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AGRICULTURAL LOGISTICS IN THE AFTERMATH OF THE FOOT AND MOUTH CRISIS: THE CASE OF THE FAT LAMB CHAIN

Michael Bourlakis
Johanne Allinson

Research Report

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Department of Agricultural Economics and Food Marketing

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Michael Bourlakis

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A Research Study funded by the Institute of Logistics and Transport

June 2003

Acknowledgements

The authors would like to acknowledge the funding received by the Institute of Logistics and Transport. We also want to thank our colleagues from the Centre of Rural Economy in the School of Agriculture, Food and Rural Development at University of Newcastle upon Tyne and particularly Professor Philip Lowe and Dr Chris Ray.

Finally, we want to acknowledge the help provided by colleagues from the Farm Business Survey team based at University of Newcastle upon Tyne, and particularly Mr Charles Scott. They provided constructive comments during the questionnaire development and suggested farmers to interview.

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Executive Summary

Foot and Mouth Disease (FMD) in the UK in 2001 exposed the complex nature of the structure and relationships in the fat lamb chain and has drawn attention to poor logistics mechanisms and practices that prevail.

Briefly, the chain comprises a high number of physical and information transactions between a high number of actors and agents. More specifically, in the fat lamb chain, an animal no longer moves from farm to market to abattoir within a reasonably defined area, but often goes through several markets and farms before finally reaching the abattoir. The liveweight movements have been primary responsible for the fast spread of the disease whilst the deadweight movements include the ones from the abattoir to the processors and later on, to the retailer.

However, it is not clear who is responsible for various stages in the channel and what is the actual role of every chain member. The fat lamb chain needs to be examined separately and treated in a different manner due to numerous characteristics that influence its structure and relationships. These characteristics include *inter alia*, the seasonality of production, the dependencies between hill and lowland farmers, the strong presence of live auction markets, the increased role of liveweight sales and the large number and different types of sheep.

This report examines the liveweight and deadweight movements across the fat lamb chain and identifies the exact role of each chain member. Hence, it aims to provide a detailed and systematic overview of these movements and secondly, to identify the best transportation practices

across that chain, i.e. from farms to auctions and abattoirs to food processors and finally to retailers. These practices were assessed on cost efficiency, animal welfare and consumer safety grounds and were based on members' views and opinions.

It was also aimed to reveal the optimum location for both auctions and abattoirs based on the aforementioned variables, i.e. cost efficiency, animal welfare and consumer safety. Members' views were again considered for that issue under examination.

In order to meet the above, qualitative – exploratory research was conducted, comprising 23 in-depth interviews with various fat lamb chain members such as farmers, hauliers, auctioneers, abattoir managers, livestock dealers, food processors and retailers.

The findings reveal the chain's changing structure and relationship dynamics pre- and post-FMD2001 and the need for closer linkages between farmers, live auction markets, and abattoirs that are the key members of the liveweight and deadweight fat lamb chain.

They also illustrate the need for auctions and abattoirs to be located close to each other and the source of production. Such a suggestion was defended on cost efficiency, animal welfare and consumer safety grounds all of which are major concerns to the UK food and farming industry at the present time.

In addition, the research findings revealed that the latest concentration of the auction and abattoir sectors has engendered a gradual alienation

between the liveweight and deadweight fat lamb chains and exposed the urgent need for its holistic reassessment.

Furthermore, it was identified that post-FMD2001, various chain members re-evaluated their roles. For example, livestock dealers became managers of information between farmers, abattoirs and the rest of the chain rather than being engaged in actual physical transportation, their prime activity pre-FMD2001. On the other hand, specialist hauliers have emerged as the best mode of transportation for livestock.

To conclude, careful consideration should be given to the implications of the findings for the UK fat lamb chain, especially when there is a lack of in-depth knowledge of the structure and existing dynamics of that chain. The report offers some initial recommendations in relation to the above. Therefore, it is hoped that the report will be useful for future policy development in the sheep and red meat chain.

1 INTRODUCTION

Foot and Mouth Disease (FMD) in the UK in 2001 revealed the complex structure and nature of relationships within the domestic fat lamb chain. The chain comprises a multiplicity of actors including farmers, live and electronic auctions, livestock dealers, specialist hauliers, small and large abattoirs, meat processors, farmers' markets, small independent butchers, multiple retailers and food service firms that perform a range of physical and information transactions.

A key feature of the chain is the substantial number of sheep movements that were not always recorded. Tagging, animal passports and other traceability mechanisms are employed in other livestock chains; however, they were not used extensively in the UK fat lamb chain pre-FMD2001. This has stimulated concerns about how FMD2001 spread as quickly as it did and has compounded consumer concerns about the relationship between food traceability, product quality and safety. Moreover, it is not clear in which geographical direction the actual livestock movements take place, who is responsible for various stages in the chain (e.g. the livestock dealers, hauliers, farmers) and what is the actual role of every chain member.

