

THE EFFECT OF REGULATIONS ON THE CONTACT STRUCTURE OF THE DUTCH CATTLE SECTOR

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SUMMARY

After the FMD outbreak in the Netherlands in 2001, the Dutch government implemented some regulations with the goal of reducing the number of animal contacts between farms and consequently the risk of introduction and the spread of highly contagious animal diseases in the future. In this study, the effectiveness of these regulations was investigated. Identification and Registration data of the Dutch cattle sector were used to compare 1) the number of animal and transport movements before and after the FMD outbreak, and 2) the contact structure between different farms and holdings of the Dutch cattle sector before and after the FMD outbreak. It could be concluded that the number of animal movements decreased, the number of transport movements increased and that the contact structure changed after the FMD outbreak. A lot of these changes are due to the new regulations but they are also due to the decrease in the number of active farms after the FMD outbreak. Whether the spread of FMD or other infectious diseases will be reduced with this new contact structure could not be concluded by this study.

INTRODUCTION

On 21st March 2001, foot and mouth disease (FMD) was diagnosed in four cows on a farm in Olst, the Netherlands. This highly contagious disease occurred in the Netherlands, despite all precautions, after the United Kingdom. In total, 26 farms were infected and 2763 farms were culled preventively during the outbreak (Bouma et al., 2003). The Department of Agriculture, Nature Management and Food Quality set the FMD crisis plan in motion immediately after the first farm was diagnosed positive. A temporary movement ban was laid down for the whole of the Netherlands which applied to: all livestock and poultry, vehicles for the transport of livestock and poultry, semen, ova and embryos from biungulates, milk and feed materials. Farm premises were off-limits to visitors except in prescribed emergency situations. The plan also prescribed that all biungulates (most commonly sheep, goats, pigs and cattle) had to be killed and destroyed as soon as possible after FMD has been confirmed on a farm. Susceptible animals on farms situated within one kilometre of an infected farm were pre-emptive culled and a three kilometre protection and ten kilometre surveillance zone were implemented. The FMD crisis plan laid down other temporary regulations, such as import and export restrictions.

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All regulations were aimed at reducing the spread of the FMD virus. Most of them were withdrawn at the end of the outbreak but some became retained albeit slightly reformulated. The aim of some of the irreversible regulations was to change the contact structure of the Dutch cattle sector in such a way that the number of animal contacts between the different farms and holdings in the cattle sector was minimised. This was in order to reduce the spread of highly contagious animal diseases in future outbreaks.

The first regulation, the so-called 'live gathering' regulation, prohibits the gathering of biungulates for a period shorter than 30 days. Exceptions are gathering at certified collecting centres and slaughterhouses or gathering on one truck, if all animals are transported to one farm, livestock collecting centre or slaughterhouse. The second regulation the so-called 'thirty days' regulation prohibits the movement of biungulates off a farm within 30 days after a biungulate has been moved on to that farm. Exceptions are the sale of pigs, sheep that graze temporarily on other farms, and biungulates that are transported to a slaughterhouse via a collection centre. These two regulations caused many problems for the livestock sector and there was a lot of protest. Therefore, the government and the livestock sector agreed that the regulations would be evaluated one year after implementation.

This study was based on the evaluation (Greutink et al., 2002). Three questions were formulated for this evaluation. First, is it possible to fulfil these regulations and are they fulfilled properly in practice? Second, have these regulations changed the contact structure of the livestock sector? Third, will these regulations reduce the spread of highly contagious animal diseases in future outbreaks? The second question has been addressed in this study. For this, only the cattle sector has been under investigation, because good data of individual cattle movements were available. The research question was therefore: did the regulations result in less animal contacts between the different farms and other holdings in the Dutch cattle sector? With the help of Identification and Registration (I&R) data of the Dutch cattle sector we compared 1) the number of animal movements, 2) the number of transport movements and 3) the contact structure between different farms and other parties of the Dutch cattle sector before and after the FMD outbreak.

MATERIALS AND METHODS

Description of I&R data

Data from the National Identification and Registration system were used. In table 1 an overview of the notifications used is given. Each notification consists of the notification code, the ID number of the animal, the date, and the unique farm identity number (UBN) of the farm or holding to which the notification applies. All notifications dealing with animal movements (all except the birth notifications with code 10) were used for the analysis.

