for the uptake of raw feed, lower VEM values were taken into account, which would require an increased uptake per feed type.

Table 3.38
Feed uptake by sheep, per ewe[1)]

	Housing period			Grazing period		
	no. of days	concentrate feed	grass silage and hay	no. of days	concentrate feed	fresh grass
		kg	*kg dry weight*		*kg*	*kg dry weight*
1990	80	36	118	285	26	526
1991	80	36	118	285	26	526
1992	80	36	118	285	26	526
1993	80	36	118	285	26	526
1994	80	36	118	285	26	526
1995	80	36	118	285	26	526
1996	80	36	118	285	26	526
1997	80	36	118	285	26	526
1998	80	60	113	285	35	549
1999	80	70	97	285	15	570
2000	80	70	97	285	15	570
2001	80	70	97	285	15	570
2002	80	70	97	285	15	570
2003	80	70	97	285	15	570
2004	75	33	89	290	25	499
2005	75	33	89	290	25	499
2006	75	33	89	290	25	499
2007	75	33	89	290	25	499
2008	75	33	89	290	25	499

[1)] Including feed losses of 2% of concentrate feed, 3% of moist concentrate feed and 5% of preserved roughage.

Table 3.39
Nutrient uptake and fixation by sheep

	Nutrient uptake						Nutrient fixation					
	housing period			grazing period			housing period			grazing period		
	N	P	K	N	P	K	N	P	K	N	P	K
	kg/ewe											
1990	4.4	0.6	3.9	23.1	2.3	19.2	0.6	0.1	0.0	2.0	0.3	0.1
1991	4.6	0.6	4.3	22.7	2.1	20.3	0.6	0.1	0.0	2.0	0.3	0.1
1992	4.4	0.6	4.3	21.7	2.2	19.1	0.6	0.1	0.0	2.0	0.3	0.1
1993	4.5	0.6	4.4	22.2	2.4	21.2	0.6	0.1	0.0	2.0	0.3	0.1
1994	4.8	0.6	5.0	22.3	2.3	20.1	0.6	0.1	0.0	2.0	0.3	0.1
1995	4.6	0.6	4.6	22.3	2.2	19.6	0.6	0.1	0.0	2.0	0.3	0.1
1996	4.5	0.6	4.5	24.0	2.0	20.3	0.6	0.1	0.0	2.0	0.3	0.1
1997	5.0	0.6	4.8	23.1	2.3	19.9	0.6	0.1	0.0	2.0	0.3	0.1
1998	5.0	0.7	4.8	23.7	2.5	21.1	0.6	0.1	0.0	2.1	0.4	0.1
1999	4.5	0.6	4.3	20.9	2.5	21.2	0.6	0.1	0.0	2.1	0.4	0.1
2000	4.5	0.6	4.0	21.6	2.6	21.3	0.6	0.1	0.0	2.1	0.4	0.1
2001	4.5	0.6	4.2	21.3	2.5	20.7	0.6	0.1	0.0	2.1	0.4	0.1
2002	4.3	0.6	4.0	21.0	2.6	21.4	0.6	0.1	0.0	2.1	0.4	0.1
2003	4.3	0.6	4.2	20.9	2.4	20.8	0.6	0.1	0.0	2.1	0.4	0.1
2004	3.0	0.5	3.5	13.9	2.2	17.9	0.5	0.1	0.0	1.8	0.3	0.1
2005	3.1	0.5	3.5	14.0	2.2	18.3	0.5	0.1	0.0	1.8	0.3	0.1
2006	3.0	0.5	3.4	13.5	2.2	18.3	0.5	0.1	0.0	1.8	0.3	0.1
2007	3.1	0.5	3.3	12.9	2.1	17.3	0.5	0.1	0.0	1.8	0.3	0.1
2008	3.0	0.5	3.3	13.6	2.0	17.8	0.5	0.1	0.0	1.8	0.3	0.1

Table 3.40
Nutrient excretion from sheep

	Housing period			Grazing period			Full year		
	N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
	kg/ewe								
1990	3.9	1.1	4.6	21.1	4.5	23.0	25.0	5.6	27.6
1991	4.0	1.2	5.2	20.7	4.1	24.3	24.7	5.3	29.5
1992	3.9	1.1	5.2	19.7	4.2	22.9	23.6	5.3	28.1
1993	4.0	1.2	5.3	20.2	4.8	25.5	24.2	6.0	30.8
1994	4.2	1.2	6.0	20.3	4.4	24.2	24.5	5.6	30.2
1995	4.0	1.2	5.5	20.3	4.2	23.5	24.3	5.4	29.0
1996	3.9	1.1	5.4	21.9	3.7	24.3	25.8	4.8	29.7
1997	4.4	1.1	5.8	21.0	4.4	23.9	25.4	5.5	29.7
1998	4.4	1.3	5.7	21.6	4.9	25.3	26.0	6.2	31.0
1999	3.9	1.2	5.2	18.8	4.9	25.5	22.7	6.1	30.7
2000	3.9	1.2	4.8	19.5	5.2	25.5	23.4	6.4	30.3
2001	3.9	1.2	5.1	19.1	4.9	24.8	23.0	6.1	29.9
2002	3.7	1.2	4.8	18.9	5.1	25.7	22.6	6.3	30.5
2003	3.7	1.2	5.0	18.8	4.7	25.0	22.5	5.9	30.0
2004	2.6	0.9	4.1	12.1	4.2	21.4	14.7	5.1	25.5
2005	2.6	0.9	4.1	12.2	4.3	21.9	14.8	5.2	26.0
2006	2.6	0.9	4.1	11.7	4.2	21.9	14.3	5.1	26.0
2007	2.6	0.9	4.0	11.1	4.1	20.7	13.7	5.0	24.7
2008	2.5	0.9	3.9	11.9	3.9	21.3	14.4	4.8	25.2

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

3.4.7 Dairy goats

Nutrient excretions were calculated per dairy goat, including bucks and kids. The category 'other goats' also includes goats that were not kept for milk production (e.g. dwarf goats). For this small group, no nutrient excretion factors were determined.

Index numbers
For goats, no annual statistical or administrative data were available. The technical index numbers applied for the 1990–1997 period were derived from a report by the former Dutch Research Station for Cattle, Sheep and Horse Husbandry (*Proefstation voor de Rundveehouderij (PR*), 1986)) and from the IKC (1993a).

The fattening of kids has been included in the index numbers since 1998. These slaughter kids (predominately bucks) are not included in replacement data. In the first few days of their lives (around 1 week), these kids stay on the dairy goat farm, after which they are transported to a specialised meat producer, where they are finished in around 4 weeks.
Milk production was increased to 800 kilograms per animal (Heeres-van der Tol, 2001). In 1999, a few small changes were made in the index numbers, to bring them into agreement with data in Tamminga et al. (2000).
In 2004, index numbers on rations were revised, based on the study by Kemme et al. (2005a) and ASG (2003).
In 2008, milk production was increased from 800 to 900 kilograms (ASG, 2008).

Feed uptake
Over the entire 1990–1997 period, standard rations had been based on IKC (1992a). Here it was assumed that dairy goats would have been kept year-round inside housing facilities. In 1998, data on rations were revised, assuming a milk production of 800 kilograms. Gross concentrate feed supply amounted to 500 kilograms per goat, according to PV (1998). Concentrate feed provided to goats was assumed to have consisted of standard cow pellets. Their raw feed requirement was assumed to be a net amount of 310 kVEM (PV, 1998). At a VEM content of around 860 VEM per kilogram of dry weight raw feed, this amounts to a net 364 kilograms in dry weight, or 400 kilograms gross. Feed losses for goats were calculated at double that of others, as they are fussy eaters and choose their feed more selectively (Heeres-van der Tol, 2001).

Because these calculations also included the fattening of bucks, the use of artificial milk increased from 5.9 kilograms to 16.4 kilograms per goat.
In 1999, rations were revised following calculations by Tamminga et al. (2000).
In 2004, rations were revised considerably. Goat farmers, located mostly in the Dutch provinces of North Brabant and Gelderland, were assumed to have focused largely on protein feeds, from the viewpoint of cost management and animal health. Practical data, however, indicated dry weight uptake to be lower than assumed in previous calculations (Kemme et al., 2005a).
In 2008, feed uptake increased due to higher milk production. The increase in feed requirement was evenly spread over concentrate feed and raw feeds.

Table 3.41
Index numbers for dairy goats

	Kid losses per dairy goat	Kid reared per dairy goat	of which		Milk production per dairy goat	Birth weight	Kid weight at time of sale	Weight adult dairy goat	Finishing weight buck	Replacement of bucks per dairy goat
			supplied	retained						
					kg					*%*
1990	0.2	1.8	1.5	0.3	600	3	5	70	90	1
1991	0.2	1.8	1.5	0.3	600	3	5	70	90	1
1992	0.2	1.8	1.5	0.3	600	3	5	70	90	1
1993	0.2	1.8	1.5	0.3	600	3	5	70	90	1
1994	0.2	1.8	1.5	0.3	600	3	5	70	90	1
1995	0.2	1.8	1.5	0.3	600	3	5	70	90	1
1996	0.2	1.8	1.5	0.3	600	3	5	70	90	1
1997	0.2	1.8	1.5	0.3	600	3	5	70	90	1
1998	0.2	1.8	1.5	0.3	800	3	10	70	90	1
1999	0.2	1.8	1.5	0.3	800	3	10	70	90	1
2000	0.2	1.8	1.5	0.3	800	3	10	70	90	1
2001	0.2	1.8	1.5	0.3	800	3	10	70	90	1
2002	0.2	1.8	1.5	0.3	800	3	10	70	90	1
2003	0.2	1.8	1.5	0.3	800	3	10	70	90	1
2004	0.2	1.8	1.5	0.3	800	3	10	70	90	1
2005	0.2	1.8	1.5	0.3	800	3	10	70	90	1
2006	0.2	1.8	1.5	0.3	800	3	10	70	90	1
2007	0.2	1.8	1.5	0.3	800	3	10	70	90	1
2008	0.2	1.8	1.5	0.3	900	3	10	70	90	1

Sources: see text.

Table 3.42
Feed uptake by goats[1)]

	Artificial milk	Concentrate feed	Maize silage	Grass silage and hay
	kg		*kg dry weight*	
1990	5.9	348	–	472
1991	5.9	348	–	472
1992	5.9	348	–	472
1993	5.9	348	–	472
1994	5.9	348	–	472
1995	5.9	348	–	472
1996	5.9	348	–	472
1997	5.9	348	–	465
1998	16.4	500	–	400
1999	16.5	505	102	307
2000	16.5	505	102	307
2001	16.5	505	102	307
2002	16.5	505	102	307
2003	16.5	505	102	307
2004	15.3	437	304	204
2005	15.3	437	304	204
2006	15.3	437	304	204
2007	15.3	437	304	204
2008	15.3	464	322	216

[1)] Including feed losses of 4% of concentrate feed, and 10% of preserved roughage.

Table 3.43
Nutrient uptake, fixation and excretion by goats

	Uptake			Fixation			Excretion		
	N	P	K	N	P	K	N	P_2O_5	K_2O
	kg/dairy goat								
1990	23.6	3.4	18.4	3.8	0.7	1.3	19.9	6.1	20.7
1991	24.6	3.6	20.5	3.8	0.7	1.3	20.9	6.5	23.2
1992	24.1	3.5	20.6	3.8	0.7	1.3	20.4	6.3	23.3
1993	24.8	3.6	21.2	3.8	0.7	1.3	21.1	6.6	24.0
1994	25.4	3.7	23.2	3.8	0.7	1.3	21.6	6.8	26.5
1995	25.3	3.7	21.6	3.7	0.7	1.3	21.5	6.8	24.5
1996	24.4	3.4	21.1	3.7	0.7	1.3	20.7	6.2	23.9
1997	25.7	3.4	21.8	3.7	0.7	1.3	22.0	6.1	24.7
1998	27.6	4.0	21.4	5.2	0.9	1.7	22.4	7.1	23.8
1999	24.5	3.9	17.7	5.2	1.0	1.7	19.3	6.8	19.3
2000	24.6	3.6	16.8	5.2	1.0	1.7	19.4	6.0	18.2
2001	25.8	4.0	18.6	5.2	1.0	1.7	20.6	6.9	20.4
2002	25.3	3.9	18.9	5.2	1.0	1.7	20.1	6.7	20.7
2003	25.2	4.0	19.3	5.2	1.0	1.7	20.0	7.0	21.3
2004	22.7	3.5	16.9	4.9	1.2	1.7	17.8	5.4	18.3
2005	22.6	3.6	17.3	4.9	1.2	1.7	17.7	5.5	18.8
2006	22.6	3.6	17.0	4.9	1.2	1.7	17.7	5.6	18.5
2007	20.7	3.8	14.5	4.9	1.2	1.7	15.8	6.1	15.4
2008	21.4	4.0	15.1	5.4	1.3	1.9	16.0	6.4	15.9

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

3.4.8 Horses and ponies

Since 1 January 2006, manure and nutrient production for commercially kept horses and ponies also has been included in the Fertiliser Act. For this amendment to the law, a calculation was made of the nutrient excretion from horses and ponies of various weight classes (Kemme et al., 2005b). The calculation basis in this report was applied by the WUM for determining manure and nutrient excretions.
In order to avoid a trend break, the nutrient excretion from horses and ponies was also calculated for previous years. Because index numbers for horse and pony farmers were not available for the period up to 2006, this calculation was performed by multiplying the 2006 factors by the animal numbers of the years concerned. Manure and nutrient production was only calculated for animals included in the agricultural census; amounting to around 130,000 in total. The actual number of horses and ponies was estimated at between 400,000 and 500,000.

Index numbers
The agricultural census does not distinguish between horses and ponies according to weight class, as was done by Kemme et al. (2005b). Therefore, the Dutch Horse Council (Sectorraad Paarden) was asked to provide an estimation of the distinction in weight classes between horses and ponies. Around 75 percent of horses were estimated to have an adult weight of over 450 kilograms. For ponies, the adult weights were spread evenly over both categories (Van Toledo, 2007).

Feed uptake
Based on rations per weight class in Kemme et al. (2005b) and shares of weight classes within the population, average rations per horse and pony were calculated. For feed uptake, the share of animals at fattening farms also was taken into account. Kemme et al. did not indicate whether feed uptake included feed losses.
The composition of raw feed in 2006 was based on values from the Table Booklet Animal Nutrition 2005. For fresh grass, the composition of the fresh grass in horse pastures was used. Good hay has been assumed to consist of a combination of good and average quality hay, in a 75:25 ratio, conform the basic assumption in Kemme et al. At the time of the study by Kemme et al., no quality levels for grass hay for horses had been determined. In 2008, the composition of hay was based on grass hay for horses according to the Table Booklet Animal Nutrition 2008. This caused especially the P content to be lower.

Nutrient excretion

Average manure production and nutrient excretion factors were calculated per horse and pony, based on the division into the separate adult weight classes by the Dutch Horse Council. In addition, the Dutch Horse Council also provided an estimation of the distribution of horses and ponies over the various farming systems, which was used to determine the excretion distribution over stables and pastures.

Table 3.44
Index numbers horses and ponies

	Unit	Horses		Ponies	
		adult weight 250–450 kg	adult weight > 450 kg	adult weight <250 kg	adult weight 250–450 kg
Weight mare/gelding	*kg*	447	573	196	373
Share replaced	%	7.1	7.1	5.0	5.0
Share in population	%	25	75	50	50

Source: Kemme et al. (2005b).