The report explores the roles, relationships and linkages of both liveweight and deadweight chain members, pre- and post-FMD2001. Pre-FMD2001 is defined in this analysis as the time period up until 22nd February 2001 when the first FMD2001 incident was detected whilst post-FMD2001 is used to describe the time period from 22nd February 2001 till February 2002, when live sales via auctions were permitted again. In addition, the report attempts to reveal chain members' opinions

about existing and optimum fat lamb transportation practices and locations of auctions and abattoirs in terms of cost efficiency, management of animal welfare and consumer safety. The findings are discussed in relation to the changing environment of the UK fat lamb chain immediately post-FMD2001 to suggest possible future roles of specific chain members therein.

The next sections outline the key characteristics of the UK fat lamb chain and the recent incidence of FMD2001 with emphasis on the north east of England where the empirical research is undertaken. This is followed by a brief summary of the research objectives and the methodology used. For the latter, it is worth noting that qualitative research was conducted, comprising in-depth interviews with various fat lamb chain members.

A substantially greater number of interviews was conducted with farmers in order to explore livestock movement from farms to auctions to abattoirs. These interviews incorporate a wide spectrum of farming categories according to the type of sheep livestock and farm size. Interviews were also conducted with other chain members (e.g. hauliers, livestock dealers, processors and retailers).

The same questionnaire was used when interviewing each chain member. The purpose of the research was to explore the views of key informants in the fat lamb chain in relation to transportation practices and other themes under examination. The researchers made use of the established links between University of Newcastle upon Tyne and the agri-food sector. For example, the Farm Business Survey team and the Centre for Rural Economy, both based at University of Newcastle upon Tyne, enjoy very

good links with farmers in the north east region as well as with regional and national food processors and retailers.

It is envisaged that the findings of this report will be useful in the aftermath of the Foot and Mouth crisis as there is a great need for efficient, and most importantly safe, fat lamb, and red meat, chain practices.

2 THE UK FAT LAMB CHAIN

Sheep farming is a heavily subsidised sector. It has also been a significant element of UK and northern regional agriculture for hundreds of years (Fogerty, *et al*. 2001). Since the late 1980s, the total size of the UK sheep flock has remained constant at between 42 and 45 million sheep (see Table 1) and is the largest in the European Union (Anderson, 2002).

Table 1: Basic statistics for the UK sheep industry

	1990	**1995**	**1996**	**1997**	**1998**	**Change 1997/1998**
Sheep Flock (June census, 000 Head)						
Total sheep	43,799	43,304	42,086	42,823	44,821	+ 5%
Ewes and ewe lambs	20,424	20,830	20,277	20,696	21,386	+ 5%
Sheep Meat (000 tons carcass weight equivalent)						
Home fed production	393.2	400.3	382.4	350.0	385.0	+ 10%
Imports (live &meat)	153.5	146.7	156.2	150.3	140.0	- 7%
Exports (live &meat)	103.3	194.0	162.6	135.0	140.0	+ 4%
Consumption	437.3	351.7	377.7	363.1	383.0	+ 5%
Self sufficiency (%)	89.9	113.8	101.2	96.4	100.5	
Consumption per person (kg)	7.6	6.0	6.4	6.2	6.5	+ 5%

Source: The UK Sheep Farmers Organisation (http://www.nationalsheep.org.uk) 15/11/02

The UK fat lamb chain is traditionally a stratified system which links hill and lowland producers. The principle behind the system is the movement of breeding ewes and store lambs from the uplands to the lowlands where they are ultimately fattened (finished) for sale live at auctions, or to abattoirs and then deadweight, to processors, retailers and food service firms. Due to the climate and topography of upland Britain, most livestock is finished on the lowland, generally outside the county that

livestock is initially bred. For example, more than half of Northumberland livestock farmers produce store animals for finishing or rearing elsewhere (Dower, 2002).

The continuity of the system is therefore dependent on animal movements. More recently, the sheep market has become less profitable and this led to the situation that became apparent during FMD2001 when some livestock dealers and farmers were buying and selling stock several times during a period of a few days. Farmers also transported sheep between locations to ensure that they had filled their quota for the February-March inspection period (MLC, 2001a) so as to obtain optimum support payments.

Liveweight sales by farmers to abattoirs, processors and retailers (where possible) is the preferred mode of transaction: 54% of all lamb sales occur through livestock auctions and 46% of sheep are sold deadweight to abattoirs. This contrasts starkly with the deadweight sales proportion for the cattle and pig sectors which are 63% and 97% respectively (MLC, 2001a).

The auction and abattoir sectors of the UK meat, including fat lamb, chain are nowadays more highly concentrated and large scale than ever before (see Table 2). Historically, these sectors comprised units of widely varying size evenly distributed throughout the country (Fearne, 1998a).