Definition of periods

To compare the effect of the applied regulations, data from before and after the FMD outbreak were analysed and compared. The pre-outbreak period, which is called '2000' in this paper, was a period of 9 months and ran from the first of May 2000 until the first of February 2001. The post-outbreak period, which is called '2002' in this paper, was a period of 12 months and ran from the first of September 2001 until the first of September 2002. The pre-outbreak period did not comprise a whole year because data before the first of April 2000

were partly deleted from the system. For the comparison of the total number of movements between the two periods, the number of movements in period 2000 was scaled to 12 months by multiplying all numbers with 12/9.

Table 1. Codes and descriptions of the notifications used in the Dutch I&R system for cattle and the number of notifications¹ used and the percentage of the total in the defined pre- and post- FMD periods.

CODE	DESCRIPTION	TYPE ²	2000 ³		2002 ⁴	
			NUMBER	%	NUMBER	%
10	Birth		749,386	8.7	772,644	7.4
18	Re-import	→●	350	0.0	285	0.0
19	Birth and send off	●→	494,205	5.7	967,184	9.2
20	Send off	●→	2,342,490	27.2	3,079,601	29.4
21	Export	●→	74,335	0.9	173,396	1.7
29	Send off of IKB ⁵ -certified animal	●→	161,741	1.9	326,217	3.1
30	Arrival	→●	1,587,535	18.4	1,607,342	15.3
31	Import	→●	508,225	5.9	468,528	4.5
32	Transit / trade	●→&→●	846,609	9.8	701,576	6.7
40	Death	●→	106,992	1.2	249,931	2.4
41	Slaughter	→●	1,540,872	17.9	1,951,471	18.6
	Total		8,607,484	100.0	10,480,944	100.0

Including double notifications

For one movement a 'sending off (dot then arrow)' and a 'receiving (arrow then dot)' notification is needed.

Covers a period of more than 9 months from 1st April 2000 until 1st February 2001.

Covers a period of more than 12 months from 1st August 2001 until 1st September 2002.

IKB (Integrale Kwaliteits Bewaking) is a certification scheme for quality meat products.

From notification to animal movement

Each notification dealt with one event: sending off or receiving the animal. Thus, for an animal movement – within the Netherlands – two notifications of two different farms were needed. To complete an animal movement the two successive notifications were found and coupled. This coupling was done in different steps. First, all successive notifications that consisted of the same animal ID and date were examined closely. Second, when available, the transit notifications (code 32) were coupled to each other. This meant that an animal had been on two cattle-collection centres or trade farms in a row. Third, the transit notifications were coupled to other sending-off or receiving notifications. Fourth, all other notifications were coupled. Used notifications were blocked directly after the coupling, except for the transit notifications, which were blocked after the second time they are used in a movement. These steps were repeated for each difference in arrival and departure date up to a 14 day difference. Coupling of the import and export notifications was not necessary, because foreign farms were not included in the Dutch I&R system. These notifications were directly transformed into movements to and from abroad.

Five movement types can be differentiated: for live gathering, for slaughter, for destruction, import or export. Movements in which code 41 is used are 'for slaughter', in which code 40 is used are 'for destruction', in which codes 18 and 31 are used are import movements and in which code 21 is used are export movements. All other movements are 'for live gathering'.

From animal movement to transport movement

A transport movement included all animal movements that were registered at the same departure and arrival dates from and to farms or holdings with the same UBN. More transport movements were assumed if more than 40 adult cattle, 100 veal calves ready for slaughter or 300 very young veal calves were transported on the same date from and to the same holdings.

Calculation of the distance

For all movements within the Netherlands the direct distance between the two farms or holdings was estimated. For each UBN the x and y co-ordinates were identified. If (x1,y1) are the co-ordinates of the 'sending off' farm and (x2,y2) the co-ordinates of the 'receiving' farm, then the direct distance between the two was calculated as follows:

$$\text{distance} = \sqrt{(x2 - x1)^2 + (y2 - y1)^2}.$$

This calculated distance represented the length of a straight line between the two farms and was therefore the minimum movement distance. Thus, the actual distance of the route via the road was bigger than the calculated.

Farm types

Each farm or holding that trades, keeps or processes cattle in the Netherlands should have a unique farm identity number (UBN). In the two periods, 67305 different UBNs or farms have notified the Dutch I&R-system. Although it is possible that more than one UBN is located at one address (12.3%) it is assumed that each UBN represents one single farm or holding.