Table 3.45
Feed uptake by horses and ponies, per animal

	Winter							Summer						
	concentrate feed			roughage				concentrate feed			roughage			
	standard feed	sport feed	stud feed	fresh grass	mediocre hay	good hay	grass-seed straw	standard feed	sport feed	stud feed	fresh grass	mediocre hay	good hay	grass-seed straw
	kg			*kg dry weight*				*kg*			*kg dry weight*			
Horses	259	33	41	318	528	202	109	120	15	19	748	246	94	50
Ponies	94	9.9	14	228	320	57	40	30	3.1	4.4	496	101	18	13

Table 3.46
Nutrient uptake, fixation and excretion by horses and ponies

	Uptake			Fixation			Excretion								
	N	P	K	N	P	K	within housing systems			in pasture			full year		
							N	P_2O_5	K_2O	N	P_2O_5	K_2O	N	P_2O_5	K_2O
Horses	*kg/animal*														
2006	64.6	10.4	66.4	1.1	0.3	0.1	33.3	12.4	41.7	30.2	10.8	38.2	63.5	23.2	79.9
2007	62.6	11.7	75.5	1.1	0.3	0.1	32.1	14.1	48.2	29.4	12.0	42.6	61.5	26.1	90.8
2008	59.6	10.2	59.0	1.1	0.3	0.1	30.3	12.0	36.6	28.2	10.6	34.5	58.5	22.6	71.1
Ponies															
2006	34.7	5.4	36.9	0.4	0.1	0.0	14.4	5.2	18.7	19.9	6.9	25.7	34.3	12.1	44.4
2007	33.6	6.0	41.1	0.4	0.1	0.0	13.8	5.9	21.4	19.4	7.4	27.9	33.2	13.3	49.3
2008	32.4	5.2	33.4	0.4	0.1	0.0	13.2	5.1	16.5	18.9	6.7	23.8	32.1	11.8	40.3

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake - K fixation) * 47/39.

4. Nutrient excretion from pigs

4.1 Categorisation of animals

Calculations refer to the following animal categories in the agricultural census:
– fattening pigs;
– gilts and young boars of 20 to 50 kilograms;
– gilts of 50 kilograms and over;
– breeding sows, including piglets up to 25 kilograms;
– young boars of 50 kilograms and over;
– stud boars.

The agricultural census includes fattening pigs of 20 kilograms and over. This weight limit of 20 kilograms, separating piglets and fattening pigs is consistent with the official regulations by the EU Farm Structure Survey. In actual practice, starting weights of fattening pigs have increased over the 1990s, to around 25 kilograms per animal. The instructions provided in the agricultural census indicate that for the entry of animal numbers, practical data should be leading. Therefore, calculations of excretion factors generally assumed the practical limit of around 25 kilograms, following results from annual records.

4.2 Feed use and animal production

Each year, data on feed use and animal production related to pigs are derived from technical economic administration systems by Agrovision B.V. and their predecessors. In addition, the LEI also accumulates data on pig farming, through the Farm Accountancy Data Network (BIN). Agrovision is focused on comparing technical and economic index numbers per animal, between farms. The BIN was established to provide calculations of economic results per farming sector. The number of farms participating in the administration systems of Agrovision is substantially larger than those in the sample surveys by the LEI. However, farms that participate in Agrovision were not chosen randomly and small farms are represented in larger numbers than in the BIN. Agrovision merely calculates averages and provides no scale up per size class for the total population. Moreover, in 1990, Agrovision stopped weighing results per animal according to animal numbers per farm. For 1990, such a scale up according to farm size appeared to have had only a negligible influence on overall results.

Because of the fast availability and wide range, the Agrovision data are used on a large scale in research on pig farming and in education. In addition, the results provide a large amount of information needed to determine index numbers. Therefore, the WUM working group also chose to use Agrovision data (WUM, 1994b).

In addition to compound feed, a number of pigs also received moist by-products. The Agrovision system converts these by-products on a dry-weight basis to compound feed. To calculate excretion factors, wet by-products were taken into account, although nutrient uptakes from these products were not indicated separately. The calculation of manure volumes per animal did not take into account the use of any wet by-products.
As feed residues largely disappear in flushing and cleaning water, the calculations on feed use did not correct for feed losses.

The total feed use by fattening pigs and sows based on technical economic administration systems, plus the feed use in the other pig categories based on fixed index numbers, corresponded well with the estimated total of available pig feed. Availability of pig feed was estimated from the sum of compound feed, raw feed materials and moist concentrate feed. There are several sources of compound feed production. The Dutch National Service for the Implementation of Regulations (*Dienst Regelingen (DR)*) of the Ministry of Agriculture) has sales data available, based on reported deliveries of compound feed. The European Feed Manufacturers' Federation (FEFAC) holds data on production per country. And, finally, CBS publishes quarterly data on the production of animal feeds. The total amount

of pig feed used according to calculations was slightly larger than the amount of feed available according to sales data from DR, but was 5 percent to 10 percent below the production data level. However, sales data based on production data were not corrected for exports.

Technical index numbers for young pigs and stud boars, generally, could not be derived from annual index number administrations, but were based on periodically revised practical data. Growth data on young pigs in 1990 were based on IKC/LEI (1991) and on feed use according to IKC (1993b). In 1999, index numbers were revised according to results from Tamminga et al. (2000). From 2003 onwards, index numbers have been derived from Jongbloed and Kemme (2005). For stud boars in 1990, the duration of the production cycle and feed use were based on data from IKC (1991a), while starting and finishing weights were based on SIVA (1991).

Tables with index numbers on fattening pigs (Table 4.3), young pigs (Table 4.4) and stud boars (Table 4.7) also contain data on uptake, fixation and excretions.

4.3 Compound feed content

At the time the working group was first established, in the early 1990s, annual data on nutrient content in compound feed were available from several sources. The working group chose to use data on nutrient content in compound feed, on the basis of statistical data on the availability of the raw materials in concentrate feed. These data also were used by the CBS in their annual project on nutrient balances. For this project, data on the availability and use of the raw materials in concentrate feed were derived from the annual statistics on animal feed from LEI-DLO. For the project on nutrient balances, various entries were calculated independently of each other, whereby one entry would serve as verification for another. The required distinction between the types of compound feed for fattening pigs and breeding pigs was made on the basis of analyses of specialised feeds (WUM 1994b and 1994c).

For the development in the availability of data on concentrate feed, see Subsection 3.2.2.

From 2004 onwards, data on the use and composition of compound feed per farm have been available from the Dutch National Service for the Implementation of Regulations (*Dienst Regelingen*). These data, subsequently, were coupled to data from the agricultural census, thus enabling derivation of the average composition of compound feed for the various categories of pigs and poultry. This method meant that the former way of distinguishing between the various types of compound feed, by using calibration, was no longer necessary.

Table 4.1 shows the average composition of pig feeds.

4.4 Nutrient content in animals and animal products

Nutrient fixation in animals depends on weight gain and content per kilogram of live weight. The nutrients were calculated as finishing weight x nutrient content for the finished animal, minus starting weight x corresponding nutrient content. Data on live weights are provided in the following section on nutrient excretions per animal category. Table 4.2 presents the nutrient content in pigs.

4.5 Nutrient excretion per animal category

Tables 4.3 to 4.7 provide standard data and calculations of nutrient excretion factors for fattening pigs, young pigs, gilts and young boars, breeding sows (including piglets) and stud boars. Standard data were not rounded off during calculations. Therefore, calculations that are based on the data presented in the tables may results in slightly varying outcomes.

Losses did not need to be corrected as the technical index numbers express average number of animals present. And this number would correspond with those in the agricultural census. Calculations of nutrient fixation in piglets (per breeding sow) did take losses into account and, from 1999 onwards, also the number of stillbirths.

In the 1990–1998 period, the finishing weight of piglets as used in calculations of the nutrient excretion from sows was higher than the starting weight of fattening pigs in calculations of their excretions. Differences in weight were caused by the use of different sources (i.e. index numbers for sows and those for fattening pigs). Differences in fixation were negligible. From 1999 onwards, finishing weights would equal starting weights.

Swine fever in 1997
Generally speaking, animal numbers in the agricultural census correspond with the average number of animals present. In 1997, this was not the case for pigs. From early February 1997 up to early 1998 a large number of swine fever outbreaks took place. The main heart of the outbreak was located in around 50 municipalities in North Brabant and Limburg. Pigs could not be transported out of the infected areas due to a transportation ban. Therefore, there were around a million more pigs present at the time of the agricultural census of 1997 than at the beginning of the year. Following that agricultural census, pig numbers declined steadily. The average number of pigs in 1997, in the Netherlands, was calculated on the basis of data from random animal counts of December 1996, August and December 1997, and the agricultural census of 1 April 1997. In this calculation, a distinction was made between the swine fever area, the area within this region for which a breeding ban was imposed from June onwards, and the rest of the Netherlands. In collaboration with IKC Agriculture, average manure production and nutrient excretions were calculated per fattening pig and per sow.

Table 4.1
Nutrient content in pig feed

	Average composition pig feed[1)]											
	fattening pigs			young pigs			breeding sows			stud boars		
	N	P	K	N	P	K	N	P	K	N	P	K
	g/kg											
1990	26.9	5.1	11.3	26.7	6.4	11.3	27.4	6.6	11.3	26.2	6.6	11.3
1991	26.4	5.2	11.7	26.9	6.4	11.7	26.2	6.4	11.7	25.7	6.6	11.7
1992	27.3	5.1	11.6	26.7	6.5	11.6	26.7	6.4	11.6	26.6	6.9	11.6
1993	27.1	5.1	12.0	26.3	6.5	12.0	26.3	6.4	12.0	25.8	5.8	12.0
1994	28.1	5.0	11.8	26.1	6.1	11.9	25.8	6.0	11.5	24.3	6.2	12.2
1995	27.8	4.9	11.8	27.3	5.7	11.8	27.0	5.7	11.4	25.8	5.7	12.1
1996	27.4	4.8	11.8	26.6	5.5	11.7	26.3	5.4	11.3	25.0	5.2	12.4
1997	27.4	4.8	11.7	26.4	5.3	12.3	26.4	5.4	11.0	24.1	5.3	12.7
1998	26.9	4.7	11.3	25.7	5.5	11.5	25.4	5.4	10.2	23.8	5.2	11.8
1999	27.3	4.6	11.3	26.5	5.4	11.9	25.9	5.1	10.6	23.7	4.8	12.2
2000	26.3	4.6	11.3	27.0	5.7	11.9	25.9	5.3	10.6	24.2	5.2	12.2
2001	25.3	4.4	11.3	25.2	5.2	11.9	24.7	5.0	10.5	24.4	5.0	12.2
2002	25.1	4.5	11.3	25.7	5.1	11.9	25.2	5.2	10.5	24.3	4.8	12.2
2003	25.5	4.6	11.3	25.6	5.2	9.1	25.1	5.1	9.2	24.6	5.3	8.9
2004	25.1	4.5	9.0	24.3	5.1	9.5	24.1	5.0	9.1	24.5	5.7	8.9
2005	25.7	4.7	9.1	25.8	5.4	9.1	25.6	5.5	9.2	24.5	5.7	8.9
2006	25.8	4.8	9.2	26.1	5.3	9.1	25.5	5.4	9.2	24.7	5.2	8.9
2007	25.6	4.7	9.3	25.6	5.1	9.1	25.6	5.3	9.2	24.2	5.2	8.9
2008	25.6	4.7	9.4	24.8	4.9	9.1	25.1	5.3	9.2	24.4	5.3	8.9

[1)] Including supplementary feeds and singular compounded concentrate feed sources.

For fattening pigs inside the swine fever area, the nutrient balance was determined for culled animals (13 percent) and for those animals that were bought at an average weight of 137 kilograms (73 percent). The remaining animals (14 percent) were finished according to normal practice. Of the sows within the swine fever area with a breeding ban imposed, 53 percent over that year did not have any piglets. In the rest of the swine fever area,

around 28 percent of sows had heavy piglets. Index numbers of fattening pigs and sows refer to average numbers of animals present. Tables 4.3 and 4.6 show the nutrient excretion from fattening pigs and sows, per average number of animals present and animal numbers according to the agricultural census. Correction factors were used for the conversion of factors per average number of animals present to factors per animal counted in the agricultural census. The correction factor for fattening pigs outside the swine fever area was 1.1. Because of the imposed export ban, an average 10 percent more fattening pigs were present than those counted in the agricultural census. Inside the swine fever area, there was an average 55 percent left of the fattening pigs counted in the agricultural census and 87 percent of the number of counted sows. For young pigs and stud boars, animal numbers were not corrected for the numbers in the agricultural census, because of their relatively small contribution (10 percent) to the manure production.

Table 4.2
Nutrient content in pigs

	Status	N	P	K
		g/kg live weight		
Newborn piglets				
1990–1998	0 days	19.2[1)]	6.15[1)]	1.54[1)]
1999–2000	0 days	19.4[2)]	4.95[3)]	2.75[3)]
2001–2008	0 days	18.7[4)]	6.15[4)]	1.81[4)]
Piglet losses				
1990–1998	1–75 days	19.2[1)]	6.15[1)]	1.54[1)]
1999–2003	1–75 days	20.9[2)]	5.00[3)]	2.64[3)]
2004–2008	1–75 days	23.1[5)]	5.36[5)]	2.64[3)]
Starting pig				
1990–1998	ca. 10 weeks	24.0[1)]	5.14[1)]	2.32[1)]
1999–2000	ca. 10 weeks	24.8[6)]	5.10[3)]	2.33[3)]
2001–2008	ca. 10 weeks	24.8[4)]	5.32[4)]	2.42[4)]
Fattening pig				
1990–1998	ca. 26 weeks	23.2[1)]	5.03[1)]	2.10[1)]
1999–2000	ca. 26 weeks	24.8[6)]	5.10[3)]	2.15[3)]
2001–2008	ca. 26 weeks	25.0[4)]	5.36[4)]	2.28[4)]
Gilts				
1990–1998	first mating	23.2[1)]	5.36[1)]	2.10[1)]
1999–2000	first mating	24.4[7)]	5.12[3)]	2.13[3)]
2001–2008	first mating	24.9[4)]	5.35[4)]	2.25[4)]
Breeding sows				
1990–1998	1 week after weaning piglets	24.0[1)]	5.00[1)]	2.00[1)]
1999–2002	1 week after weaning piglets	26.0[8)]	5.15[3)]	2.08[3)]
2003–2008	1 week after weaning piglets	25.0[9)]	5.35[9)]	2.08[3)]
Stud boars				
1990–1998	2 years	24.0[1)]	5.00[1)]	2.00[1)]
1999–2002	2 years	24.0[1)]	5.14[3)]	2.04[3)]
2003–2008	2 years	25.0[9)]	5.35[9)]	2.04[3)]

[1)] Coppoolse et al., 1990.
[2)] Jongbloed, 1987.
[3)] Jongbloed, 2001.
[4)] Jongbloed et al., 2002a
[5)] Jongbloed and Kemme, 2005.
[6)] Jongbloed et al., 1999.
[7)] Everts and Dekker, 1991.
[8)] Jongbloed, 2000.
[9)] Jongbloed and Kemme, 2002b

Table 4.3
Annual nutrient excretions per fattening pig included in the agricultural census

	Production cycle	Starting weight	Finishing weight	Growth	Total feed use	Uptake			Fixation			Excretion		
						N	P	K	N	P	K	N	P_2O_5	K_2O
	days	*kg*		*kg/day*	*kg*	*kg/animal*								
1990	115	25.0	108.0	0.718	756	20.3	3.8	8.5	6.0	1.3	0.5	14.3	5.8	9.6
1991	118	25.0	109.0	0.712	746	19.7	3.9	8.7	6.0	1.3	0.5	13.7	6.0	9.9
1992	119	25.0	110.0	0.714	748	20.4	3.8	8.7	6.0	1.3	0.5	14.4	5.8	9.8
1993	119	25.0	111.0	0.723	759	20.6	3.8	9.1	6.1	1.3	0.5	14.5	5.8	10.3
1994	118	26.0	112.0	0.726	748	21.0	3.8	8.9	6.1	1.3	0.5	14.9	5.6	10.0
1995	119	26.0	113.0	0.729	741	20.6	3.7	8.7	6.1	1.3	0.5	14.5	5.3	9.9
1996	121	25.0	114.0	0.737	748	20.5	3.6	8.8	6.2	1.3	0.5	14.3	5.2	9.9
1997[1)]	120	25.0	114.0	0.743	748	20.5	3.6	8.8	6.2	1.4	0.6	14.3	5.1	9.9
1997[2)]	154	25.0	137.0	0.725	807	22.0	3.8	9.5	6.1	1.3	0.5	16.0	5.7	10.7
1997[3)]	77	25.0	80.0	0.715	664	18.4	3.2	7.7	6.0	1.3	0.5	12.4	4.4	8.7
1997[4)]												8.4	3.0	5.7
1997[5)]												15.7	5.6	10.9
1997[6)]												13.0	4.6	9.0
1998	117	26.0	114.0	0.755	748	20.1	3.5	8.5	6.3	1.4	0.6	13.8	4.9	9.5
1999	114	25.6	113.0	0.770	741	20.2	3.4	8.4	7.0	1.4	0.6	13.3	4.6	9.4
2000	113	25.5	112.0	0.768	734	19.3	3.4	8.3	7.0	1.4	0.6	12.3	4.5	9.3
2001	118	27.8	117.0	0.754	741	18.7	3.3	8.4	6.9	1.5	0.6	11.8	4.1	9.4
2002	116	25.5	114.0	0.762	741	18.6	3.4	8.4	7.0	1.5	0.6	11.6	4.3	9.3
2003	118	26.0	115.8	0.762	741	18.9	3.4	8.4	7.0	1.5	0.6	11.9	4.4	9.3
2004	115	25.8	114.6	0.774	748	18.8	3.4	6.7	7.1	1.5	0.6	11.7	4.2	7.4
2005	116	25.4	115.5	0.779	756	19.4	3.6	6.9	7.1	1.5	0.6	12.3	4.6	7.5
2006	117	25.3	115.9	0.772	763	19.7	3.6	7.0	7.1	1.5	0.6	12.6	4.9	7.7
2007	117	25.2	116.7	0.783	774	19.8	3.6	7.2	7.2	1.5	0.6	12.6	4.8	7.9
2008	117	25.3	116.6	0.778	781	20.0	3.7	7.3	7.1	1.5	0.6	12.9	5.0	8.1

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

The factors for fattening pigs of 1997 are averages of the factors for areas with and without swine fever.