Table 2: Number of livestock auctions and abattoirs in the UK red meat chain (1971-2001)

Date	Number of livestock auctions	Number of abattoirs
1971 / 1972	416	1,890
1990	259	919 (year 1988)
2000 / 2001	180	359

Source: Adapted from Jones and Steele (1995), Meat and Livestock Commission (2000), (2001a)

The present degree of centralisation and concentration has come about because of the need to reduce costs through economies of scale and to regulate hygiene and food safety standards more efficiently. Currently, 37 abattoirs are responsible for 76% of sheep slaughtered, with the top 10 abattoirs accounting for almost 47% of total sheep slaughtered in UK (MLC, 2001a). Consequently, this makes the UK meat industry more competitive and able to meet multiple retailers' low cost, flexible and concentrated procurement strategies (see Fearne, 1998b). For example, St Merryn Meats' abattoir works on behalf of Tesco to procure and slaughter the specific types and quality of animal which Tesco prefers to sell. Such relationships are rarely based upon a formal contract and so create insecurity amongst chain members (MLC, 2001a). Increased concentration is also noticeable in the retail sector where, in 1997, the top 5 UK food multiple retailers enjoyed 44% of total lamb sales (Fearne, 1998a).

Yet, despite this concentration, the UK abattoir sector suffers from considerable excess capacity estimated at 50 - 60% (Promar International, 2001). It is unsurprising then, that the price paid for sheep and other livestock is not always determined solely via competition among members of the chain (MLC, 2001a).

In the North East region, the number of abattoirs has decreased by 50% since 1992 (Table 3 and Table 4). Moreover, the region has relatively small plants in comparison to the rest of the UK. The major characteristics of the region's abattoir sector are overcapacity and the continuous consolidation at national level.

Table 3: Trends in the number of animals slaughtered in the North East region

	No of abattoirs	Cattle (ex.calves) ('000 head)	Sheep ('000 head)
1990	N/A	99.4	456.2
1991	N/A	103.9	438.6
1992	37	98.2	368.5
1993	28	87.5	305.1
1994	23	82.5	278.0
1995	23	85.2	284.8
1996	23	86.4	301.9
1997	20	92.4	289.3
1998	18	88.9	356.3
1999	18*	80.1	395.4

* Includes one specialist pork abattoir
Source: DEFRA cited in Promar International (2001)

Table 4: Comparison between the NorthEast region and England (1999)

	North East	England	% of England
No of abattoirs*	18	338	5.3%
Cattle (ex. calves) ('000 head)	80.1	1,318.7	6.1%
Sheep ('000 head)	395.4	11,621.3	3.4%

* includes abattoirs that were open at any time during 1999
Source: DEFRA cited in Promar International (2001)

3 FMD IN THE UK AND IN NORTH EAST ENGLAND IN 2001

The last major FMD outbreak in UK occurring in 1967/8 with 2,228 confirmed cases was a localised phenomenon due to the disease being spread by wind, birds, rodents and other fauna (one confirmed case being attributed to animal movements).

In contrast, it is widely believed that the geographical and temporal dynamics of FMD2001 were caused by multiple and long distance sheep movements, exacerbated by a three week delay in the detection of the source of the outbreak (see Dower, 2002; Lowe *et al.,* 2001).

FMD2001 was detected initially on infected pigs at a slaughterhouse in Essex on 22nd February. The pigs were from a farm in Heddon-on-the Wall in Northumberland, 400 km away, and it is believed that the virus was spread by airborne plume to seven neighbouring farms, one of which sent infected sheep to auction in Hexham. From there, sheep were bought and sold by dealers at auctions across the country. Infected sheep were therefore, crossing the country in a multitude of separate movements, directly on to individual farms or via livestock auctions that, on many occasions, brought them into contact with other livestock. Indeed, two million sheep were moved around the country during the three-week period before the source of the outbreak was known.

It should be noted that whilst pigs are able to spread FMD quicker than other livestock, they were not a significant cause of the spread of FMD2001. This may be partly due to legislation introduced in 1975 to combat Swine Vesicular Disease which stipulates that there must be a 21 day period between live pig movements in the food chain. This allows

sufficient time for disease identification on one premise before other premises are put at risk from the movement of infected pigs.

Similarly, cattle movements have not been cited as the cause of the spread of FMD2001 which may be due to the close regulation of cattle movements using passports and tagging mechanisms that were introduced in UK after the BSE crisis in 1996. In stark contrast, such legislation and regulation do not exist for UK lamb and sheep movements. This has been identified as a key action point for the industry in the future (MLC, 2001b).

The spread of FMD was soon out of control and in an attempt to combat the situation, on 23rd February 2001, the Ministry of Agriculture, Fisheries and Food banned animal movements and implemented a cull of infected animals. The number of new cases gradually declined until August 2001 when a new outbreak occurred in Northumberland creating concern that the restrictions were ineffective and insufficient. The response of the UK government was to introduce a 20 day standstill ruling which prevented animal movements between farms for 20 days after their arrival at the premises.

Many English counties were affected by FMD2001. In Northumberland (see Table 5), 75% of farms were placed under some form of restriction, while more than 300 farms had their stock culled resulting in 205,000 sheep and 28,000 cattle being slaughtered (Dower, 2002). Nationally, 2,030 farms were infected by FMD2001, 6,5 million animals were slaughtered and the cost to the national economy was around £6.5 billion (DEFRA / DCMS, 2002).