Registration of the type of farm or holding for each UBN in the Dutch I&R-system was available but the data were not up-to-date and were incomplete. Therefore, the farm type had to be identified. This was done with help of another database of the Dutch I&R-system. This database contained the number of animals in three different age classes on four predefined dates from the period of May 1st 2000 until February 1st 2000, for each UBN. Based on these numbers and on the number and type of notifications made in the 2000 database, a farm type was defined for each UBN. In Table 2 the different farm types and the descriptive statistics based on the period 2000 are given.

Table 2. The farm types with description, the number of farms per type for both periods, the average number of animals present in three age classes and the average number of animals that were sent off from that farm or have arrived on that farm type, based on the period 2000. 1002

TYPE	DESCRIPTION	# UBNS		# ANIMALS PRESENT ON FARM				AVERAGE # ANIMALS MOVED					
		2000	2002	<1 Y	1-2 Y	>2 Y	FROM	STD.	TO	STD.			
Da	Dairy	27661	27370	20.6	13.4	20.0	12.6	60.7	33.1	32.6	18.3	2.5	6.6
Da/Be	Dairy and beef ¹	327	319	29.0	22.0	30.2	21.0	29.9	36.0	26.8	22.9	12.3	17.9
Da/Tr	Dairy and trade	171	166	6.4	9.1	9.7	12.0	58.3	49.5	60.2	40.1	20.9	20.0
Yo	Young stock raising ²	579	524	13.9	23.0	23.1	29.4	8.1	13.3	10.7	10.3	7.7	11.1
Be	Beef ¹	3768	3380	191.4	243.2	10.4	24.1	4.7	12.1	17.8	20.2	58.6	104.9
Tr	Trade ³	3087	2642	9.2	40.9	10.1	21.5	13.3	21.1	24.4	48.8	29.3	402.9
Be/Tr	Beef and trade	128	119	309.7	326.7	7.7	39.3	11.2	37.0	31.2	37.3	87.0	101.0
Su	Suckling cows ⁴	2361	2316	8.1	7.3	8.0	7.4	20.1	16.8	12.5	16.1	5.3	13.6
Cc	Cattle collection centre	20	6	0.0	0.0	0.1	0.5	0.1	0.5	1839	3448	2709	5398
C-Cc	Certified cattle collection centre ⁵	77	61	23.4	89.6	7.6	20.4	10.7	21.1	370.4	1160	2127	5473
Others	Not ⁶	20828	16089	1.8	2.4	2.1	3.0	3.5	4.4	2.9	3.5	1.3	2.4
Sl	Slaughterhouse ⁷	412	296	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	586.3	2792
New	Farms that did not own or trade animals in period 2000	0	1808	7.3	67.0	1.0	0.0	1.4	8.1	5.1	12.9	11.7	68.4

1) veal calves or bulls

2) sometimes combined with beef

3) import en export included

4) sometimes combined with beef and trade

5) certification was obliged from 1 January 2002

6) E.g. small farms that own <10 cows, cattle markets and cattle shows

7) including 'at home' slaughters

It was assumed that the farm type did not change between the two periods. Only if a farm stopped its activities was it excluded from the calculations. If a non-active farm of 2000 became active again in 2002, it was classified as a 'New' farm in 2002 (see Table 1).

RESULTS

From notification to animal movement

A total of 5.8% of the pre-outbreak notifications (2000) and 12.7% of the post-outbreak notifications (2002) could not be coupled to an animal movement. One reason that the percentage in the post-outbreak period was higher than the post-outbreak period was that it was no longer possible to use the combined 'birth and send off' notification (code 19) as a 'send off' notification as from 2001. The affected animals were therefore also treated as a separate 'send off' notifications.

Animal movements per month

The start and the end date of a movement could differ and fall in two different months. Therefore, the allocation of movements to different months was based on the start date of the movement, which was the date of the 'send off' notification. The import movements were based on the end date, because the start date was unknown. The number of animal movements per month and the average difference between the two periods are given in figure 1 and table 3, respectively.