1) Outside the areas with swine fever, per average animal present.
2) Within the areas with swine fever, deliveries of heavy pigs, per average animal present.
3) Within the areas with swine fever, culled pigs, per average animal present.
4) Within the areas with swine fever, per animal included in the agricultural census.
5) Outside the areas with swine fever, per animal included in the agricultural census.
6) Average per animal included in the agricultural census.

Table 4.4
Annual nutrient excretions per gilt and young boar included in the agricultural census

	Production cycle	Starting weight	Finishing weight	Growth	Total feed use	Uptake			Fixation			Excretion		
						N	P	K	N	P	K	N	P_2O_5	K_2O
	days	*kg*		*kg/day*	*kg*	*kg/animal*								
1990	155	25.0	124	0.630	725	19.3	4.6	8.2	5.4	1.3	0.5	14.0	7.7	9.3
1991	155	25.0	124	0.630	725	19.5	4.6	8.5	5.4	1.3	0.5	14.1	7.7	9.6
1992	155	25.0	124	0.630	725	19.4	4.7	8.4	5.4	1.3	0.5	14.0	7.9	9.6
1993	155	25.0	124	0.630	725	19.1	4.7	8.7	5.4	1.3	0.5	13.7	7.9	9.9
1994	155	25.0	124	0.630	725	18.9	4.4	8.6	5.4	1.3	0.5	13.6	7.2	9.8
1995	155	25.0	124	0.630	725	19.8	4.2	8.6	5.4	1.3	0.5	14.4	6.6	9.7
1996	155	25.0	124	0.630	725	19.3	4.0	8.5	5.4	1.3	0.5	13.9	6.2	9.7
1997	165	25.0	129	0.630	725	19.1	3.9	8.9	5.3	1.2	0.5	13.8	6.0	10.2
1998	165	25.0	129	0.630	725	18.6	4.0	8.4	5.3	1.2	0.5	13.4	6.3	9.5
1999	157	25.6	132	0.678	751	19.9	4.0	8.9	6.0	1.3	0.5	13.9	6.4	10.1
2000	157	25.5	132	0.678	751	20.3	4.3	8.9	6.0	1.3	0.5	14.2	6.8	10.1
2001	157	27.8	132	0.664	751	18.9	3.9	8.9	6.0	1.3	0.5	12.9	6.0	10.1
2002	157	25.5	132	0.678	751	19.3	3.9	8.9	6.2	1.3	0.5	13.1	5.8	10.1
2003	163	26.0	140	0.699	804	20.6	4.2	7.3	6.4	1.4	0.6	14.2	6.4	8.1
2004	163	25.8	140	0.701	804	19.6	4.1	7.7	6.4	1.4	0.6	13.2	6.3	8.6
2005	163	25.4	140	0.703	804	20.7	4.3	7.3	6.4	1.4	0.6	14.3	6.7	8.1
2006	163	25.3	140	0.704	804	21.0	4.3	7.3	6.4	1.4	0.6	14.6	6.6	8.1
2007	163	25.2	140	0.704	804	20.6	4.1	7.3	6.4	1.4	0.6	14.2	6.2	8.1
2008	163	25.3	140	0.704	804	19.9	3.9	7.3	6.4	1.4	0.6	13.5	5.9	8.1

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

Table 4.5
Index numbers for the annual nutrient excretions per breeding sow included in the agricultural census

	Live births per sow	Still born piglets per sow	Reared piglets per sow	Piglets lost per sow	Weight still born piglets	Weight piglet losses	Finishing weight piglets	Starting weight sows	Finishing weight sows	Replaced sows	Total feed use
					kg					*share*	*kg*
1990	23.5		20.4	3.1		1.3	25.5				1,713
1991	22.4		18.8	3.6		1.3	25.2				1,661
1992	24.0		20.5	3.5		1.3	25.6				1,712
1993	24.5		21.0	3.5		2.8	26.1	124	205	0.42	1,751
1994	24.5		21.3	3.2		2.8	25.7	124	205	0.42	1,718
1995	24.9		21.3	3.6		2.8	25.5	124	205	0.42	1,689
1996	25.1		21.5	3.6		2.8	25.3	124	205	0.43	1,723
1997[1]	25.1		21.8	3.3		2.8	25.6	129	205	0.38	1,757
1997[2]	0.0		0.0					129	205	0.38	1,010
1997[3]	25.1		0.0	25.1		2.8	2.8	129	205	0.38	1,010
1997[4]	25.1		21.8	3.3		2.8	33.0	129	205	0.38	2,062
1998	25.5		21.7	3.8		2.8	25.9	129	205	0.41	1,745
1999	26.2	1.9	22.6	3.6	1.3	2.8	25.6	132	205	0.41	1,774
2000	26.4	2.1	22.6	3.8	1.3	2.8	25.5	132	205	0.43	1,786
2001	26.2	2.1	22.4	3.8	1.3	2.8	27.8	132	220	0.41	1,904
2002	26.9	2.1	23.2	3.7	1.3	2.8	25.5	132	220	0.43	1,817
2003	27.4	2.1	23.6	3.8	1.3	2.8	26.0	140	220	0.41	1,841
2004	27.5	2.3	23.8	3.7	1.3	2.8	25.8	140	220	0.42	1,844
2005	28.6	2.4	24.2	4.4	1.3	2.8	25.4	140	220	0.42	1,840
2006	29.1	2.4	24.8	4.3	1.3	2.8	25.3	140	220	0.42	1,865
2007	30.3	2.4	25.5	4.8	1.3	2.8	25.2	140	230	0.42	1,904
2008	31.2	2.4	26.5	4.7	1.3	2.8	25.3	140	230	0.42	1,941

Source: see text.

[1] Outside the areas with swine fever, per average animal present.
[2] Within swine fever areas with breeding bans in place, sows without piglets, per average animal present.
[3] Within swine fever areas with breeding bans in place, sows of which the piglets were culled, per average animal present.
[4] Within other areas with swine fever, deliveries of heavy pigs, per average animal present

Table 4.6
Annual nutrient excretions per breeding sow included in the agricultural census

	Uptake			Fixation			Excretion		
	N	P	K	N	P	K	N	P_2O_5	K_2O
	kg/animal								
1990	46.9	11.3	19.4	13.1	2.8	1.3	33.8	19.5	21.8
1991	43.6	10.7	19.4	12.7	2.7	1.2	30.9	18.3	22.0
1992	45.7	11.0	19.9	13.9	3.0	1.3	31.8	18.4	22.3
1993	46.1	11.2	21.0	14.2	3.0	1.3	31.9	18.7	23.7
1994	44.3	10.3	19.7	14.2	3.0	1.3	30.1	16.6	22.1
1995	45.5	9.6	19.2	14.1	3.0	1.3	31.4	15.2	21.6
1996	45.4	9.3	19.4	14.1	3.0	1.3	31.3	14.3	21.7
1997[1]	46.4	9.4	19.4	14.3	3.1	1.4	32.1	14.6	21.7
1997[2]	24.4	5.2	12.3	0.7	0.1	0.1	23.7	11.5	14.8
1997[3]	24.4	5.2	12.3	2.1	0.6	0.2	22.4	10.5	14.7
1997[4]	55.7	11.2	22.2	18.2	3.9	1.7	37.5	16.7	24.6
1997[5]							28.8	13.3	18.8
1997[6]							32.5	14.7	21.5
1997[7]							25.0	11.6	16.3
1997[8]							28.3	12.8	18.7
1997[9]							29.9	13.6	20.0
1998	44.4	9.4	17.8	14.5	3.1	1.4	29.9	14.4	19.8
1999	46.0	9.1	18.7	15.5	3.2	1.4	30.6	13.7	20.8
2000	46.3	9.4	18.9	15.5	3.2	1.4	30.9	14.3	21.0
2001	47.1	9.6	19.9	16.7	3.6	1.6	30.3	13.7	22.1
2002	45.8	9.4	19.2	16.0	3.4	1.5	29.9	13.7	21.2
2003	46.2	9.5	16.9	16.3	3.5	1.6	29.9	13.6	18.5
2004	44.3	9.3	16.8	16.4	3.5	1.6	28.0	13.2	18.4
2005	47.1	10.0	16.9	16.4	3.5	1.6	30.7	14.9	18.5
2006	47.6	10.1	17.2	16.7	3.6	1.6	30.8	14.8	18.7
2007	48.7	10.1	17.5	17.3	3.7	1.7	31.5	14.6	19.1
2008	48.7	10.3	17.9	17.9	3.9	1.7	30.8	14.7	19.4

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

[1] Outside the areas with swine fever, per average animal present = animals included in the agricultural census.
[2] Within swine fever areas with breeding bans in place, sows without piglets, per average animal present.
[3] Within swine fever areas with breeding bans in place, sows of which the piglets were culled, per average animal present .
[4] Within swine fever areas (with and without breeding bans in place), deliveries of heavy pigs, per average animal present.
[5] Within swine fever areas with breeding bans in place, per average animal present.
[6] Within other swine fever areas, per average animal present.
[7] Within swine fever areas with breeding bans in place, per animal included in the agricultural census.
[8] Within other swine fever areas, per animal included in the agricultural census.
[9] Average excretion factors, per animal included in the agricultural census.

Table 4.7
Annual nutrient excretions per stud boar included in the agricultural census

	Starting weight	Finishing weight	Replacement	Total feed use	Uptake			Fixation			Excretion		
					N	P	K	N	P	K	N	P_2O_5	K_2O
	kg		*share*	*kg*	*kg/animal*								
1990	130	300	0.67	1,060	27.8	7.0	12.0	2.8	0.5	0.2	25.0	14.8	14.2
1991	130	300	0.67	1,060	27.2	7.0	12.4	2.8	0.5	0.2	24.5	14.8	14.7
1992	130	300	0.67	1,060	28.2	7.3	12.3	2.8	0.5	0.2	25.4	15.5	14.6
1993	130	300	0.67	1,060	27.3	6.1	12.7	2.8	0.5	0.2	24.6	12.9	15.1
1994	130	300	0.67	1,060	25.8	6.6	12.9	2.8	0.5	0.2	23.0	13.8	15.3
1995	130	300	0.67	1,060	27.3	6.0	12.8	2.8	0.5	0.2	24.6	12.6	15.2
1996	130	300	0.67	1,060	26.5	5.5	13.1	2.8	0.5	0.2	23.7	11.4	15.6
1997	130	300	0.67	1,060	25.5	5.6	13.5	2.8	0.5	0.2	22.8	11.6	16.0
1998	130	300	0.67	1,060	25.2	5.5	12.5	2.8	0.5	0.2	22.4	11.4	14.8
1999	130	300	0.67	1,059	25.1	5.1	12.9	2.7	0.6	0.2	22.4	10.3	15.3
2000	130	300	0.67	1,059	25.6	5.5	12.9	2.7	0.6	0.2	22.9	11.3	15.3
2001	130	300	0.67	1,059	25.8	5.3	12.9	2.6	0.6	0.2	23.2	10.8	15.3
2002	130	300	0.67	1,059	25.7	5.1	12.9	2.6	0.6	0.2	23.1	10.3	15.3
2003	135	325	0.67	1,095	26.9	5.8	9.7	3.2	0.7	0.2	23.8	11.7	11.5
2004	135	325	0.67	1,095	26.8	6.2	9.7	3.2	0.7	0.2	23.7	12.7	11.5
2005	135	325	0.67	1,095	26.8	6.2	9.7	3.2	0.7	0.2	23.7	12.7	11.5
2006	135	325	0.67	1,095	27.0	5.7	9.7	3.2	0.7	0.2	23.9	11.5	11.5
2007	135	325	0.67	1,095	26.5	5.7	9.7	3.2	0.7	0.2	23.3	11.5	11.5
2008	135	325	0.67	1,095	26.7	5.8	9.7	3.2	0.7	0.2	23.5	11.7	11.5

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

5. Nutrient excretion from poultry, rabbits and fur-bearing animals

5.1 Categorisation of animals

For the calculation of excretion factors for animal categories in poultry farming, and rabbit and fur-bearing animal breeders, the following categories from the agricultural census are distinguished:
- Broilers;
- Parent animals of meat breeds, 18 weeks and under (up to 1994: female parents of meat breeds, 18 weeks and under);
- Parent animals of meat breeds, 18 weeks and over (up to 1994: female parents of meat breeds, 18 weeks and over);
- Laying hens (including parent animals), 18 weeks and under;
- Laying hens (including parent animals), 18 weeks and over;
- Meat ducks (from 1995 including parent animals);
- Meat turkeys (from 2000 including parent animals);
- Turkeys in hatching egg production, 7 months and under;
- Turkeys in hatching egg production, 7 months and over;
- Rabbits, does;
- Minks, female parents;
- Foxes, female parents (up to and including 2007).

Up to 1994, the agricultural census inquired about the number of female parents of meat breeds. In the excretion calculations for the 1990–1994 period, the excretions of male animals were factored into those of the female parents.

In 1999, the agricultural census still inquired about the number of turkeys kept for hatching egg production, but in that year excretion factors were no longer determined for this category. The number of turkeys kept for hatching egg production was very small. From 2000 onwards, total numbers of turkeys were counted, including those kept for the production of hatching eggs.

Since 2008, fox breeding is no longer allowed.

5.2 Feed use and animal production

Data on annual animal production and feed use, for laying hens and broilers, were derived from the Farm Accountancy Data Network (BIN) of the LEI. The LEI agricultural administration only represents small samples, but the advantage over other administrative systems is that the LEI samples were chosen randomly. Up to 2000, data were available per financial year; since 2001 the annual data cover calendar years. The ratio between white laying hens and brown (medium heavy) laying hens in 1990 was based on data from the Product Board for Poultry and Eggs (PPE) (PPE, 1993). In later years, data on the housing of laying hens were taken from the agricultural census. Analogous with the handbooks Quantitative Livestock Farming Information (KWIN-V) for battery cages we assumed an occupation of 50 percent white hens and 50 percent medium heavy hens.

Index numbers for 1990 on other poultry categories, rabbits and fur-bearing animals were derived from the following sources:
- Young hens: IKC (1991b) and Evers and Ruchtie (1993);
- Female parents of meat breeds: IKC(1991b) and Ross (1990);
- Meat turkeys: IKC (personal communication);
- Turkeys in hatching egg production: Van der Hoek (1987);
- Meat ducks: IKC (1991b);
- Rabbits: IKC (1992a);
- Minks and foxes: Van Kerkhof (1994).