Table 5: Number of animals slaughtered in Northumberland

	Animals in Infected Premises	Animals in Direct contact - Contiguous Premises	Animals in Direct contact - Non Contiguous Premises	Animals Slaughtered on Suspicion	Grand Total
Cattle	11,102	12,636	3,888	335	**27,961**
Sheep	66,346	104,490	29,181	4,938	**204,955**
Pig	24	763	350	0	**1,137**
Goats	7	10	0	5	**22**
Deer	0	42	0	0	**42**
Total	**77,479**	**117,941**	**33,419**	**5,278**	**234,117**

Source: Dower (2002)

Therefore, it became apparent that there was a need to understand the structure of the fat lamb chain and to identify best practices to help prevent the spread of FMD in the future.

4 RESEARCH DESIGN

A research objective was to examine the current transportation practices used by fat lamb chain members in the north east of England and to reveal an optimum transportation option (best practice) in terms of cost efficiency, management of animal welfare and consumer safety. These three variables have not only attracted considerable attention in the agri-food supply chain and food industry (see Curry, 2002; Hughes, 1995; Ritson and Mai, 1998), but have also been used to determine the optimum location of auctions and abattoirs. In order to meet this objective, the empirical research had a three-pronged approach.

Firstly, primary data was collected on fat lamb chain members' views and opinions. This was supplemented by secondary data to illustrate and describe the structure and relationships that comprised the chain, pre- and post-FMD2001. Secondly, primary data was collected on chain members' opinions on the transportation practices used by chain members, pre- and immediately, post-FMD and on the optimum practices of fat lamb transport in terms of cost efficiency, management of animal welfare and consumer safety identified. Thirdly, primary data was collected on chain members' opinions on the optimum location for auctions and abattoirs in terms of cost efficiency, management of animal welfare and consumer safety.

Primary data collection comprised in-depth, face-to-face and telephone-based structured interviews with 23 fat lamb chain members either situated, or working with other chain members, in the north east of England. The interviewees are key informants selected on the basis of their expertise / knowledge. The vast majority of the interviewees

were fairly co-operative. The interviews were conducted in each respondent's office (with the exception of two phone interviews) making for a friendly and familiar environment. Moreover, the method enabled the researcher to decide upon the timing of the questions based on the progress of the discussion, as to focus on certain issues that the respondent was willing to answer with less hesitation. Twenty-three persons were interviewed, a number that is regarded quite satisfactory for qualitative inquiry (see Burgess, 1984; Patton, 1991).

The sample comprised 11 farmers (see Table 6), 2 specialist hauliers, 2 multiple retailers, 2 meat processors, 2 auction companies, 2 abattoir managers, 1 small butcher and 1 livestock dealer. Since FMD2001 was related primarily to the volume of sheep movements at the producer end of the fat lamb chain, information was sought from a proportionally larger number of farmers in order to scrutinise their understandings. Interviews were carried out between January-April 2002.

Table 6: Data for interviewed farmers

Variable	**Data for 11 interviewed farmers**
Average size of flock	221 ewes
Average Type of Sales	92% of the lamb crop is sold finished (fat)
Average Amount of Sales	365 animals per farm per year and £39 per head
% of farms in Lowland, Disadvantaged or Severely Disadvantaged Area	Almost half (50%) of farms have land in the Disadvantaged Area (DA) None have land in the Severely Disadvantaged Area (SDA)
Data for other Livestock	3 farms have suckler herds producing suckler halves 4 farms produce finished cattle
Impact of foot and mouth	3 farms lost all their stock, 1 farm lost some stock, 7 farms lost no stock

Source: Farm Business Survey team, School of Agriculture, Food and Rural Development, University of Newcastle upon Tyne

5 FINDINGS

The fat lamb chain consists of physical transactions where animals are traded and information flows that enable those transactions to take place. Figures 1 and 2 illustrate the nature of the physical - product transactions and information flows pre-FMD2001, respectively.

With regard to the physical - product flows pre-FMD2001 (see Figure 1), the research underlined that live auctions occupied a central role and are regarded highly by farmers. Live auctions provide an open forum for information dissemination about market prices and demands between producers and customers that is not available in the deadweight chain (see also Allinson and MacFarlane, 1999). In addition to live auctions, electronic auctions also exist and are of some importance nationally (see Harvey and Scott, 1999; Hobbs, 1997; Jones and Steele, 1995). The research revealed however, that members of the North East fat lamb chain consider them a viable or comparable alternative to live auctions on the basis of the type and quality of service they provide.

The findings showed that a number of chain members buy from auction. They include farmers, livestock dealers, export agents and procurement agents that, in most cases, work on behalf of larger abattoirs. It was determined that the majority of live auction sales were to larger abattoirs that procured animals to slaughter on behalf of multiple grocery retailers, meat processors and food service firms. Thus, the larger abattoirs were key actors in the physical - product and information transactions and flows at the interface of the live and deadweight chain pre-FMD2001. In contrast, it was revealed that smaller abattoirs often enter into specific contracts with small butchers, small retailers, farmers' markets and

farmers. For example, it was mentioned that a small abattoir provided an organic slaughter facility for farmers within a fifty-mile radius of the plant.