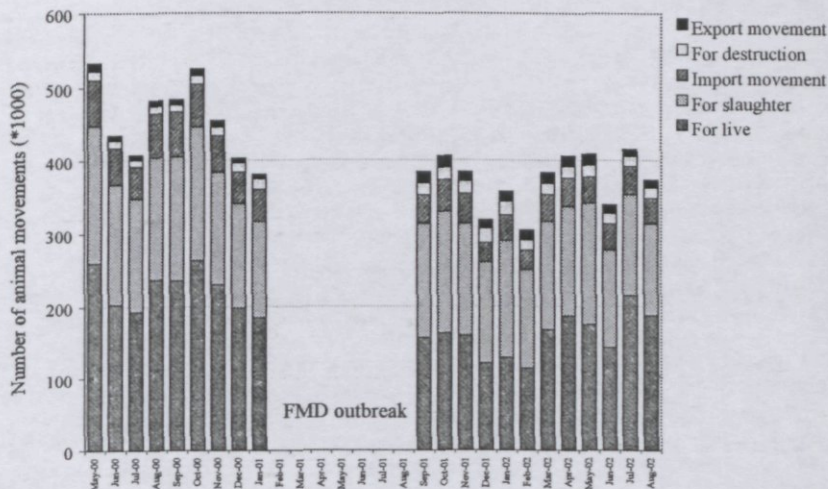


Fig. 1 Number of animal movements per months from May 2000 to August 2002.

The number of animal movements decreased significantly after the FMD outbreak with 82852 movements per month. This difference was for the greater part attributed to movements

of live animals for collection (62879 movements). This decrease might have been caused by the new regulations in combination with the decrease in the number of farms (see table 2).

The number of animals moved for this purpose and the number of imported animals per month decreased significantly after the FMD outbreak, with 62879 and 16441 movements per month, respectively. The number of exported animals per month and the number of animals going for destruction each month increased significantly with 5480 and 4833, respectively. The latter was probably due to an administrative "catch-up" with notification of animals that had been culled during the FMD outbreak. Also slaughterhouses started to notify that cows which were not suitable for human consumption were sent from the slaughterhouse to the destruction plant in 2002.

Table 3. The average number of animal movements per month, the standard deviation and the difference in number of movements between the pre-outbreak period (2000) and the post-outbreak period (2002).

MOVEMENT TYPE	2000		2002		DIFFERENCE
	# / MONTH	STD.	# / MONTH	STD.	# / MONTH
For live	222591	27008	159712	29587	62879*
For slaughter	162015	15205	148169	13171	13846.
Import	52642	8009	36201	5063	16441*
For destruction	11440	1314	16273	1838	-4833*
Export	7773	1471	13253	2124	-5480*
Total	456460	49334	373608	36509	82852*

* Significant with $\alpha=0,05$ based on a student t-test.

Contact structure based on animal movements

The contact structure based on animal movements between the different holdings in the Dutch cattle sector is summarised in the contact matrix of appendix A1. The difference in the number of movements is calculated by scaling the number of movements in 2000 to one whole year ($\times 12/9$) and distract it from the number of movements in the period of 2002. In appendix A2 the difference between the two periods is given. In the following paragraph only big differences are discussed.

The total number of animals moved decreased after the FMD outbreak with 1,246,302. Dairy farms (Da) sending off more and receiving fewer animals in 2002. Many more animals were moved from dairy farms directly to beef farms, traders and slaughterhouses and far less from dairy farms to the collection centres. The number of dairy farms decreased after the FMD outbreak with 291 farms.

The total number of animals transported to beef farms (Be) and sent off from beef farms decreased a lot after the FMD outbreak. A lot of animals transported to a beef farm come directly from dairy farms or foreign countries, whereas in 2000 most animals are coming from collection centres. The number of beef farms has decreased also with 388.

Traders moved fewer animals to and from their farms in period 2002 compared to 2000. Traders imported a lot fewer animals and sold many less animals to beef farms. The total number of trade farms decreased by 445.

The activity of collection centres (certified or not) decreased a lot after the FMD outbreak. Notably, the flows from dairy farms to collection centres and from collection centres to beef farms are much smaller.

Furthermore, the total number of imports decreased a lot, which also applies to the number of animal slaughtered. A total of 1808 holdings that were not active in the 2000 period started up again after the FMD outbreak and moved a lot of animals.

Transport movements per month

The number of animal movements per month and the average difference between the two periods are given in figure 2 and table 4, respectively.