Data on total feed use by broilers and laying hens based on BIN, plus feed use by other chicken categories based on fixed index numbers were compared with the supplied quantities of chicken compound feed and the amounts of feed produced. This showed that the calculated feed use was 10 percent to 15 percent above the supplied quantities of compound feed. The difference between the amounts was small, but it must be noted that production data were not corrected for exports. An explanation for the difference could be that the agricultural census would overestimate poultry stocks, thus causing the calculated amount of feed to be too high, see Subsection 2.5.2. It is also possible that some poultry farms produced their own feed, for example, those with combined arable and poultry farming. For ducks, the calculated feed use was even around twice the amount of supplied feed. Also for rabbits and fur-bearing animals, the calculated feed use was higher than the compound feed deliveries.
Only for turkeys, the calculated feed use was smaller than the actual amounts supplied.
As stated above, index numbers on feed use and animal production for laying hens and broilers are being updated, annually. Most index numbers for other poultry categories as well as for rabbits and fur-bearing animals are only updated as new information becomes available.

In 1995, index numbers for poultry and rabbits were revised, except for parent animals of meat breeds (Working group on practical data *(Werkgroep Praktijkcijfers*), 1996a and 1996b). The index numbers for minks were revised in 1996 (TEAP, 1997), and, in 1999, index numbers for all animal categories were revised according to the results from Tamminga et al. (2000). From 2003 onwards, index numbers were adopted from Jongbloed and Kemme (2005). Index numbers for meat ducks were revised in 2008 (De Buisonjé et al., 2009). Furthermore, index numbers in the handbooks for Quantitative Livestock Farming Information (KWIN-V) are being updated, annually.

The index numbers are presented in the tables containing data on calculated excretion factors.

5.3 Compound feed content

Data on the nutrient content of compound feed for poultry, rabbits and fur-bearing animals were taken from the same sources as those for pigs. For a description, see Section 4.3.
For the data on average feed composition (Tables 5.1 and 5.2) for each animal category the various feed shares in the total feeding package were taken into account. The categories of feeds for ducks, turkeys, rabbits and fur-bearing animals were too divers and divergent to calculate average feed compositions using the method described in Section 4.3. Compositions, therefore, were initially based on information from a few large producers. For the years following the implementation of the nutrient accounting system MINAS, also for these animal categories we derived such data from the information that compound feed producers are obliged to supply to the Dutch National Service for the Implementation of Regulations (DR). The change in method from 2004 onwards, as described in Section 4.3, has improved the reliability of especially the composition of poultry feed.

5.4 Nutrient content in animals and animal products

The level of nutrient fixation in animals depends on body weight increases and the content per kilogram of live weight (Table 5.3). These nutrient levels were calculated as finishing weight x nutrient content in finished animals, minus starting weight x corresponding nutrient content. Data on live weights per animal are provided in the following section on nutrient excretions per animal category.

5.5 Nutrient excretions per animal category

For animal categories for which only female parents are counted, the excretion factors also include those of the male animals. Calculations of excretion factors for rabbits and

fur-bearing animals also include those for animals in meat and fur production; excretion data on young animals and male parents are included in those on female parents.

Index numbers in poultry farming are often expressed per housed animal or finished animal. Technical index numbers in this report, however, are expressed per animal counted in the agricultural census.
The numbers of animals included in the agricultural census, normally, correspond with the actual numbers of animals present, and include any vacancies and animal losses. Therefore, losses only have to be accounted for in cases where the data concern technical index numbers per housed or finished animal.

Table 5.1
Nutrient content in chicken feed

	Broilers			Parent animals of broilers, 18 weeks and under			Parent animals of broilers, 18 weeks and over			Laying hens, 18 weeks and under			Laying hens, 18 weeks and over		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
	g/kg														
1990	35.6	5.8	10.6	30.5	6.7	8.4	26.9	6.1	8.4	30.5	6.7	8.4	26.6	6.0	8.4
1991	35.9	5.7	10.3	31.3	7.3	9.4	28.4	6.3	9.4	31.3	7.3	9.4	28.2	6.2	9.4
1992	35.7	5.7	10.3	33.3	6.5	9.5	29.4	6.2	9.5	33.3	6.5	9.5	29.1	6.2	9.5
1993	35.1	5.8	10.0	31.3	6.6	9.3	30.6	6.2	9.3	31.3	6.6	9.3	30.5	6.2	9.3
1994	34.2	5.7	10.0	30.5	6.7	10.3	28.2	6.1	9.4	30.5	6.7	10.3	28.0	6.0	9.3
1995	36.7	5.7	9.7	30.3	6.4	10.1	28.5	5.8	8.2	30.3	6.4	10.1	28.4	5.7	8.1
1996	35.9	5.6	9.7	28.9	5.7	10.9	28.6	5.5	9.0	28.9	5.7	10.9	28.6	5.5	8.9
1997	34.3	5.7	10.2	30.5	5.9	12.0	26.6	5.3	9.1	30.5	5.9	12.0	26.3	5.3	8.9
1998	32.1	5.3	9.0	28.5	5.7	11.1	26.5	5.4	8.4	28.5	5.7	11.1	26.3	5.4	8.2
1999	32.8	5.5	8.3	27.7	5.6	10.2	26.6	5.4	8.4	27.7	5.6	10.2	26.1	5.4	7.2
2000	32.0	5.5	8.5	26.9	5.6	10.2	25.4	5.3	8.2	26.9	5.6	10.2	25.4	5.3	7.2
2001	30.9	4.9	8.5	25.2	5.4	10.2	24.6	5.0	7.4	25.2	5.4	10.2	24.5	5.0	7.2
2002	32.2	4.9	8.5	25.5	5.4	10.2	24.6	5.0	7.4	25.5	5.4	10.2	24.5	5.0	7.2
2003	32.0	5.1	7.8	25.2	5.2	7.3	23.5	4.8	6.7	25.2	5.2	7.3	24.0	4.9	7.0
2004	31.0	5.0	7.6	25.6	5.7	7.0	24.5	4.8	6.7	26.3	5.6	7.3	25.1	4.7	7.0
2005	31.6	5.0	7.5	25.3	5.7	7.0	24.4	4.9	6.7	26.0	5.6	7.3	25.0	4.7	7.0
2006	31.2	4.9	7.5	25.4	5.7	7.0	24.4	5.0	6.7	26.6	5.7	7.3	25.1	4.8	7.0
2007	30.7	4.9	7.5	25.7	5.7	7.0	24.7	4.9	6.7	26.6	5.7	7.3	25.5	4.8	7.0
2008	30.8	4.8	7.5	25.4	5.7	7.0	24.5	4.8	6.7	26.5	5.7	7.3	25.7	4.8	7.0

Table 5.2
Nutrient content in feed for ducks, turkeys, rabbits and fur-bearing animals

	Ducks			Meat turkeys			Turkeys in the production of hatching eggs, 7 months and under			Turkeys in the production of hatching eggs, 7 months and over[1)]			Rabbits			Fur-bearing animals		
	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K	N	P	K
	g/kg																	
1990	28.0	6.6	8.5	32.0	6.7	8.6	26.1	7.1	8.6	26.4	7.5	8.5	29.4	6.8	8.9	17.5	5.2	0.8
1991	28.0	6.6	8.5	32.0	6.7	8.6	26.1	7.1	8.6	26.4	7.5	8.5	29.4	6.8	8.9	17.5	5.2	0.8
1992	28.0	6.6	8.5	32.0	6.7	8.6	26.1	7.1	8.6	26.4	7.5	8.5	29.4	6.8	8.9	17.5	5.2	0.8
1993	28.0	6.6	8.5	32.0	6.7	8.6	26.1	7.1	8.6	26.4	7.5	8.5	29.4	6.8	8.9	17.5	5.2	0.8
1994	28.0	6.6	8.5	32.0	6.7	8.6	26.1	7.1	8.6	26.4	7.5	8.5	29.4	6.8	8.9	17.5	5.2	0.8
1995	27.8	6.5	8.7	31.2	6.2	8.1	25.0	6.2	7.5	24.8	5.5	7.0	26.9	5.9	14.2	17.5	5.2	0.8
1996	27.8	6.5	8.7	31.2	6.2	8.1	25.2	6.2	7.6	24.8	5.5	7.0	26.9	5.9	14.2	17.5	5.5	2.6
1997	27.8	6.5	8.7	31.2	6.2	8.1	25.2	6.2	7.6	24.8	5.5	7.0	26.9	5.9	14.2	17.5	5.5	2.6
1998	28.1	5.8	8.7	30.4	6.3	8.1	25.2	6.2	7.6	24.8	5.5	7.0	26.4	5.3	14.2	18.4	4.7	2.6
1999	27.7	5.6	8.0	30.4	6.1	8.1							26.9	5.5	16.0	19.0	4.6	2.6
2000	27.5	5.4	8.0	30.5	6.2	8.1							26.2	5.2	16.0	16.3	3.7	2.6
2001	26.8	5.4	8.1	29.0	5.9	8.1							26.3	5.2	16.0	15.4	3.9	2.6
2002	26.8	5.3	8.1	28.8	5.9	8.1							26.3	5.1	16.0	14.2	4.0	2.6
2003	26.7	5.2	8.1	29.6	6.0	7.4							26.6	5.3	15.0	13.5	3.5	2.6
2004	26.7	5.2	8.1	28.6	5.6	7.4							26.6	5.4	15.0	14.0	3.9	2.6
2005	26.1	5.3	8.1	29.1	5.9	7.4							26.8	5.5	15.0	13.6	3.5	2.6
2006	26.4	5.1	8.1	27.7	5.5	7.4							26.6	5.7	15.0	13.0	3.2	2.6
2007	26.3	4.9	8.1	27.5	5.5	7.4							26.8	5.4	15.0	12.8	2.8	2.6
2008	26.5	5.0	8.1	27.7	5.3	7.4							26.5	5.3	15.0	12.7	2.7	2.6

[1)] Since 1999, animals in these categories have been added to the numbers of meat turkeys.

Table 5.3
Nutrient content in poultry, eggs, rabbits and fur-bearing animals

	Status	N	P	K
		g/kg		
Eggs, laying hens sector				
1990–1997		19.2[1)]	2.0[1)]	1.20[1)]
1998–2002		19.4[2)]	1.9[2)]	1.20[1)]
2003–2008		18.5[3)]	1.7[3)]	1.20[1)]
Eggs, meat sector				
1990–1997		19.2[1)]	2.0[1)]	1.20[1)]
1998–2002		19.4[2)]	1.9[2)]	1.20[1)]
2003–2008		19.3[2)]	1.9[2)]	1.20[1)]
		g/kg live weight		
Broilers				
1990–2002	day-old chicks	n/a	n/a	n/a
2003	day-old chicks	30.4[1)]	4.4[4)]	2.40[4)]
2004–2008	day-old chicks	30.4[1)]	3.4[1)]	2.40[4)]
1990–1998	final weight	28.0[1)]	4.7[1)]	1.54[1)]
1999–2008	final weight	27.8[4)]	4.4[4)]	2.40[4)]
Female parents of broilers				
1990–2008	19 weeks	33.4[2)]	4.9[2)]	2.50[2)]
1990–2008	final weight	28.4[2)]	5.4[2)]	2.20[2)]
Male parents of broilers				
1990–2008	19 weeks	34.5[2)]	5.4[2)]	2.50[2)]
1990–2008	final weight	35.4[2)]	5.7[2)]	2.50[2)]
Laying hens				
1990–1998	day-old chicks	n/a	n/a	n/a
1999–2008	day-old chicks	30.4[1)]	3.4[1)]	2.00[1)]
1990–2002	17 weeks, light	28.0[1)]	6.1[1)]	1.91[1)]
2003–2008	17 weeks, light	28.0[1)]	5.5[3)]	1.91[1)]
1990–2002	final weight, light	28.0[1)]	5.1[1)]	1.85[1)]
2003–2008	final weight, light	28.0[1)]	5.6[3)]	1.85[1)]
1990–2002	17 weeks, middle weight	28.0[1)]	6.4[1)]	1.65[1)]
2003–2008	17 weeks, middle weight	28.0[1)]	5.5[3)]	1.65[1)]
1990–2002	final weight, middle weight	28.0[1)]	5.4[1)]	1.85[1)]
2003–2008	final weight, middle weight	28.0[1)]	5.6[3)]	1.85[1)]
Meat ducks				
1990–1998	day-old chicks	n/a	n/a	n/a
1999–2003	day-old chicks	25.9[5)]	5.7[5)]	2.00[1)]
2004–2007	day-old chicks	30.0[6)]	3.1[6)]	2.00[1)]
2008	day-old chicks	27.9[7)]	2.8[7)]	1.83[7)]
1990–2003	final weight	25.9[5)]	5.7[5)]	2.00[1)]
2004–2007	final weight	25.9[5)]	5.3[3)]	2.00[1)]
2008	final weight	29.5[7)]	5.1[7)]	2.49[7)]
Meat turkeys				
1990–1998	day-old chicks	n/a	n/a	n/a
1999–2002	day-old chicks	33.0[8)]	7.2[9)]	2.04[9)]
2003–2008	day-old chicks	30.0[6)]	3.4[1)]	2.04[9)]
1990–2002	hens, final weight	33.0[8)]	7.2[9)]	2.04[9)]
2003	hens, final weight	33.0[8)]	5.1[3)]	2.04[9)]
2004–2008	hens, final weight	33.0[8)]	5.0[3)]	2.04[9)]
1990–2002	cocks, final weight	33.0[8)]	7.2[9)]	2.04[9)]
2003	cocks, final weight	33.0[8)]	5.1[3)]	2.04[9)]
2004–2008	cocks, final weight	33.0[8)]	5.2[3)]	2.04[9)]
Turkeys in hatching egg production				
1990–1998	hens	33.0[8)]	6.4[9)]	2.04[9)]
1990–1998	cocks	33.0[8)]	7.2[9)]	2.04[9)]
Rabbits				
1990–2003	young animals	30.0[10)]	6.0[10)]	2.00[10)]
2004–2008	young animals	28.9[3)]	6.0[10)]	2.00[10)]
1990–2003	adult animals	30.0[10)]	6.0[10)]	2.00[10)]
2004–2008	adult animals	32.3[3)]	6.0[10)]	2.00[10)]
Minks				
1990–2003		30.0[10)]	6.0[10)]	2.00[10)]
2004–2008		27.9[3)]	6.0[10)]	2.00[10)]
Foxes				
1990–2007		30.0[10)]	6.0[10)]	2.00[10)]

NB For day-old chicks the weight was set to 0 grams for the first years of the time series

1) Coppoolse et al., 1990.
2) Versteegh and Jongbloed, 2000b.
3) Jongbloed and Kemme, 2002b.
4) Versteegh and Jongbloed, 2000a.
5) PP, 1993.
6) LNV, 2004.
7) De Buisonjé et al., 2009.
8) IKC, 1992c.
9) WPSA, 1985.
10) IKC, 1993b.