Furthermore, findings identified that information use and exchange in the chain was fragmented pre-FMD2001 (see Figure 2). Generally, information was managed by individual companies at each stage of the chain communicating primarily with the immediately previous or subsequent stage of the chain but rarely with farmers. Although multiple retailers nearly always constructed the messages and instigated their conveyance through the chain, they only maintained direct communication with processors or with abattoirs acting on their behalf. The research showed that the type of information involved in these flows included existing and future demand for animals of a certain quality based on retailers' specification of desired carcass quality and based on the price paid by the retailer on delivery of such produce.

Post-FMD2001, many changes occurred in the liveweight fat lamb chain in particular. Figures 3 and 4 illustrate how these impacted upon the chain's physical - product and information transactions and flows.

> "Since foot and mouth, collaboration and co-operation have become far more important than competition in the red meat chain"
>
> (Interviewed Farmer)

> "We changed to direct selling, straight from farms to abattoirs due to foot and mouth restrictions"
>
> (Interviewed Farmer)

Figure 1: Physical - Product Flows in the UK Fat Lamb Chain: Structure and Agency Pre FMD 2001

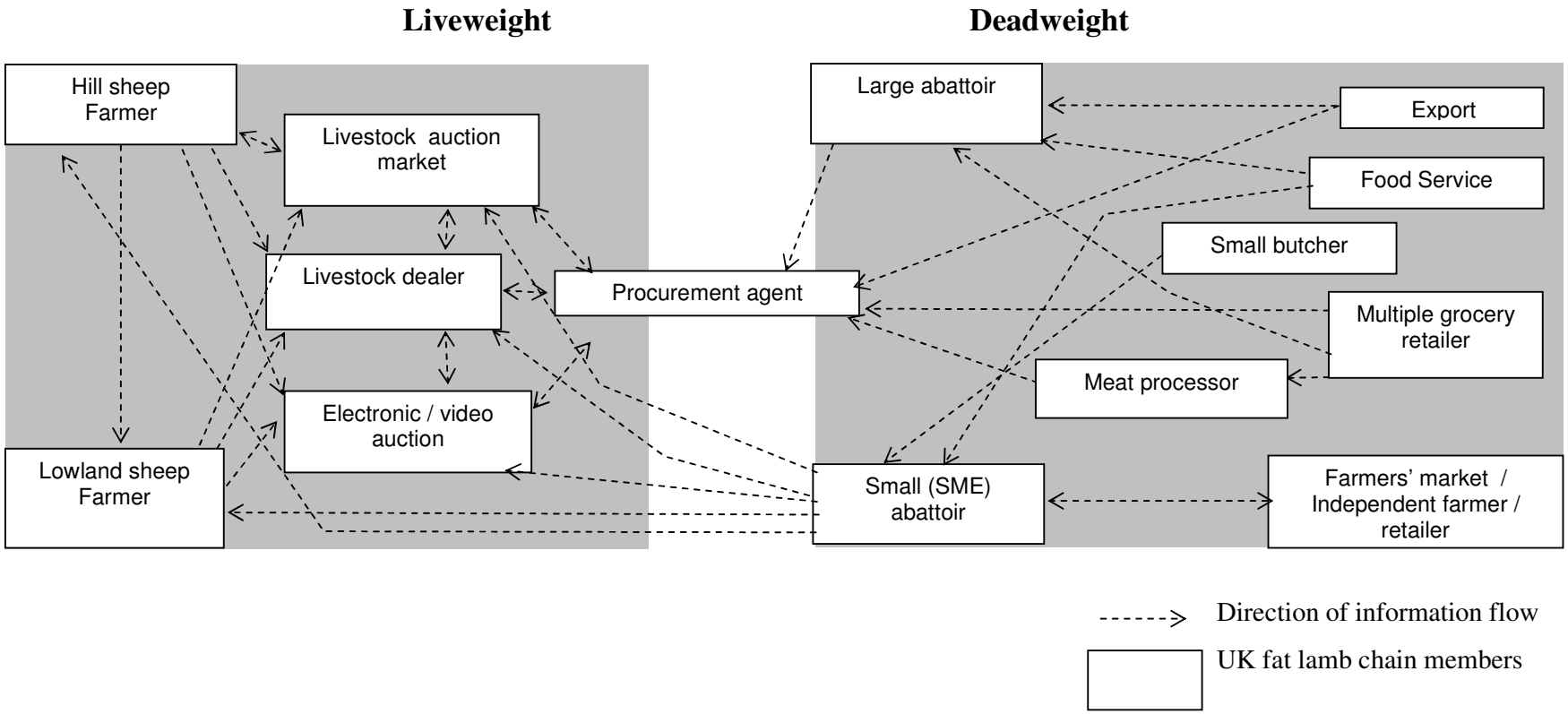
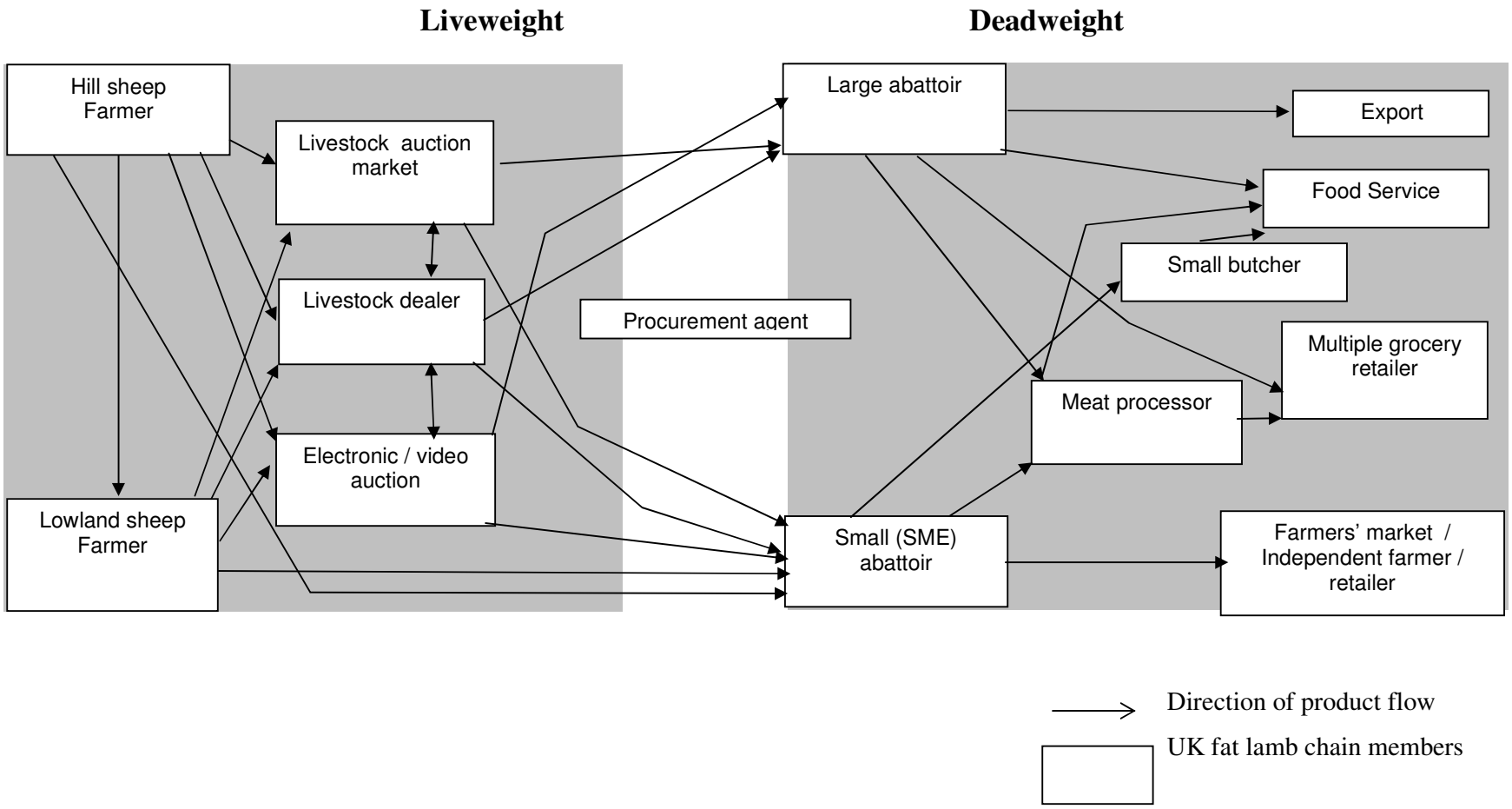