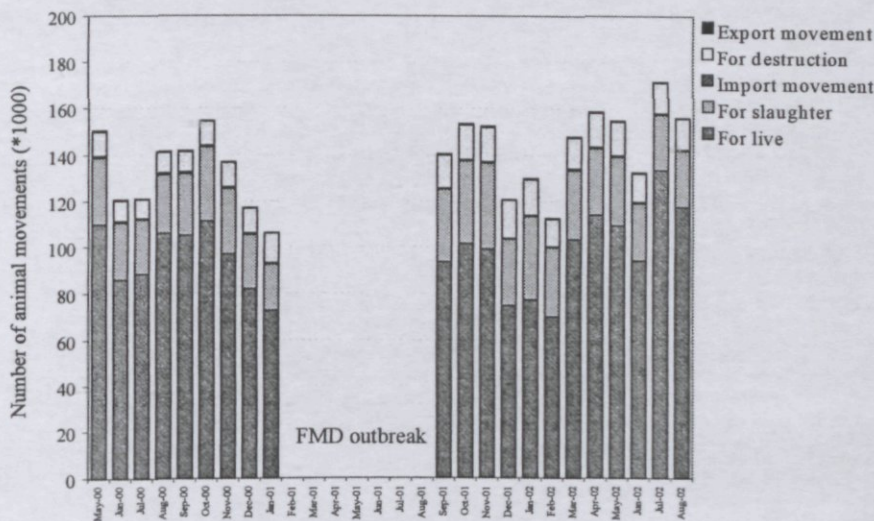


Fig. 2 The number of transport movements per months from May 2000 to August 2002.

The number of transports increased from 132329 to 144343 per month. The number of live transports was not significantly different between both periods. However, the number of transports to the slaughterhouse, and the destruction plant increased significantly. The number of imports decreased significantly, whereas the number of monthly exports increased significantly.

Contact structure based on transport movements

The contact structure based on transport movements between the different holdings in the Dutch cattle sector is summarised for both periods in the contact matrix of appendix B1. The

difference in the number of transport movements has been calculated in the same manner to the difference in the number of animal movements and is given in appendix B2. In the following paragraph only the big differences are discussed.

Table 4. The average number of transport movements per month, the standard deviation and the difference in number of movements between the pre-outbreak period (2000) and the post-outbreak period (2002).

MOVEMENT TYPE	2000		2002		DIFFERENCE
	# / MONTH	STD.	# / MONTH	STD.	# / MONTH
For live	95385	11485	99088	18754	3703 .
For slaughter	25972	3036	30234	4651	42628*
Import	723	109	539	72	-184*
For destruction	9907	970	14027	1364	4120*
Export	342	62	455	87	113*
Total	132329	14288	144343	17195	12014 .

* Significant with $\alpha=0,05$ based on a student t-test.

The total number of transports increased in 2002. The number of transports coming from dairy farms caused a big part of this increase. The number of transports from dairy farms to beef farms, trade farms, slaughterhouses and the destruction plant increased a lot whereas the number of transports from dairy farms to cattle-collection centres decreased in 2002. The number of transports to the dairy farms decreased in 2002.

The number of transports from the beef farms to the slaughterhouse decreased. The number of transports to the beef farms increased in 2002. Most of them were coming directly from the dairy farms, whereas the number of transports originating from collection centres decreased a lot in 2002. The number of transports between traders mutually and between traders and collection centres decreased a lot in 2002. Also the number of transports from dairy farms to traders decreased. A total of 1808 farms classified as empty became active in 2002. The actual holding types were not revealed, but a lot of transports to these farms were coming from dairy farms and most transports coming from these farms went to all different kinds of farm.

Number of contacts per farm

The average number of different farms or holdings that had contact with one typical farm of a specified type has been calculated for both periods. In table 5 the average number of contact farms, subdivided for farms that delivered to or received cattle from a typical farm for both periods, is given.

The average number of different receiving farms, to which a typical dairy farm is moving cattle, increased from 14.08 in 2000 to 26.13 in 2002. The number of different delivering farms (that deliver cattle to a typical dairy farm) remained the same for both periods. The number of delivering farms for a typical beef farm increased a lot, from 56.77 in 2000 to 169.56 in 2002. This was due to the fact that most calves were delivered by dairy farms directly and not via collection centres, which were less active in 2002. The average number of delivering farms to a cattle collection centre decreased a lot from 294.29 in 2000 to 46.84 in 2002.

Table 5. The average number of farms (and standard deviation) that had contact with one typical farm of that farm type, subdivided to delivering and receiving farms for both periods, 2000 and 2002, respectively.