Table 5.4
Annual nutrient excretions per broiler included in the agricultural census

	Fattening period	Starting weight	Finishing weight	Feed conversion	Total feed use	Uptake			Fixation			Excretion		
						N	P	K	N	P	K	N	P_2O_5	K_2O
	days	*grams*		*kg feed/ kg growth*	*kg*	*kg/animal*								
1990	43.1	0	1,790	1.92	29.1	1.04	0.17	0.31	0.42	0.07	0.02	0.61	0.22	0.34
1991	42.3	0	1,830	1.90	30.0	1.08	0.17	0.31	0.44	0.07	0.02	0.64	0.22	0.34
1992	41.9	0	1,840	1.91	30.6	1.09	0.17	0.32	0.45	0.08	0.02	0.64	0.23	0.35
1993	41.8	0	1,850	1.89	30.6	1.07	0.18	0.31	0.45	0.08	0.02	0.62	0.23	0.34
1994	41.2	0	1,850	1.83	30.0	1.03	0.17	0.30	0.46	0.08	0.03	0.57	0.22	0.33
1995	42.0	0	1,860	1.83	29.6	1.09	0.17	0.29	0.45	0.08	0.02	0.63	0.21	0.32
1996	42.6	0	1,910	1.82	29.8	1.07	0.17	0.29	0.46	0.08	0.03	0.61	0.21	0.32
1997	42.6	0	1,980	1.83	31.1	1.07	0.18	0.32	0.48	0.08	0.03	0.59	0.22	0.35
1998	42.0	0	1,960	1.82	31.0	1.00	0.16	0.28	0.48	0.08	0.03	0.52	0.19	0.30
1999	41.2	0	1,950	1.80	31.1	1.02	0.17	0.26	0.48	0.08	0.04	0.54	0.22	0.26
2000	41.5	0	2,000	1.78	31.3	1.00	0.17	0.27	0.49	0.08	0.04	0.51	0.22	0.27
2001	41.9	0	2,090	1.77	32.2	1.00	0.16	0.27	0.51	0.08	0.04	0.49	0.18	0.28
2002	41.8	0	2,105	1.76	32.3	1.04	0.16	0.27	0.51	0.08	0.04	0.53	0.18	0.28
2003[1)]	40.4	42	2,050	1.79	32.4	1.04	0.17	0.25	0.50	0.08	0.04	0.53	0.20	0.25
2004	43.2	42	2,180	1.83	33.0	1.02	0.16	0.25	0.50	0.08	0.04	0.52	0.19	0.25
2005	42.4	42	2,179	1.83	33.6	1.06	0.17	0.25	0.51	0.08	0.04	0.55	0.20	0.25
2006	41.9	42	2,170	1.80	33.5	1.04	0.16	0.25	0.51	0.08	0.04	0.53	0.19	0.25
2007	41.8	42	2,220	1.80	34.3	1.05	0.17	0.26	0.53	0.08	0.05	0.53	0.19	0.26
2008	41.8	42	2,230	1.80	34.5	1.06	0.17	0.26	0.53	0.08	0.05	0.53	0.19	0.26

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake — P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

1) The factors apply to the average numbers of animals present. The animal numbers according to the agricultural census were adjusted, because of the avian flu, to average numbers of animals present.

Table 5.5
Annual nutrient excretions per parent animal of broilers of 18 weeks and under included in the agricultural census[1)]

	Production cycle	Starting weight	Finishing weight hens	Finishing weight cocks	Total feed use	Uptake			Fixation			Excretion		
						N	P	K	N	P	K	N	P_2O_5	K_2O
	days	*grams*			*kg*	*kg/animal*								
1990	126.0	0	1,800	2,350	23.8	0.73	0.16	0.20	0.20	0.03	0.02	0.52	0.30	0.22
1991	126.0	0	1,800	2,350	23.8	0.74	0.17	0.22	0.20	0.03	0.02	0.54	0.33	0.25
1992	126.0	0	1,800	2,350	23.8	0.79	0.15	0.23	0.20	0.03	0.02	0.59	0.29	0.25
1993	126.0	0	1,800	2,350	23.8	0.74	0.16	0.22	0.20	0.03	0.02	0.54	0.29	0.25
1994	126.0	0	1,800	2,350	23.8	0.73	0.16	0.25	0.20	0.03	0.02	0.52	0.30	0.28
1995	126.0	0	1,800	2,350	20.8	0.63	0.13	0.21	0.18	0.03	0.01	0.45	0.24	0.24
1996	126.0	0	1,800	2,350	20.8	0.60	0.12	0.23	0.18	0.03	0.01	0.42	0.21	0.26
1997	126.0	0	1,800	2,350	20.8	0.63	0.12	0.25	0.18	0.03	0.01	0.45	0.22	0.28
1998	126.0	0	1,800	2,350	20.8	0.59	0.12	0.23	0.18	0.03	0.01	0.41	0.21	0.26
1999	126.0	42	1,900	2,600	20.7	0.57	0.12	0.21	0.19	0.03	0.01	0.38	0.20	0.24
2000	126.0	42	1,900	2,600	20.7	0.56	0.12	0.21	0.19	0.03	0.01	0.37	0.20	0.24
2001	126.0	42	1,900	2,600	20.7	0.52	0.11	0.21	0.19	0.03	0.01	0.33	0.19	0.24
2002	126.0	42	1,900	2,600	20.7	0.53	0.11	0.21	0.19	0.03	0.01	0.34	0.19	0.24
2003[2)]	126.0	42	2,000	2,750	20.7	0.52	0.11	0.15	0.20	0.03	0.01	0.32	0.18	0.16
2004	126.0	42	2,000	2,750	20.7	0.53	0.12	0.15	0.20	0.03	0.01	0.33	0.20	0.16
2005	126.0	42	2,000	2,750	20.7	0.52	0.12	0.15	0.20	0.03	0.01	0.32	0.20	0.16
2006	126.0	42	2,000	2,750	20.7	0.53	0.12	0.15	0.20	0.03	0.01	0.33	0.20	0.16
2007	126.0	42	2,000	2,750	20.7	0.53	0.12	0.15	0.20	0.03	0.01	0.33	0.20	0.16
2008	126.0	42	2,000	2,750	20.7	0.53	0.12	0.15	0.20	0.03	0.01	0.33	0.20	0.16

Sources: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

1) Up to 1994, shares of male parents were included in data on female parents, with the assumption of 15% cocks at time of set-up and 10% cocks at time of finishing.
2) The factors apply to the average numbers of animals present. The animal numbers according to the agricultural census were adjusted, because of the avian flu, to average numbers of animals present.

Table 5.6
Annual nutrient excretions per parent animal of broilers of 18 weeks and under included in the agricultural census [1)]

	Production cycle	Starting weight hens	Starting weight cocks	Finishing weight hens	Finishing weight cocks	Egg production	Total feed use	Uptake			Fixation			Excretion		
								N	P	K	N	P	K	N	P_2O_5	K_2O
	days	*grams*				*kg*		*kg/animal*								
1990	294	1,800	2,350	3,600	4,800	12.4	60.5	1.63	0.37	0.51	0.30	0.04	0.02	1.33	0.75	0.59
1991	294	1,800	2,350	3,600	4,800	12.4	60.5	1.72	0.38	0.57	0.30	0.04	0.02	1.42	0.78	0.66
1992	294	1,800	2,350	3,600	4,800	12.4	60.5	1.78	0.38	0.57	0.30	0.04	0.02	1.48	0.77	0.67
1993	294	1,800	2,350	3,600	4,800	12.4	60.5	1.85	0.38	0.56	0.30	0.04	0.02	1.55	0.77	0.65
1994	294	1,800	2,350	3,600	4,800	12.4	60.5	1.71	0.37	0.57	0.30	0.04	0.02	1.41	0.75	0.66
1995	298	1,800	2,350	3,600	4,800	11.1	54.7	1.56	0.31	0.45	0.27	0.03	0.02	1.29	0.64	0.52
1996	298	1,800	2,350	3,600	4,800	11.1	54.7	1.56	0.30	0.49	0.27	0.03	0.02	1.29	0.61	0.57
1997	298	1,800	2,350	3,600	4,800	11.1	54.7	1.45	0.29	0.50	0.27	0.03	0.02	1.18	0.59	0.58
1998	298	1,800	2,350	3,600	4,800	11.1	54.7	1.45	0.30	0.46	0.27	0.03	0.02	1.17	0.60	0.53
1999	298	1,900	2,600	3,600	4,800	11.1	54.7	1.45	0.30	0.46	0.27	0.03	0.02	1.18	0.60	0.53
2000	298	1,900	2,600	3,600	4,800	11.1	54.7	1.39	0.29	0.46	0.27	0.03	0.02	1.13	0.59	0.53
2001	298	1,900	2,600	3,600	4,800	11.1	54.7	1.34	0.27	0.41	0.27	0.03	0.02	1.07	0.55	0.47
2002	298	1,900	2,600	3,600	4,800	11.1	54.7	1.34	0.27	0.41	0.27	0.03	0.02	1.08	0.55	0.47
2003[2)]	298	2,000	2,750	3,600	4,800	11.4	55.9	1.31	0.27	0.38	0.27	0.03	0.02	1.05	0.54	0.43
2004	298	2,000	2,750	3,700	4,800	11.5	56.2	1.38	0.27	0.38	0.27	0.03	0.02	1.11	0.54	0.43
2005	298	2,000	2,750	3,700	4,800	11.7	56.6	1.38	0.28	0.38	0.28	0.03	0.02	1.10	0.55	0.43
2006	298	2,000	2,750	3,700	4,800	11.7	56.6	1.38	0.28	0.38	0.28	0.03	0.02	1.10	0.57	0.43
2007	298	2,000	2,750	3,700	4,800	11.9	57.3	1.41	0.28	0.38	0.28	0.04	0.02	1.13	0.56	0.44
2008	298	2,000	2,750	3,700	4,800	11.9	57.3	1.40	0.27	0.38	0.28	0.04	0.02	1.12	0.55	0.44

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

1) Up to 1994, shares of male parents were included in data on female parents, with the assumption of 10% cocks at time of set-up. Cock losses were assumed to be 35% and hen losses 10%.
2) The factors apply to the average numbers of animals present. The animal numbers according to the agricultural census were adjusted, because of the avian flu, to average numbers of animals present.

Table 5.7
Annual nutrient excretions per laying hen of 18 weeks and under included in the agricultural census

	Production cycle	Starting weight	Finishing weight[1)]	Total feed use	Uptake			Fixation			Excretion		
					N	P	K	N	P	K	N	P_2O_5	K_2O
	days	*grams*		*kg*	*kg/animal*								
1990	119	0	1,316	16.2	0.49	0.11	0.14	0.11	0.03	0.01	0.38	0.19	0.15
1991	119	0	1,316	16.2	0.51	0.12	0.15	0.11	0.03	0.01	0.39	0.21	0.17
1992	119	0	1,316	16.2	0.54	0.11	0.15	0.11	0.03	0.01	0.43	0.18	0.18
1993	119	0	1,316	16.2	0.51	0.11	0.15	0.11	0.03	0.01	0.39	0.19	0.17
1994	119	0	1,316	16.2	0.49	0.11	0.17	0.11	0.03	0.01	0.38	0.19	0.19
1995	119	0	1,286	15.6	0.47	0.10	0.16	0.11	0.02	0.01	0.36	0.17	0.18
1996	119	0	1,286	15.6	0.45	0.09	0.17	0.11	0.02	0.01	0.34	0.15	0.20
1997	119	0	1,293	15.6	0.48	0.09	0.19	0.11	0.02	0.01	0.36	0.15	0.22
1998	119	0	1,293	15.6	0.44	0.09	0.17	0.11	0.02	0.01	0.33	0.15	0.20
1999	119	33	1,338	15.8	0.44	0.09	0.16	0.11	0.03	0.01	0.33	0.14	0.19
2000	119	33	1,338	15.8	0.43	0.09	0.16	0.11	0.03	0.01	0.31	0.14	0.19
2001	119	33	1,338	15.8	0.40	0.09	0.16	0.11	0.03	0.01	0.29	0.14	0.19
2002	119	33	1,338	15.8	0.40	0.09	0.16	0.11	0.03	0.01	0.29	0.14	0.19
2003[2)]	119	35	1,445	16.9	0.43	0.09	0.12	0.12	0.02	0.01	0.30	0.15	0.14
2004	119	35	1,456	17.0	0.45	0.10	0.12	0.12	0.02	0.01	0.33	0.16	0.14
2005	119	35	1,456	17.0	0.44	0.10	0.12	0.12	0.02	0.01	0.32	0.16	0.14
2006	119	35	1,456	17.0	0.45	0.10	0.12	0.12	0.02	0.01	0.33	0.17	0.14
2007	119	35	1,474	17.3	0.46	0.10	0.13	0.12	0.02	0.01	0.34	0.17	0.14
2008	119	35	1,474	17.3	0.46	0.10	0.13	0.12	0.02	0.01	0.34	0.17	0.14

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

1) Average of white and middle-weight laying hens.
2) The factors apply to the average numbers of animals present. The animal numbers according to the agricultural census were adjusted, because of the avian flu, to average numbers of animals present.

Table 5.8
Annual nutrient excretions per laying hen of 18 weeks and over included in the agricultural census

	Production cycle	Starting weight[1]	Finishing weight[1]	Egg production	Total feed use	Uptake			Fixation			Excretion		
						N	P	K	N	P	K	N	P_2O_5	K_2O
	days	*grams*		*kg*		*kg/animal*								
1990	421	1,316	1,938	17.6	41.4	1.10	0.25	0.35	0.35	0.04	0.02	0.75	0.48	0.39
1991	417	1,316	1,938	17.6	41.7	1.18	0.26	0.39	0.35	0.04	0.02	0.82	0.51	0.45
1992	405	1,316	1,938	17.7	42.1	1.23	0.26	0.40	0.36	0.04	0.02	0.87	0.51	0.46
1993	419	1,316	1,938	17.8	41.6	1.27	0.26	0.39	0.36	0.04	0.02	0.91	0.50	0.44
1994	409	1,316	1,938	18.2	41.9	1.17	0.25	0.39	0.37	0.04	0.02	0.81	0.49	0.44
1995	419	1,286	1,942	18.4	41.4	1.18	0.24	0.34	0.37	0.04	0.02	0.81	0.45	0.38
1996	421	1,286	1,942	18.3	40.8	1.17	0.22	0.36	0.37	0.04	0.02	0.80	0.43	0.41
1997	424	1,293	1,955	18.3	40.5	1.07	0.21	0.36	0.37	0.04	0.02	0.70	0.40	0.41
1998	419	1,293	1,955	18.4	40.3	1.06	0.22	0.33	0.37	0.04	0.02	0.69	0.41	0.37
1999	410	1,338	1,920	18.0	41.1	1.07	0.22	0.30	0.36	0.04	0.02	0.71	0.43	0.33
2000	410	1,338	1,920	18.2	41.0	1.04	0.22	0.30	0.37	0.04	0.02	0.67	0.42	0.33
2001	410	1,338	1,920	18.0	41.4	1.01	0.21	0.30	0.36	0.04	0.02	0.65	0.39	0.33
2002	410	1,338	1,920	18.4	41.9	1.03	0.21	0.30	0.37	0.04	0.02	0.66	0.40	0.34
2003[2]	414	1,442	1,867	16.2	42.0	1.01	0.21	0.29	0.31	0.03	0.02	0.70	0.40	0.33
2004	412	1,454	1,744	17.8	41.7	1.05	0.20	0.29	0.34	0.03	0.02	0.71	0.38	0.33
2005	412	1,454	1,744	17.8	41.9	1.05	0.20	0.29	0.34	0.03	0.02	0.71	0.38	0.33
2006	412	1,454	1,744	17.2	42.4	1.07	0.21	0.30	0.33	0.03	0.02	0.74	0.40	0.33
2007	410	1,465	1,753	17.2	41.6	1.06	0.20	0.29	0.33	0.03	0.02	0.74	0.39	0.33
2008	409	1,469	1,757	17.3	41.9	1.08	0.20	0.29	0.33	0.03	0.02	0.75	0.39	0.33

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake –- P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

1) Average of white and middle-weight laying hens.
2) The factors apply to the average numbers of animals present. The animal numbers according to the agricultural census were adjusted, because of the avian flu, to average numbers of animals present.