Figure 2: Information Flows in the UK Fat Lamb Chain: Structure and Agency Pre FMD 2001



" The foot and mouth disease stressed that the fat lamb chain is long and complex with many intermediaries being involved; hence, the shorter the chain, the better. We need to increase the role and the importance of the deadweight chain and minimise transactions in the liveweight chain".

(Interviewed Abattoir Manager)

Figures 3 and 4 show that immediately after FMD was identified in February 2001, the number of flows, and particularly the physical - product ones, was dramatically reduced in the fat lamb chain. Due to the biosecurity risks considered to be posed by live auctions, live sales were not permitted until February 11th 2002, almost one year after FMD had been identified and additional biosecurity measures, including movement restrictions, were introduced to reduce the risk of another FMD outbreak (Francis and Wragg, 2002). This meant that no physical transactions were allowed between hill and lowland farmers. Lowland farmers who had not had their animals culled retained some of their own stock for replacements, or relied on the lifting of movement restrictions to allow them to begin trading with upland farmers again. Liveweight exports were banned and, although the role of livestock dealers in physical - product transactions was questioned during FMD2001, their knowledge of who produced what, where and when was essential to the continuity of the supply chain. Some dealers were thus able to reinvent themselves as principal providers of information about stock availability. Procurement agents remained in close contact with collection centres that were previously acting as live auctions providing information on abattoir and retailer demand.