TYPE	DELIVERING FARMS				RECEIVING FARMS			
	2000		2002		2000		2002	
	#	STD.	#	STD.	#	STD.	#	STD.
Da	3.07	4.64	3.37	7.97	14.1	8.35	26.1	13.1
Yo	5.33	7.03	4.75	6.43	5.75	5.15	5.94	4.97
Da/Be	9.00	9.87	8.94	14.7	11.9	8.46	13.3	11.4
Be	56.8	93.7	169	247	4.30	4.08	4.38	3.41
Da/Tr	12.1	11.1	15.8	31.8	25.1	16.7	31.0	22.2
Tr	14.7	101	19.6	152	10.7	20.0	9.27	12.8
Be/Tr	73.2	91.2	222	223	5.71	6.61	5.50	6.06
Su	5.55	8.55	5.89	11.9	6.43	5.31	8.54	7.10
Cc	2150	3355	202	306	625	1063	24.0	24.0
C-Cc	686	1197	923	1089	178	399	48.4	68.6
Cc & C-Cc	1087	2076	857	1062	294	662	46.8	66.8
Others	2.19	2.17	2.87	10.9	2.77	2.22	3.27	3.17
Sl	237	1048	415	1638	0.00	0.00	1.00	0.00
New	1.14	0.53	13.7	68.0	1.30	0.92	3.79	6.65

Distance of transports

The cumulative distribution of the direct distances that were covered by the transports for "live gathering" is illustrated in figure 3. From this figure it can be seen that the distance of the transports in the period 2002 was bigger than in period 2000.

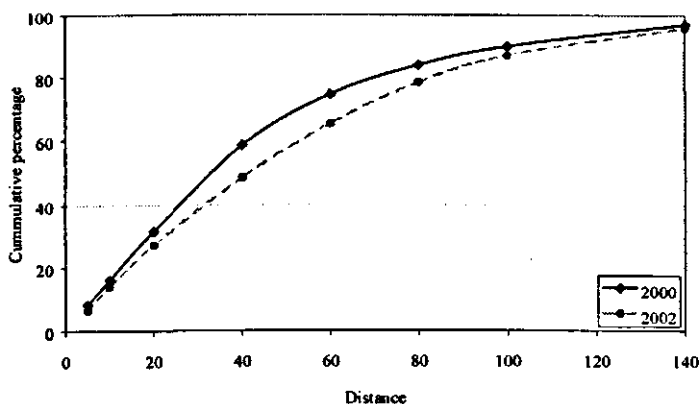


Fig. 3 Cumulative distribution of the transport distances for live for the two periods 2000 and 2002.

DISCUSSION

The research question was; "Did new regulations on animal movements change the contact structure of the Dutch cattle sector?" The relevant regulations were aimed at reducing the spread of possible highly contagious animal diseases by reducing the number of animal contacts between farms or other cattle holdings. The regulations were briefly a regulation that prohibited the collection of live cattle on cattle markets or cattle collection centres, and a regulation that prohibited a farmer to move cattle live from his farm within 30 days after cattle had moved on to his farm.

Data of the Dutch Identification and Registration system were used to answer this question. The answer to the research question is that the number of animal movements decreased, the number of transport movements increased and that the contact structure has changed after the FMD outbreak.

The most important changes were that the number of transports from dairy farms to cattle collection centres decreased significantly, and that the number of transports from dairy farms to beef farms (including veal calf farms) increased significantly. The total number of transports towards and from cattle collection centres decreased significantly after the FMD outbreak. Each dairy farm delivered cattle to more different farms after the FMD outbreak; the number of receiving farms per dairy farm was 14.1 before, and 26.1 after the FMD outbreak. Furthermore, more different farms delivered cattle to each beef farm; the number of delivery contact farms was 56.8 before and 169.6 after the FMD outbreak. The number of delivery and receiving contact farms to and from one average cattle collection centre decreased from 1087.0 to 856.9 and from 294.3 to 46.8, respectively.

The trading of cattle has become much less attractive due to the new regulations. This is illustrated by the fact that the number of trading farms decreased a lot and that the number of animal movements and transport movements via trade farms decreased. The activity of cattle collection centres also decreased a lot. Only gathering of cattle was allowed on certified cattle collection centres in 2002.

Summarising, it can be concluded that the number of animal movements decreased and that the contact structure changed after the FMD outbreak. A lot of these changes were due to the new regulations. However, some effect can also be attributed to the decrease in the number of active farms after the FMD outbreak. Whether the spread of FMD or other infectious diseases will be reduced with this new contact structure can not be concluded at this point.