Table 5.9
Annual nutrient excretions per meat turkey included in the agricultural census

	Fattening period	Starting weight	Finishing weight[1]	Feed conversion	Total feed use	Uptake			Fixation			Excretion		
						N	P	K	N	P	K	N	P_2O_5	K_2O
	days	*grams*		*kg feed/ kg growth*	*kg*	*kg/animal*								
1990	132.0	0	13,000	2.75	98.9	3.16	0.66	0.85	1.19	0.26	0.07	1.98	0.92	0.94
1991	132.0	0	13,000	2.75	98.9	3.16	0.66	0.85	1.19	0.26	0.07	1.98	0.92	0.94
1992	132.0	0	13,000	2.75	98.9	3.16	0.66	0.85	1.19	0.26	0.07	1.98	0.92	0.94
1993	135.0	0	13,852	2.77	103.7	3.32	0.70	0.89	1.24	0.27	0.08	2.08	0.97	0.98
1994	135.0	0	13,852	2.77	103.7	3.32	0.70	0.89	1.24	0.27	0.08	2.08	0.97	0.98
1995	134.0	0	14,280	2.68	104.2	3.25	0.65	0.84	1.28	0.28	0.08	1.97	0.84	0.92
1996	134.0	0	14,280	2.68	104.2	3.25	0.65	0.84	1.28	0.28	0.08	1.97	0.84	0.92
1997	134.0	0	14,280	2.68	104.2	3.25	0.65	0.84	1.28	0.28	0.08	1.97	0.84	0.92
1998	134.0	0	14,280	2.68	104.2	3.17	0.66	0.84	1.28	0.28	0.08	1.89	0.86	0.92
1999	131.5	57	14,000	2.65	102.6	3.12	0.63	0.83	1.28	0.28	0.08	1.84	0.79	0.91
2000	131.5	57	14,000	2.65	102.6	3.13	0.64	0.83	1.28	0.28	0.08	1.85	0.82	0.91
2001	131.5	57	14,000	2.65	102.6	2.97	0.61	0.83	1.28	0.28	0.08	1.70	0.75	0.91
2002	131.5	57	14,000	2.65	102.6	2.95	0.61	0.83	1.28	0.28	0.08	1.68	0.75	0.91
2003[2]	131.5	57	14,000	2.65	102.6	3.04	0.62	0.76	1.28	0.20	0.08	1.76	0.96	0.82
2004	130.2	57	14,525	2.65	107.5	3.07	0.60	0.80	1.34	0.21	0.08	1.74	0.90	0.86
2005	129.5	57	14,650	2.65	109.0	3.17	0.64	0.81	1.36	0.21	0.08	1.81	0.99	0.87
2006	129.5	57	14,650	2.65	109.0	3.02	0.60	0.81	1.36	0.21	0.08	1.66	0.89	0.87
2007	129.5	57	15,000	2.65	112.0	3.08	0.62	0.83	1.39	0.22	0.09	1.69	0.92	0.90
2008	129.5	57	15,000	2.65	112.0	3.10	0.59	0.83	1.39	0.22	0.09	1.71	0.87	0.90

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

1) Average weight hens and cocks.
2) The factors apply to the average numbers of animals present. The animal numbers according to the agricultural census were adjusted, because of the avian flu, to average numbers of animals present.

Table 5.10
Annual nutrient excretions per turkey of 7 months and under, in hatching egg production, included in the agricultural census[1)]

	Production cycle	Starting weight[2)]	Finishing weight[2)]	Total feed use	Uptake			Fixation			Excretion		
					N	P	K	N	P	K	N	P_2O_5	K_2O
	days	*grams*		*kg*	*kg/animal*								
1990	168	1,795	13,173	122.1	3.19	0.87	1.05	0.82	0.17	0.05	2.38	1.58	1.20
1991	168	1,795	13,173	122.1	3.19	0.87	1.05	0.82	0.17	0.05	2.38	1.58	1.20
1992	168	1,795	13,173	122.1	3.19	0.87	1.05	0.82	0.17	0.05	2.38	1.58	1.20
1993	168	1,795	13,173	122.1	3.19	0.87	1.05	0.82	0.17	0.05	2.38	1.58	1.20
1994	168	1,795	13,173	122.1	3.19	0.87	1.05	0.82	0.17	0.05	2.38	1.58	1.20
1995	168	1,943	13,706	144.9	3.63	0.90	1.09	0.84	0.18	0.05	2.78	1.64	1.25
1996	168	1,943	13,706	133.3	3.37	0.83	1.01	0.84	0.18	0.05	2.52	1.49	1.16
1997	168	1,943	13,706	133.3	3.37	0.83	1.01	0.84	0.18	0.05	2.52	1.49	1.16
1998	168	1,943	13,706	133.3	3.37	0.83	1.01	0.84	0.18	0.05	2.52	1.49	1.16

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

1) Young animals 6–30 weeks, including 1 cock per 11 hens.
2) Average weight hens and cocks.

Table 5.11
Annual nutrient excretions per turkey of 7 months and over, in hatching egg production, included in the agricultural census[1)]

	Laying period	Starting weight[2)]	Finishing weight[2)]	Egg production	Total feed use	Uptake			Fixation			Excretion		
						N	P	K	N	P	K	N	P_2O_5	K_2O
	days	*grams*		*kg*		*kg/animal*								
1990	168	13,000	12,358	17.45	131.1	3.46	0.98	1.11	0.29	0.02	0.02	3.17	2.20	1.32
1991	168	13,000	12,358	17.45	131.1	3.46	0.98	1.11	0.29	0.02	0.02	3.17	2.20	1.32
1992	168	13,000	12,358	17.45	131.1	3.46	0.98	1.11	0.29	0.02	0.02	3.17	2.20	1.32
1993	168	13,000	12,358	17.45	131.1	3.46	0.98	1.11	0.29	0.02	0.02	3.17	2.20	1.32
1994	168	13,000	12,358	17.45	131.1	3.46	0.98	1.11	0.29	0.02	0.02	3.17	2.20	1.32
1995	168	13,706	13,827	20.15	138.6	3.44	0.76	0.97	0.40	0.04	0.02	3.04	1.65	1.14
1996	168	13,706	13,827	20.15	138.6	3.44	0.76	0.97	0.40	0.04	0.02	3.04	1.65	1.14
1997	168	13,706	13,827	20.15	138.6	3.44	0.76	0.97	0.40	0.04	0.02	3.04	1.65	1.14
1998	168	13,706	13,827	20.15	138.6	3.44	0.76	0.97	0.40	0.04	0.02	3.04	1.65	1.14

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

1) Including 1 cock per 12 hens.
2) Average weight hens and cocks.

Table 5.12
Annual nutrient excretions per meat duck included in the agricultural census

	Fattening period	Starting weight	Finishing weight	Feed conversion	Total feed use	Uptale			Fixation			Excretion		
						N	P	K	N	P	K	N	P_2O_5	K_2O
	days	*grams*		*kg feed/ kg growth*	*kg*	*kg/animal*								
1990	50	0	3,100	2.70	61.1	1.71	0.40	0.52	0.59	0.13	0.05	1.12	0.63	0.57
1991	50	0	3,100	2.70	61.1	1.71	0.40	0.52	0.59	0.13	0.05	1.12	0.63	0.57
1992	50	0	3,100	2.70	61.1	1.71	0.40	0.52	0.59	0.13	0.05	1.12	0.63	0.57
1993	50	0	3,100	2.70	61.1	1.71	0.40	0.52	0.59	0.13	0.05	1.12	0.63	0.57
1994	50	0	3,100	2.70	61.1	1.71	0.40	0.52	0.59	0.13	0.05	1.12	0.63	0.57
1995	47	0	3,025	2.59	60.8	1.69	0.40	0.53	0.61	0.13	0.05	1.09	0.60	0.58
1996	47	0	3,025	2.59	60.8	1.69	0.40	0.53	0.61	0.13	0.05	1.09	0.60	0.58
1997	47	0	3,025	2.59	60.8	1.69	0.40	0.53	0.61	0.13	0.05	1.09	0.60	0.58
1998	47	0	3,025	2.59	60.8	1.71	0.35	0.53	0.61	0.13	0.05	1.10	0.50	0.58
1999	45	55	3,000	2.45	58.5	1.62	0.33	0.47	0.62	0.14	0.05	1.00	0.44	0.51
2000	45	55	3,000	2.45	58.5	1.61	0.32	0.47	0.62	0.14	0.05	0.99	0.41	0.51
2001	45	55	3,000	2.45	58.5	1.57	0.32	0.47	0.62	0.14	0.05	0.95	0.41	0.51
2002	45	55	3,000	2.45	58.5	1.57	0.31	0.47	0.62	0.14	0.05	0.95	0.40	0.51
2003[1)]	48	53	3,150	2.40	56.5	1.51	0.29	0.46	0.61	0.13	0.05	0.90	0.37	0.49
2004	45	55	3,150	2.40	60.2	1.61	0.31	0.49	0.65	0.13	0.05	0.96	0.41	0.53
2005	45	55	3,150	2.35	59.0	1.54	0.31	0.48	0.65	0.13	0.05	0.89	0.41	0.52
2006	45	55	3,150	2.35	59.0	1.56	0.30	0.48	0.65	0.13	0.05	0.91	0.38	0.52
2007	45	55	3,100	2.25	56.6	1.49	0.28	0.46	0.64	0.13	0.05	0.85	0.33	0.49
2008	46	56	3,210	2.22	56.6	1.50	0.28	0.46	0.74	0.13	0.06	0.76	0.36	0.48

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake -–P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

1) The factors apply to the average numbers of animals present. The animal numbers according to the agricultural census were adjusted, because of the avian flu, to average numbers of animals present.

Table 5.13
Annual nutrient excretions per parent animal of meat rabbits included in the agricultural census

	No. of litters	No. of kits per litter	Supplied meat	Losses	Re-placement[1)]	Total feed use	Uptake			Fixation			Excretion		
							N	P	K	N	P	K	N	P_2O_5	K_2O
			kg				*kg/animal*								
1990	6.75	8.2	103.0	10.82		412	12.1	2.8	3.7	3.4	0.7	0.2	8.7	4.9	4.1
1991	6.75	8.2	103.0	10.82		412	12.1	2.8	3.7	3.4	0.7	0.2	8.7	4.9	4.1
1992	6.75	8.2	103.0	10.82		412	12.1	2.8	3.7	3.4	0.7	0.2	8.7	4.9	4.1
1993	6.75	8.2	103.6	10.38		412	12.1	2.8	3.7	3.4	0.7	0.2	8.7	4.9	4.1
1994	6.75	8.2	103.6	10.38		412	12.1	2.8	3.7	3.4	0.7	0.2	8.7	4.9	4.1
1995	7.10	8.1	109.5	13.33		438	11.8	2.6	6.2	3.7	0.7	0.2	8.1	4.2	7.2
1996	7.10	8.1	109.5	13.33		438	11.8	2.6	6.2	3.7	0.7	0.2	8.1	4.2	7.2
1997	7.10	8.1	109.5	13.33		438	11.8	2.6	6.2	3.7	0.7	0.2	8.1	4.2	7.2
1998	7.10	8.1	109.5	13.33		438	11.6	2.3	6.2	3.7	0.7	0.2	7.9	3.6	7.2
1999	7.00	8.4	118.7	10.01		437	11.8	2.4	7.0	3.9	0.8	0.3	7.9	3.7	8.1
2000	7.00	8.4	118.7	10.01		437	11.5	2.3	7.0	3.9	0.8	0.3	7.6	3.4	8.1
2001	7.00	8.4	118.7	10.01		437	11.5	2.3	7.0	3.9	0.8	0.3	7.6	3.4	8.1
2002	7.00	8.4	118.7	10.01		437	11.5	2.2	7.0	3.9	0.8	0.3	7.6	3.3	8.1
2003	7.20	8.5	126.2	12.33		451	12.0	2.4	6.8	4.2	0.8	0.3	7.8	3.6	7.8
2004	7.20	8.5	120.2	12.33	7.22	455	12.1	2.5	6.8	4.1	0.8	0.3	8.0	3.7	7.9
2005	7.20	8.7	123.4	12.62	6.80	461	12.4	2.5	6.9	4.2	0.9	0.3	8.2	3.8	8.0
2006	7.20	8.7	123.4	12.62	6.80	461	12.3	2.6	6.9	4.2	0.9	0.3	8.1	4.1	8.0
2007	7.00	8.6	118.7	12.13	6.38	449	12.0	2.4	6.7	4.0	0.8	0.3	8.0	3.7	7.8
2008	7.00	8.6	118.7	12.13	6.38	449	11.9	2.4	6.7	4.0	0.8	0.3	7.9	3.6	7.8

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

1) Up to 2004, fixation due to the replacement of does and bucks was included in supplied meat.

Table 5.14
Annual nutrient excretions per parent animal of minks included in the agricultural census

	Supplied minks	Losses	Replacement[1)]	Total feed use	Uptake			Fixation			Excretion		
					N	P	K	N	P	K	N	P_2O_5	K_2O
	kg				*kg/animal*								
1990	9.50	0.18		250	4.4	1.3	0.2	0.3	0.1	0.0	4.1	2.8	0.2
1991	9.50	0.18		250	4.4	1.3	0.2	0.3	0.1	0.0	4.1	2.8	0.2
1992	9.50	0.18		250	4.4	1.3	0.2	0.3	0.1	0.0	4.1	2.8	0.2
1993	9.50	0.18		250	4.4	1.3	0.2	0.3	0.1	0.0	4.1	2.8	0.2
1994	9.50	0.18		250	4.4	1.3	0.2	0.3	0.1	0.0	4.1	2.8	0.2
1995	9.50	0.18		250	4.4	1.3	0.2	0.3	0.1	0.0	4.1	2.8	0.2
1996	10.28	0.08		218	3.8	1.2	0.6	0.3	0.1	0.0	3.5	2.6	0.7
1997	10.28	0.08		218	3.8	1.2	0.6	0.3	0.1	0.0	3.5	2.6	0.7
1998	10.28	0.08		218	4.0	1.0	0.6	0.3	0.1	0.0	3.7	2.2	0.7
1999	11.90	0.43	0.15	241	4.6	1.1	0.6	0.4	0.1	0.0	4.2	2.4	0.7
2000	11.90	0.43	0.15	241	3.9	0.9	0.6	0.4	0.1	0.0	3.5	1.9	0.7
2001	11.90	0.43	0.15	241	3.7	0.9	0.6	0.4	0.1	0.0	3.3	2.0	0.7
2002	11.90	0.43	0.15	241	3.4	1.0	0.6	0.4	0.1	0.0	3.0	2.0	0.7
2003	12.08	0.17	0.15	243	3.3	0.8	0.6	0.4	0.1	0.0	2.9	1.8	0.7
2004	12.10	0.16	0.16	227	3.2	0.9	0.6	0.3	0.1	0.0	2.8	1.9	0.7
2005	12.10	0.16	0.16	227	3.1	0.8	0.6	0.3	0.1	0.0	2.7	1.7	0.7
2006	12.10	0.16	0.16	227	3.0	0.7	0.6	0.3	0.1	0.0	2.6	1.5	0.7
2007	12.10	0.16	0.16	220	2.8	0.6	0.6	0.3	0.1	0.0	2.5	1.2	0.7
2008	12.10	0.16	0.16	220	2.8	0.6	0.6	0.3	0.1	0.0	2.4	1.2	0.7

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake –- K fixation) * 47/39.

1) Up to 1999 fixation due to replacement of breeding animals was included in supplied minks.

Table 5.15
Annual nutrient excretions per parent animal of foxes included in the agricultural census[1)]

	Finished foxes	Losses and replacements	Total feed use	Uptake			Fixation			Excretion		
				N	P	K	N	P	K	N	P_2O_5	K_2O
	kg			*kg/animal*								
1990	52.5	3.24	890	15.6	4.6	0.7	1.7	0.3	0.1	13.9	9.8	0.7
1991	52.5	3.24	890	15.6	4.6	0.7	1.7	0.3	0.1	13.9	9.8	0.7
1992	52.5	3.24	890	15.6	4.6	0.7	1.7	0.3	0.1	13.9	9.8	0.7
1993	52.5	3.24	890	15.6	4.6	0.7	1.7	0.3	0.1	13.9	9.8	0.7
1994	52.5	3.24	890	15.6	4.6	0.7	1.7	0.3	0.1	13.9	9.8	0.7
1995	52.5	3.24	890	15.6	4.6	0.7	1.7	0.3	0.1	13.9	9.8	0.7
1996	52.5	3.24	610	10.7	3.4	1.6	1.7	0.3	0.1	9.0	6.9	1.8
1997	52.5	3.24	610	10.7	3.4	1.6	1.7	0.3	0.1	9.0	6.9	1.8
1998	52.5	3.24	610	11.2	2.9	1.6	1.7	0.3	0.1	9.6	5.8	1.8
1999	52.5	3.24	610	11.6	2.8	1.6	1.7	0.3	0.1	9.9	5.7	1.8
2000	52.5	3.24	610	9.9	2.3	1.6	1.7	0.3	0.1	8.3	4.4	1.8
2001	52.5	3.24	610	9.4	2.4	1.6	1.7	0.3	0.1	7.7	4.7	1.8
2002	52.5	3.24	610	8.7	2.4	1.6	1.7	0.3	0.1	7.0	4.8	1.8
2003	52.5	3.24	610	8.2	2.1	1.6	1.7	0.3	0.1	6.6	4.1	1.8
2004	52.5	5.42	637	8.9	2.5	1.7	1.7	0.3	0.1	7.2	4.9	1.9
2005	52.5	5.42	637	8.7	2.2	1.7	1.7	0.3	0.1	6.9	4.3	1.9
2006	52.5	5.42	637	8.3	2.0	1.7	1.7	0.3	0.1	6.5	3.9	1.9
2007	52.5	5.42	637	8.2	1.8	1.7	1.7	0.3	0.1	6.4	3.3	1.9

Source: see text.