Figure 3: Direction of Physical - Product Flows in the UK Fat Lamb Chain: Structure and Agency Post FMD 2001

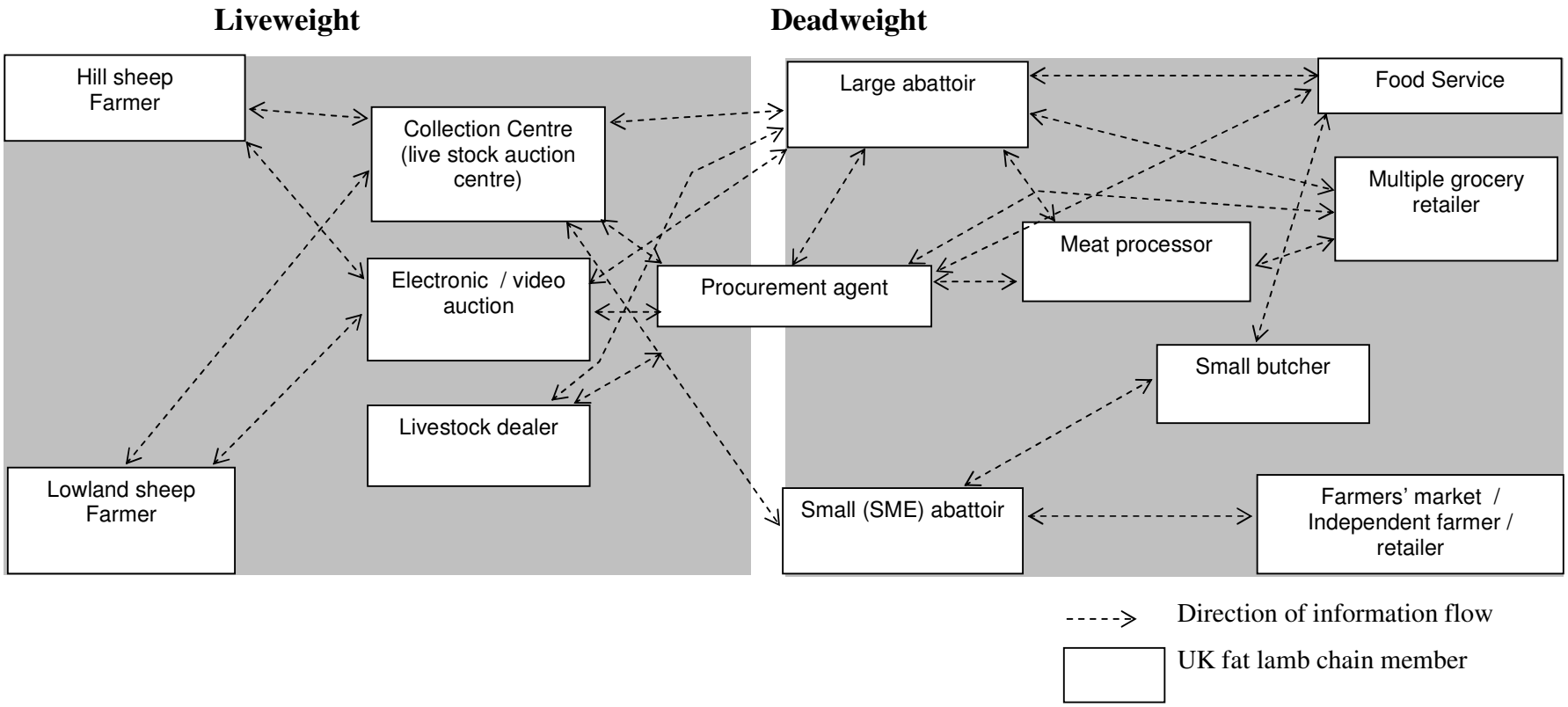
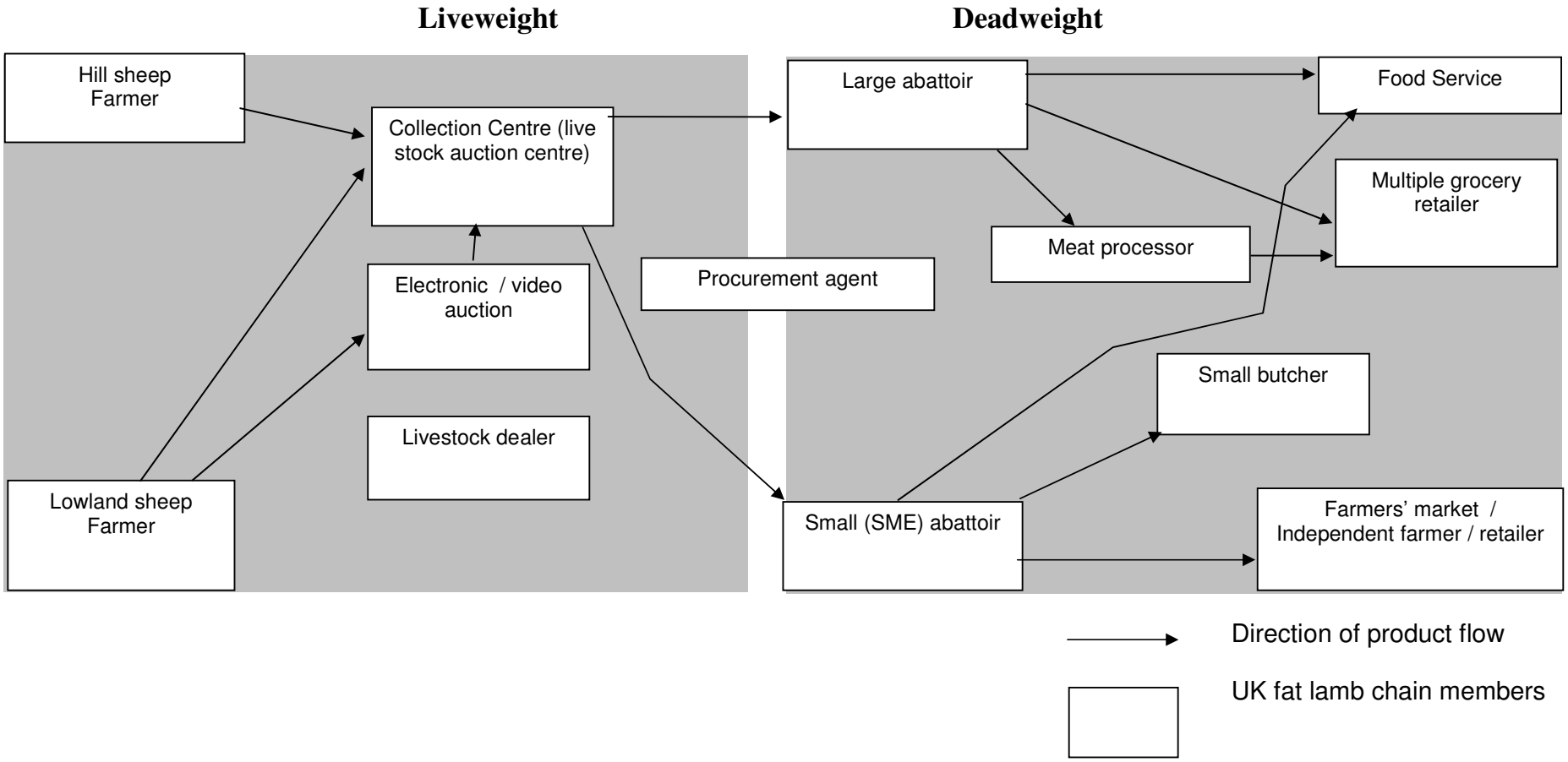