Another reason for publishing the contact structure of the Dutch cattle population is to provide data for epidemiological studies on the spread of animal diseases. Many of the existing models developed to explore disease transmission and control options assume a homogeneous mixing of farms or take on an explicit spatial structure but assume a random contact structure. A good understanding of the cattle contact structure would enable models to capture the true heterogeneity in the system and allow more realistic comparison of control strategies than is currently possible (Nielen et al., 1996a; Nielen et al., 1996b). In another study carried out for this evaluation the interFMD model has been used, based on the contact structures of 2000 and 2002, to simulate FMD outbreaks in the Netherlands. The results of this study have only been published in a report (Greutink et al., 2002).

The need for a good understanding of the contact structure of farm animal population became imperative during the FMD outbreak in Great Britain, where efforts to use mathematical models to forecast the spread of the FMD virus were hampered by a lack of information on this contact structure (Webb et al., 2002)

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Appendix A1. Contact matrix based on animal movements. The total number of animal movements between the different farm types for periods, 2000 and 2002, respectively.

	Da	Yo	Da/Be	Be	Da/Tr	Tr	Im/Be	Su	Cc	C-C	Others	Sl	New	Des	Foreign	Total
Da 2000	60420	7751	3888	200575	2659	82783	8876	9009	261268	257919	19432	221076	8	55619	3553	1194836
Da 2002	85808	8390	4262	640303	4403	166118	29355	12942	6505	477573	29975	486292	30628	126871	21160	2130585
Yo 2000	5704	845	375	751	741	1832	16	134	315	1776	408	2115	0	408	119	15539
Yo 2002	5510	462	175	1060	710	1549	14	145	16	1879	485	4378	193	754	687	18017
Da/Be 2000	2081	253	467	918	80	1176	95	216	1873	1467	505	7399	1	883	150	17564
Da/Be 2002	2083	225	167	1783	85	1303	82	220	5	2073	548	10107	170	1217	514	20882
Be 2000	1100	266	278	49454	163	4550	2794	372	2226	1911	828	986148	0	38157	9123	1096870
Be 2002	1614	318	253	24339	185	4449	409	377	1	5287	1022	1028526	2799	44810	48002	1162391
Da/Tr 2000	1355	562	124	2208	369	1436	158	186	2956	2387	448	3062	0	393	124	15768
Da/Tr 2002	1161	474	128	4746	102	1533	302	163	10	3565	366	4925	232	862	354	18923
Tr 2000	14927	1543	868	242044	886	27665	13547	2404	22736	19531	5859	60828	14	3867	28664	445383
Tr 2002	12267	960	572	42484	940	11999	3424	1396	17	30994	4053	68859	2430	4805	25419	210619
Im/Be 2000	208	9	12	276	1	264	175	127	55	28	122	58294	0	2229	98	61898
Im/Be 2002	44	7	10	667	1	266	85	29	0	221	63	59081	62	2345	2034	64915
Su 2000	3434	149	188	3968	147	3135	255	1848	7369	5231	1807	20429	0	2130	199	50289
Su 2002	4956	209	448	9012	192	5047	613	1351	29	7165	2269	28931	1098	3306	468	65094
Cc 2000	8654	697	823	193649	970	28415	8551	3882	11749	16231	6372	74357	2	52	21	354425
Cc 2002	18	1	0	2795	0	106	196	0	0	597	2	8	134	7	9	3873
C-Cc 2000	5115	380	811	280615	448	22547	12898	2257	10950	23303	2800	47297	0	191	31808	441420
C-Cc 2002	203	86	112	67958	5	9598	3941	76	412	24513	470	13821	2604	373	62860	187032
Others 2000	13475	752	738	5196	515	8990	289	2560	13579	9602	8618	26614	6	3032	491	94457
Others 2002	14959	674	1081	10534	593	10818	620	2801	39	9795	7796	44824	2178	4280	3024	114016
Sl 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sl 2002	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New 2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New 2002	4743	47	232	3429	52	1210	732	408	7	1769	580	27781	1596	2079	3633	48298
Foreign 2000	2318	49	540	154382	59	254779	11738	2189	0	81619	988	3	0	12	1	508677
Foreign 2002	3381	309	732	362682	27	28426	20951	2212	0	182	2300	122	13798	24	260	435406
Total 2000	118811	13257	9112	1134036	7038	437590	58892	25184	335078	421005	48194	1507622	37	106992	74351	4297126
Total 2002	136747	12162	8172	1171792	7295	242422	60724	22120	7041	565613	49929	1777655	57922	195279	168424	4483297

Appendix A2. The difference in the number of animal movements between the different farm types between the two periods 2000 and 2002.