NB P_2O_5 excretion calculated according to: (P uptake – P fixation) * 2.29. K_2O excretion calculated according to: (K uptake – K fixation) * 47/39.

1) Since 2008, the keeping and/or breeding of foxes has been illegal in the Netherlands.

6. Manure volumes

6.1 Introduction

In this report, manure production per animal refers to the amount of manure in kilograms present in storage, including feed residue, cleaning water and spilled drinking water. For cattle, sheep, horses and ponies, the amounts of manure produced in pasture must be added.
The amount of manure per animal depends on the animal characteristics (age, health, rations and drinking water intake) and the type of farm management (length of housing period, litter use, housing temperature, drinking water supply system, and the use of flushing water to clean milking machines and housing). In addition, groundwater and rainwater seeping into storage may cause considerable increases in manure volumes (Aarnink and Huijben, 1988).
Information on produced manure per animal, usually, is not based on hard data.

6.2 Manure volumes grazing animals

Annual manure production by grazing animals is difficult to determine, as a large number of grazing animals spend the summer season in pasture. Manure production during grazing periods, therefore, is based entirely on estimations. For cattle it is assumed that manure production during grazing periods is 15 percent higher than during housing periods, as grazing rations contain more water (De Koning, 1994).
Furthermore, there are no actual measurement data available per animal during housing periods. Therefore, calculations of manure production per animal were based on dry weight and nutrient content of ruminant slurry. For calculations of cattle manure volumes (excluding suckler, feedlot and grazing cows), slurry was assumed, not taking solid manure production into account. During the late 1980s, the share of dairy cows in housing facilities with solid manure was estimated at 14 percent, and for young cattle this was 25 percent (Van Eerdt, 1987). Manure production by animals kept mostly in deep-litter systems, such as suckler, feedlot and grazing cows, sheep, goats, horses and ponies, was calculated as solid manure.

6.2.1 Dairy cows

Manure production by dairy cows was mainly determined by feed rations, drinking water intake and the amount of water used for flushing. At increases in milk production, the intake of feed and drinking water as well as manure production also increases – by 10 percent per 1,000 litres of milk (De Koning, 1994). Manure production was calculated according to the two methods below:

1. Assuming index numbers on manure production per day, per grazing system and feed rations;
2. Assuming digestibility coefficients of dry weights.

Results from the first method were taken, with those from the second method used for verification; both generally proved to be similar.

For 1990, a daily manure production of 52 kilograms per animal was assumed during housing periods under an annual milk production of 6,000 kilograms. Manure production during the grazing period was 15 percent higher. The amount of manure that would have ended up inside housing during the grazing period in 1990 was calculated from the share of manure that would end up inside housing facilities per grazing system and the distribution of the animals over the various grazing systems. Any differences in feed rations caused by differences in grazing systems were not taken into account. The amount of flushing water that would have ended up in manure storage was estimated from data from the Information and Knowledge Centre (IKC) on Livestock Farming (IKC, 1992b).

In 2000, the manure production factor for dairy cows for the first time was revised according to the increased milk production (7,500 kg/year) and higher feed uptake. In addition, the

amount of flushing water was increased to 10 litres per day, due to stipulations in the Dutch drainage decree (*Lozingenbesluit*), which caused an increase in the amount of waste water in the manure pit.
Manure production was revised again in 2004. Calculations using Method 1 showed an annual manure production of up to 26,000 kilograms. According to Method 2, the annual manure production would be 25,000 kilograms. We decided to set the annual manure production at 26,000 kilograms, according to the manure production factor in Tamminga et al. (2004).

The distribution of manure production over housing and grazing periods may vary from year to year, due to differences in the actual length of both periods. A certain share of the manure during the grazing period is produced inside housing. The size of this share depends on the grazing system applied; unlimited grazing, limited grazing or full-time housing. The share of manure that is produced indoors was assumed to be proportional to the number of hours the animals spent inside their housing facilities. For unlimited grazing, the number of hours inside housing was set at 4 per day, for limited grazing in 2005 the number of indoor hours was set at 14, and for later years at 16, and full-time housing was set at 24 hours per day. This means that the share of manure produced inside animal housing would equal 15 percent for unlimited grazing, a respective 60 percent and 67 percent for limited grazing in 2005 and the years thereafter, and 100 percent for full-time housing.
Up to 2001, the average amount of manure produced indoors in both regions during grazing periods was assumed to be 40 percent. Data from LEI (BIN) on 2002 showed that there had been a shift from unlimited grazing to limited grazing and full-time grazing for dairy cattle. Therefore, in 2002, new shares were determined per region for the manure produced indoors during grazing periods. For the north-western region, this was set at 50 percent and for the south-eastern region at 60 percent. From 2003 onwards, these data have been updated annually, on the basis of information on the grazing systems applied.

6.2.2 Other cattle

The amount of flushing water used for cleaning the housing facilities for other cattle is only small (around 5 percent), compared to the manure produced. Especially for young stock, very little data is available on manure production, as their manure often is stored together with that of dairy cows. Only the manure that is produced by suckler cows is calculated as solid manure. Similar to calculations of excretion factors, manure volumes from grazing and feedlot cows also are considered to be equal to those from suckler cows. The daily manure production during grazing periods would be higher than during housing periods. For suckler cows, also straw bedding of 7 kg/day has been taken into account (De Koning, 1994).

In order to check the plausibility of results, excretions of dry weights were calculated on the basis of digestibility coefficients of the feed. The calculated dry weight content varied from 10 percent to 12 percent. These values corresponded with the expected dry weight content of manure from young stock. Quantitative data, however, were lacking. The calculated dry weight content of solid manure from suckler cows was 21.5 percent.

In 2004, manure production by white-meat calves declined from 3,500 to 3,000 kg/year (ASG, 2003). The original manure production factor referred to rations that consisted only of artificial milk. Since then, amounts of artificial milk have declined and additional raw feed materials have been supplied. This is confirmed by data from MINAS reports and manure removal certificates over the 1998–2002 periods. Because of these revised manure volumes, the calculated phosphate content corresponded better with results from manure analyses.
In 2007, manure production by pink-meat calves was reduced from 5,000 to 4,300 kg/year (ASG, 2008).

The distribution of the manure production by female young stock of up to 12 months over housing and grazing periods was revised in 2008, according to the trend of increased housing time for young stock. This trend first became apparent from CBS research on grazing periods of dairy cows in 2008 (CBS, 2008).

6.2.3 Sheep and goats

Sheep and goats are usually kept in deep-litter systems. The LEI agricultural administration of sheep farming showed the daily amount of litter per sheep to be 0.5 kilograms. For goats the same amount was assumed. Flushing water used for cleaning housing of dairy goats was not accounted for, as this is not added to the compost barn manure but is stored separately. Urine production by sheep under housing rations and grazing rations was based on experiments (Van Eerdt, 1991). During these experiments, under housing rations a urine production of 1.5 litres per day was measured, and for grazing rations this was 4 to 5 litres per day. The dry weight content of faeces for both rations was around 40 percent. On this basis, faeces volumes were calculated. The urine production was calculated from the measured production volumes. For young lambs, 60 percent of the production by adult ewes was assumed. The dry weight content for compost barn manure that was calculated from these data showed a close correspondence with some measurements of this content. Because of a lack of data, manure production for goats was calculated on the basis of results from sheep experiments.

6.2.4 Horses and ponies

The Fertiliser Act (2006) provides manure production data for horses and ponies, expressed in cubic metres, for the period between 1 September and 1 March (6 months). A distinction is made in two weight classes, for both horses and ponies. For each of these weight classes, manure production in kg/day was calculated assuming a specific weight of 0.7 kg/m^3 of manure. Manure production by ponies up to 250 kilograms in body weight was set at 10.4 kg/day, and for ponies of 250 to 450 kilograms at 18.0 kg/day. For horses of between 250 to 450 kilograms, manure production was set at 22.2 kg/day and for those over 450 kilograms at 28.8 kg/day.
The Dutch Horse Council provided data on the distribution of animals over the weight classes (Van Toledo, 2007). This information was used to determine the average manure production during housing periods, including straw, per horse (27.1 kg/day) and per pony (14.2 kg/day). In addition, information was obtained about the distribution of the number of horses and ponies per weight class in the various farming systems. For both the summer half year period as the winter half year period, three farming systems can be distinguished: 24-hour housing, part housing (16 hours per day) and grazing (8 hours per day), and 24-hour grazing. During housing, 8.5 kilograms of straw is used per day. Manure production during grazing was corrected for straw use. Because of the lack of data, additional urine production during grazing was not taken into account.

Table 6.1
Manure production cattle

	Dairy cows				Female young stock (dairy and beef cattle)				Male young stock (housing)		Fattening calves, white meat (housing)	Fattening calves, pink meat (housing)	Beef bulls (housing)		Suckler, feedlot and grazing cows	
	housing period	grazing period	of which		up to 12 months		12 months and over		up to 12 months	12 months and over			up to 12 months	12 months and over	housing period	grazing period
			during housing	during grazing	housing period	grazing period	housing period	grazing period								
	kg/animal.year															
1990–1999	10,000	13,000	6,000	7,000	3,500	1,500	6,000	5,500	5,000	11,500	3,500	5,000	4,500	10,000	7,000	8,000
2000	13,000	12,000	5,000	7,000	3,500	1,500	6,000	5,500	5,000	11,500	3,500	5,000	4,500	10,000	7,000	8,000
2001	13,000	12,000	5,000	7,000	3,500	1,500	6,000	5,500	5,000	11,500	3,500	5,000	4,500	10,000	7,000	8,000
2002	13,000	12,000	6,500	5,500	3,500	1,500	6,000	5,500	5,000	11,500	3,500	5,000	4,500	10,000	7,000	8,000
2003	13,000	12,000	6,500	5,500	3,500	1,500	6,000	5,500	5,000	11,500	3,500	5,000	4,500	10,000	7,000	8,000
2004	13,000	13,000	7,500	5,500	3,500	1,500	6,000	5,500	5,000	11,500	3,000	5,000	4,500	10,000	7,000	8,000
2005	13,000	13,000	7,500	5,500	3,500	1,500	6,000	5,500	5,000	11,500	3,000	5,000	4,500	10,000	7,000	8,000
2006	14,000	12,000	7,000	5,000	3,500	1,500	6,000	5,500	5,000	11,500	3,000	5,000	4,500	10,000	7,000	8,000
2007	14,000	12,000	7,500	4,500	3,500	1,500	6,000	5,500	5,000	11,500	3,000	4,300	4,500	10,000	7,000	8,000
2008	14,000	12,000	6,500	5,500	4,000	1,000	6,500	5,000	5,000	11,500	3,000	4,300	4,500	10,000	7,000	8,000

Source: see text.

NB Volumes apply per animal present according to the agricultural census.

Table 6.2
Manure production sheep, goats, horses and ponies

	Sheep (per ewe)		Goats (per dairy goat)	Horses		Ponies	
	housing period	grazing period	housing period	housing period	grazing period	housing period	grazing period
	kg/animal.year						
1990–2008	325	2,000	1,300	5,200	3,300	2,100	2,100

Source: see text.

NB Volumes apply per animal present according to the agricultural census.

To avoid a trend breach, the horse and pony manure production in previous years was also calculated. This was done by multiplying the factors determined for 2006 by the number of animals in the agricultural census of the years involved.

6.3 Manure volumes pigs

Over 90 percent of pigs are housed in liquid manure housing systems. Therefore, manure production in the form of solid manure was not accounted for. For determining the manure volumes per animal in 1990, we used measurement carried out for farms supplemented by model calculations. Since measurements mostly were conducted on research farms or farms that would specifically monitor water use, it is questionable if the results are representative of the average situation in actual practice.

The use of drinking water determines the manure production levels of fattening pigs (Tables 6.3 and 6.4). Practical research has shown that water use is mainly determined by farm management and drinking water systems. To determine the manure production of fattening pigs for 1990, farms were classified according to their drinking water systems (IKC/LEI, 1991), combined with data on manure production per drinking water systems of research farms (Peerlings, 1985; Plagge, 1989; CVP, 1987) and model calculations. Based on these data, the manure production for 1990 and 1991 was determined at 1,300 kilograms per year and for 1992 at 1,250 kilograms (Table 6.3).
The manure production by breeding sows, including piglets up to 25 kilograms, varies per phase of production cycle and associated systems of drinking water and housing (Tables 6.3 and 6.4). Here, a distinction was made between farrowing and nursing sows (including piglets), barren and pregnant sows, and weaned piglets. For these categories, the average manure production was based on standard data on water use and an excretion coefficient that was derived from research on manure production as a function of water use (CVP, 1987).
For gilts, young boars and stud boars, the calculation method was similar to that used for breeding sows. Results from two research reports by the manure bank of 1995 (LAMI, 1994; Aalbers, 1995) containing data on manure production by pigs, provided no reasons for adjustment of the data used in this report.

In 1997, in consultation with the practical research on pig farming (*Praktijkonderzoek Varkenshouderij*), the manure production per animal was updated for fattening pigs and sows. Starting point for the update was that the average results from the LAMI research had been realised in actual practice (LAMI, 1994). Not counting the influence from the swine fever outbreaks, annual manure production declined per average animal present, for fattening pigs from 1,250 to 1,200 kilograms, and for breeding sows, including piglets, from 5,200 to 5,100 kilograms (Table 6.3).

The numbers of animals counted in the agricultural census, usually, match the average numbers of animals present. In 1997, because of the swine fever, this was not the case for pigs. Manure production factors for 1997 of fattening pigs and sows were calculated on the basis of animals present. Table 6.4 presents the result of a conversion, using correction factors, of these factors into manure production data per animal counted in the agricultural

census. The manure production in the swine fever area was determined with the help of IKC agriculture (Vermeer, 1998) (Section 4.5).
For young pigs and stud boars, animal numbers were not corrected, due to their only small contribution (< 10 percent) to the total manure production.

In 2003, the WUM carried out research into manure production per animal for animals kept in indoor housing systems, using data from the nutrient accounting system MINAS and from manure removal certificates. In order to determine the average manure production per animal, data were selected from farms with only one animal category and which would remove all of the manure produced. This meant that the amounts of manure according to the manure removal certificates equalled the total amount of actually produced manure. In addition, there had to be only one category of manure per farm. From the nutrient accounting system, animal numbers per animal category as well as the related surface

Table 6.3.
Calculation of manure production per fattening pig and breeding sow

	1990		1992		1997		
	share pigs	manure production	share pigs	manure production	share pigs	share pigs	manure production
Fattening pigs		*kg/animal.year*		*kg/animal.year*			*kg/animal.year*
Meal trough	0.36	1,150	0.55	1,150	0.49		1,100
Bite nipple	0.22	1,500	0.10	1,500	0.06		1,500
Small water trough	0.06	1,500	0.05	1,500	0.15		1,300
In the feeding trough	0.36		0.30		0.30		
of which							
meal feed	0.13	1,250	0.15	1,250	0.12		1,100
meal feed machine	0.09	1,500	0.10	1,500	0.12		1,200
trough nipple	0.14	1,250	0.05	1,250	0.06		1,250
Average	1.00	1,300	1.00	1,250	1.00		1,200
Breeding sows							
Farrowing and nursing sows, incl. piglets up to 25 kg	0.22	5,800			0.22		5,800
Weaned piglets[1)]	2.63	600			2.63		600
Barren and pregnant sows	0.78	3,000					
limited drinking water supply					0.78	0.82	3,000
unlimited drinking water supply					0.78	0.18	2,900
Average per breeding sow, incl. piglets up to 25 kg	1.00	5,200			1.00		5,100

Source: see tekst.

[1)] Number of weaned piglets per breeding sow present.

Table 6.4
Manure production pigs

	Fattening pigs	Gilts and young boars	Sows	Young boars, 50 kg and over	Stud boars
	kg/animal.year				
1990–1991	1,300	1,300	5,200	1,300	3,200
1992–1996	1,250	1,300	5,200	1,300	3,200
1997 (average)	1,100	1,300	4,700	1,300	3,200
in swine fever areas with breeding bans	750	1,300	3,800	1,300	3,200
in other swine fever areas	750	1,300	4,400	1,300	3,200
outside swine fever areas	1,320	1,300	5,100	1,300	3,200
1998–2008	1,200	1,300	5,100	1,300	3,200

Source: see text.

NB Volumes apply per animal present according to the agricultural census.

area could be obtained. It was assumed that farms with 15 or more large cattle units per hectare would remove all of the manure. To limit the effect of annual fluctuations in manure removal, data were selected from a period of five consecutive years (1998–2002).
The average manure production per gilt and per fattening pig was found to be 5 percent to 10 percent below the amounts assumed until then. However, since the spread of the results was very great and there were no possibilities for verification, it was decided not to revise the data on manure production from gilts and fattening pigs. For the other categories of pigs, such as sows and boars, this type of calculation method was not possible, as hardly any farms met the selection criteria (e.g. having just one animal category per farm).

6.4 Manure volumes poultry, rabbits and fur-bearing animals

In 1990, as a starting point, a manure accounting system was chosen which contained data on the annual manure production per animal for various housing systems. Values from 1986 were partly derived from calculations and partly from practical data. Although the degree to which the data from the manure accounting system was representative of the actual practice was uncertain, the lack of sufficient practical data meant that it was decided to use the manure accounting system data. Only for parent animals of broilers there was sufficient practical data available (IKC/NOP, 1994).

The annual manure production per animal in poultry farming varied substantially, from year to year. Apart from animal characteristics and management types, a large part of the variation was caused by the data on housing systems (Table 6.4). In order to calculate average manure production per animal category, data on manure production per housing system would be required, as well as on the distribution of the animals over the various systems. Data, some of them estimates, were available on laying hens and parent animals of broilers; however, for small animal categories the distribution was based only on assumptions.

6.4.1 Laying hens and young hens

A production level was determined for housing systems with liquid manure as well as for those with solid manure. In 1990, the average manure production for systems with solid manure was calculated on the basis of manure production per system according to the manure accounting system and the distribution of hens over the various housing systems (Table 6.5). For calculations in 1990 of manure production in deep-litter systems, these were based on the most commonly occurring systems. For laying hens, a system with partly slatted flooring was assumed, and for young hens only systems with full litter flooring (CBS, 1989; Heidemij, 1993). Manure volumes for systems with liquid manure were directly taken from the manure accounting system.

In 1994, for laying hens, the average manure production in systems with solid manure was revised. The share of laying hens in housing with manure belts with forced manure drying and direct drainage into containers has increased. The increased share in housing with manure belts and forced drying has altered the average annual manure production in systems with solid manure. The number of young hens in solid manure housing systems also increased, but the average amount of liquid and solid manure per animal remained the same (CBS, 1995).

In 1995, the manure production factor for solid manure from laying hens was slightly reduced (Working group for practical data on poultry manure and nutrients, (Werkgroep praktijkcijfers), 1996a and 1996b). However, there was a substantial increase in the actual amount of solid manure produced by laying hens due to the implementation of the measures to increase animal well-being (Decree on battery cages). The decree caused more improvements in housing design and layout than occurred in the preceding years, which resulted in more animals being kept in systems with solid manure (IKC, 1996). The number of young hens in housing systems with solid manure also increased.

In 1998, the share of laying hens in systems with liquid or solid manure was revised according to housing research that used data on housing from the agricultural census of 1998 (CBS, 1999). Animal numbers in housing with solid manure were considerably higher

than in the preceding years, especially due to large adjustments to housing designs. Details of the increase between 1995 and 1998 are unknown, and the distribution of animals over the housing systems with liquid and solid manure, therefore, was set to that of 1995. The share of young hens in housing with solid manure in 1998 was estimated on the basis of information from chick farms. Data on implementation of housing systems with solid manure have led to a revision of the average manure production factors for solid manure, for both young hens and laying hens.

Results from housing research in the agricultural census of 2002 have shown that, between 1998 and 2002, the share of systems with solid manure increased further. These results could not be used for determining the manure production per animal in 1999 and 2000. Manure production factors and the distribution of animals over housing systems with liquid and solid manure, therefore, were set to those for 1998. In 2001 and 2002, the manure production factors for laying hens were revised according to the results from the research of 2002. The factors for 2001 were determined based on the assumption that the increase between 1998 and 2002 had been gradual.
In 2003, for animals kept in indoor housing systems, research was conducted into manure production per animal (see Section 6.3). Results showed that the average manure production per animal, corrected for outliers, was lower than the data used to date – in part originating from the 1980s. One of the reasons for the lower production factors for housing systems with solid manure could be the increase in dry weight content due to new drying systems (Groot Koerkamp, 2002; Ellen, 2002). Table 6.6 presents data on manure production per hen from 2003 onwards.
The agricultural censuses of 2004 and 2008 again inquired about the housing systems of laying hens. The data on the distribution of animals over housing with solid and liquid manure in 2004 was also applied in the period from 2004 to 2006. The results for 2008 were applied from 2007 onwards (van Bruggen, 2009). Since 2003, no new information has become available on the development of manure volumes per housing system.

6.4.2 Parent animals of broilers and young parent animals

In the 1990–1994 period, the agricultural census inquired about the number of *female* parent animals, instead of parent animals in general. The share of cocks in this period was not included in the census. In order to account for the manure production by these cocks, their manure volumes were included in those of the female parents. The share of cocks in parent animals was 10 percent and in young parent animals 15 percent. From 1995, manure production was expressed per parent animal counted in the agricultural census.
Parent animals of broilers had been kept in two types of housing systems: deep-litter systems and systems with part slatted floors. Parent animals of 18 weeks and over were more or less equally distributed over both these systems (van Kerkhof, 1994). The manure volume was calculated by averaging the manure volumes of both systems. The distribution of young parent animals over both systems was unknown, and their manure volume was also calculated as an average of the manure volumes per system. The manure production for both categories was reduced, based on the research on manure production per animal in 2003 (see above).

6.4.3 Broilers and meat turkeys

Broilers and meat turkeys were kept exclusively in deep-litter systems. The figure on manure volumes in 1990 was obtained directly from the nutrient accounting system.

In 1995, the data on manure production by broilers was revised, as it appeared 10 percent higher than was previously assumed. The increase was caused by an increase in feed uptake due to a higher growth speed. The manure production by meat turkeys was also revised upwards. The possible reason for this increase could be the fact that the finishing weight of turkeys was higher than at the time when these standards had first been set (Working group for practical data on poultry manure and nutrients (*Werkgroep praktijkcijfers*), 1996b).
The manure production per broiler in 2003 was revised downwards, based on the results from the research on manure production of animals kept in indoor housing systems in 2003 (see above).

6.4.4 Turkeys in hatching egg production

Manure volumes were calculated for turkeys of 7 months and under, using phosphate excretions and the conversion standard (kg phosphate/tonne manure) from the manure accounting system. In fertiliser legislation this category is subdivided into animals younger than 6 weeks and those between 6 and 30 weeks old. Phosphate excretions were calculated based on the category of 6 to 30 weeks, as the manure produced in the category of animals up to 6 weeks old is negligible.
The category of turkeys of 7 months and over that are kept for the production of hatching eggs only involved deep-litter systems. Manure volumes were calculated from the phosphate excretion per hen (including 1 cock per 11 hens) and the conversion standard (kg phosphate/tonne manure).

6.4.5 Meat ducks

For the calculations of manure volumes for meat ducks, it was assumed that they were all housed in deep-litter systems. In the early 1990s, a small share of ducks were still being kept in housing with slatted flooring, but this was not taken into account in the calculations of manure volumes for 1990. Manure volumes were calculated from the phosphate excretion per duck and the conversion standard (kg phosphate/tonne manure) from the manure accounting system.

In 1995, data on manure production by meat ducks was revised according to the results from practical research (Working group for practical data on poultry manure and nutrient (*Werkgroep praktijkcijfers*), 1996a). These results showed the manure production to be lower than had been calculated on the basis of the manure accounting system.
In 2003, research was conducted on the manure production per animal, for animals kept in indoor housing systems (Section 6.3). This research provided no reason for revising the manure production for meat ducks.
Recent research into the housing balance of meat ducks, including their manure production, at four different farms (De Buisonjé et al., 2009). The outcome of this research (68.5 kg/animal.year) was similar to the manure volumes used previously (70 kg/animal.year). Therefore, manure volumes were not revised.

6.4.6 Rabbits

No research data are available to determine manure volumes. Manure volumes were calculated in 1990 on the basis of phosphate excretions per animal and the conversion standard of phosphate content per tonne of manure. In the calculation of the conversion standard, manure production divided over the various different systems was taken into account (dry manure, deep pit). The dry weight content according to the Fertiliser Act was shown to largely match the content that was determined in actual practice (Steverink, 1990).

6.4.7 Minks and foxes

For these categories no research data were available to determine manure volumes. Manure volumes were calculated for 1990 on the basis of phosphate excretions per animal and the conversion standard of phosphate content per tonne of manure.

Table 6.5
Calculation of manure production per young hen and laying hen, based on applied housing systems

	1990		1994		1995		1998		2002	
	share animal places	manure volume	share animal places	manure volume	share animal places	manure volume	share animal places	manure volume	share animal places	manure volume
	%	*kg/animal. year*	*%*	*kg/animal. year*	*%*	*kg/animal. year*	*%*	*kg/animal. year*	*%*	*kg/animal. year*
Young hens										
Wet manure	66	25.4	60	25.4	55	25.4	25	25.4	15	25.4
of which										
in open storage	32		25		23		.		.	
manure belt and transport to closed storage	34		25		23		.		.	
other systems	–		10		9		.		.	
Dry manure	34	10.0	40	10.0	45	10.0	75	9.0	85	9.1
of which										
manure belt with ventilation, without additional drying	6	11.8	21	11.8	25	9.5	27	9.5	24	9.5
manure belt with ventilation and additional drying	0	7.4	2	7.4	2	7.4	21	7.4	20	7.4
deep litter system	28	9.6	13	9.6	14	9.6	24	9.6	37	9.6
other systems	–	11.8	4	11.8	4	11.8	2	11.8	4	11.8
Laying hens										
Wet manure	60	63.5	50	63.5	42	63.5	22	63.5	13	63.5
of which										
in open storage			15		8		9		3	
manure belt and transport to closed storage			25		24		10		9	
other systems			10		10		3		1	
Dry manure	40	22.5	50	24.5	58	23.5	78	24.0	87	25.4
of which										
channel/deep-pit housing	7	13.0	8	13.0	8	13.0	7	13.0	1	13.0
manure belt with ventilation, without additional drying	10	29.5	18	29.5	26	26.0	26	26.0	26	26.0
manure belt with ventilation and additional drying	15	18.5	11	18.5	11	18.5	20	18.5	22	18.5
deep litter system	8	29.5	11	29.5	11	29.5	23	29.5	33	29.5
other systems	–	29.5	2	29.5	2	29.5	2	29.5	4	29.5

Source: see text.

Table 6.6
Manure production laying hens

	Laying hens, 18 weeks and under				Laying hens, 18 weeks and over			
	liquid manure		solid manure		liquid manure		solid manure	
	manure volume	number of animals	manure volume	number of animals	manure volume	number of animals	manure volume	number of animals
	kg/animal.year	*%*	*kg/animal.year*	*%*	*kg/animal.year*	*%*	*kg/animal.year*	*%*
1990	25.4	66.0	10.0	34.0	63.5	60.0	22.5	40.0
1991	25.4	66.0	10.0	34.0	63.5	60.0	22.5	40.0
1992	25.4	66.0	10.0	34.0	63.5	60.0	22.5	40.0
1993	25.4	66.0	10.0	34.0	63.5	60.0	22.5	40.0
1994	25.4	60.0	10.0	40.0	63.5	50.0	24.5	50.0
1995	25.4	55.0	10.0	45.0	63.5	42.0	23.5	58.0
1996	25.4	55.0	10.0	45.0	63.5	42.0	23.5	58.0
1997	25.4	55.0	10.0	45.0	63.5	42.0	23.5	58.0
1998	25.4	25.0	9.0	75.0	63.5	22.0	24.0	78.0
1999	25.4	25.0	9.0	75.0	63.5	22.0	24.0	78.0
2000	25.4	25.0	9.0	75.0	63.5	22.0	24.0	78.0
2001	25.4	17.0	9.1	83.0	63.5	15.0	25.4	85.0
2002	25.4	15.0	9.1	85.0	63.5	13.0	25.4	87.0
2003	22.5	15.0	7.6	85.0	53.4	13.0	18.9	87.0
2004	22.5	9.6	7.6	90.4	53.4	7.2	18.9	92.8
2005	22.5	9.6	7.6	90.4	53.4	7.2	18.9	92.8
2006	22.5	9.6	7.6	90.4	53.4	7.2	18.9	92.8
2007	22.5	5.1	7.6	94.9	53.4	2.4	18.9	97.6
2008	22.5	5.1	7.6	94.9	53.4	2.4	18.9	97.6

Source: see text.

NB Volumes apply per animal present according to the agricultural census.

Table 6.7
Manure production meat poultry, rabbits and fur-bearing animals

	Broilers	Parent animals of broilers[1]		Meat turkeys	Turkeys in hatching egg production		Meat ducks	Rabbits[2]	Minks[2]	Foxes[2]
		18 weeks and under	18 weeks and over		7 months and under[3]	7 months and over[3]				
	kg/animal.year									
1990	10.0	15.4	25.3	37.9	49.4	78.6	86.3	377	104	272
1991	10.0	15.4	25.3	37.9	49.4	78.6	86.3	377	104	272
1992	10.0	15.4	25.3	37.9	49.4	78.6	86.3	377	104	272
1993	10.0	15.4	25.3	37.9	49.4	78.6	86.3	377	104	272
1994	10.0	15.4	25.3	37.9	49.4	78.6	86.3	377	104	272
1995	11.0	13.4	23.0	45.0	49.4	78.6	70.0	377	104	272
1996	11.0	13.4	23.0	45.0	49.4	78.6	70.0	377	104	272
1997	11.0	13.4	23.0	45.0	49.4	78.6	70.0	377	104	272
1998	11.0	13.4	23.0	45.0	49.4	78.6	70.0	377	104	272
1999	11.0	13.4	23.0	45.0			70.0	377	104	272
2000	11.0	13.4	23.0	45.0			70.0	377	104	272
2001	11.0	13.4	23.0	45.0			70.0	377	104	272
2002	11.0	13.4	23.0	45.0			70.0	377	104	272
2003	10.9	8.2	20.6	45.0			70.0	377	104	272
2004	10.9	8.2	20.6	45.0			70.0	377	104	272
2005	10.9	8.2	20.6	45.0			70.0	377	104	272
2006	10.9	8.2	20.6	45.0			70.0	377	104	272
2007	10.9	8.2	20.6	45.0			70.0	377	104	272
2008	10.9	8.2	20.6	45.0			70.0	377	104	272

Source: see text.

NB Volumes apply per animal present according to the agricultural census.

[1] For the years up to and including 1994, manure production is expressed per female parent, which includes the share of males.
[2] Manure production is expressed per counted female parent.
[3] For the years from 1999 onwards, these categories are included into that of meat turkeys.

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