	Da	Yo	Da/Be	Be	Da/Tr	Tr	Im/Be	Su	Cc	C-cc	Others	SI	New	Des	Foreign	Total
Da	5248	-1945	-922	372870	858	55741	17520	930	-341852	133681	4066	191524	30617	16423	52712	537470
Yo	-2095	-665	-325	59	-278	-894	-7	-34	-404	-489	-59	1558	193	528	210	-2702
Da/Be	-692	-112	-456	559	-22	-265	-45	-68	-2492	117	-125	242	169	314	40	-2837
Be	147	-37	-118	-41600	-32	-1618	-2650	-119	-2967	2739	-82	-286338	2799	35838	-6066	-300102
Da/Tr	-646	-275	-37	1802	-390	-382	91	-85	-3931	382	-231	842	232	189	338	-2101
Tr	-7636	-1097	-585	-280241	-241	-24888	-14639	-1809	-30298	4953	-3759	-12245	2411	-12800	-351	-383225
Im/Be	-233	-5	-6	299	0	-86	-148	-140	-73	184	-100	-18644	62	1903	-627	-17616
Su	377	10	197	3721	-4	867	273	-1113	-9796	190	-140	1692	1098	203	466	-1958
Cc	-11521	-928	-1097	-255404	-1293	-3781	-11205	-5176	0	-21044	-8494	-99135	131	-19	-62	-468694
C-Cc	-6617	-421	-969	-306195	-592	-20465	-13256	-2933	-14188	-6558	-3263	-49242	0	20449	118	-401528
Others	-3008	-329	97	3606	-94	-1169	235	-612	-18066	-3008	-3695	9339	2170	2369	237	-11927
SI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3546
New	4743	47	232	3429	52	1210	732	408	7	1769	580	27781	1596	2079	3633	48298
For	290	244	12	156839	-52	-311279	5300	-707	0	-108643	983	118	0	259	8	-242830
Total	-21641	-5513	-3977	-340256	-2089	-341007	-17799	-11459	-424062	4273	-14320	-232508	41479	67735	54202	-1246204

→ 9 months → 12 months

Appendix B2. The difference in the number of transport movements between the different farm types between the two periods 2000 and 2002.

	Da	Yo	Da/Be	Be	Da/Tr	Tr	Im/Be	Su	Cc	C-cc	Others	Sl	New	Des	Foreign	Total
Da	-10996	-1282	-991	259397	197	36290	12412	-867	-260889	83439	-149	64015	17921	47174	6437	252108
Yo	-652	-166	-61	148	-80	-373	3	-25	-231	-397	-20	285	49	-1	15	-1506
Da/Be	-570	-27	-234	456	-20	-198	14	-48	-1567	-35	-75	-13	59	-15	27	-2245
Be	-217	-11	-46	-2928	-33	-219	-77	-57	-1447	-224	-153	-11026	228	-4881	913	-20179
Da/Tr	-567	-102	-37	890	-237	-229	37	-48	-2515	12	-163	-131	137	294	32	-2626
Tr	-4226	-240	-241	-8913	-210	-6644	-682	-744	-12149	-4687	-1727	-7008	613	-275	-637	-47768
Im/Be	-67	-2	-4	-26	0	-68	-89	-40	-44	13	-39	-913	11	-247	55	-1461
Su	-454	-34	42	2475	-18	78	152	-791	-6556	183	-347	533	495	405	95	-3742
Cc	-6715	-412	-440	-11842	-689	-9692	-511	-2485	-1617	-2158	-4856	-7436	3	-41	-7	-48900
C-Cc	-3844	-148	-269	-11129	-328	-4521	-778	-1196	-1980	-1610	-1979	-2825	86	79	318	-30124
Others	-2861	-118	-92	1870	-69	-1183	145	-494	-12217	-2921	-2665	2519	1082	146	163	-16694
Sl	0	0	0	0	0	0	0	0	0	0	0	0	0	740	0	740
New	1252	9	32	1456	13	520	96	110	2	1052	259	2446	239	1553	158	9197
For	-21	4	-3	1897	-4	-3830	-327	-56	0	-623	-24	24	193	21	13	-2737
Total	-29938	-2531	-2345	233751	-1478	9931	10395	-6740	-301208	72043	-11938	40471	21117	44953	7582	84064