Figure 4: Information Flows in the UK Fat Lamb Chain: Structure and Agency Post FMD 2001



"Post foot and mouth and as auction markets were closed, livestock dealers, procurement agents and abattoirs were the prime source for information for the rest of the deadweight chain"

(Interviewed small butcher)

Specialist hauliers were transporting clean stock from farms to the nearest collection centre where it was sold to abattoirs. Hence, collection centres became an essential contact point in the chain, working explicitly to connect livestock producers with abattoirs and ultimately, retailers and food service firms. During this time, because abattoirs were able to specify the price they would pay, this being the only market available to farmers, the abattoirs effectively constructed and regulated the physical - product and information transactions and flows in the chain. The research revealed that farmers had mixed responses to this, with some arguing that the basis of the sale was unfair, and others suggesting that they found these arrangements more effective. There is though, ongoing demand for the closure of live auctions because of the biosecurity risks they pose and on the grounds that direct sales to abattoirs are more efficient (see Stevenson, 2001). From the above, it appears that particular chain members extended and strengthened their roles.

In relation to transportation practices used in the fat lamb chain, Question 1 (see column Q1 in Table 7) examined how are fat lambs transported from the farm to the next stage in the marketing chain (see sub-columns Pre/Post FMD). In addition, Question 2 (see column Q2 in Table 7) investigated the way fat lambs are transported from the auction to other fat lamb marketing chain members (see sub-columns Pre/Post FMD).

Following the above examination, Table 7 illustrates that the most popular transportation practice in the liveweight chain pre- and post-FMD2001, was specialist hauliers.

Table 7: Empirical research findings for favoured fat lamb transportation practices (pre–post FMD2001)

Transportation Practice	Q1		Q2		Q3		Q4		Q5		Q6	
	Pre FMD	Post FMD	Pre FMD	Post FMD	Pre FMD	Post FMD	Pre FMD	Post FMD	Pre FMD	Post FMD	Pre FMD	Post FMD
Specialist haulier	13	21	12	15	10	10	12	22	8	18	4	4
Small meat retailer / butcher's vehicle	-	-	-	-	1	1	-	-	-	-	-	-
Vehicles jointly owned with other farmers	-	-	-	-	-	-	-	-	-	-	-	-
Auctioneer's vehicle	-	-	-	-	-	-	-	-	-	-	-	-
Farmer's vehicle	7	0	-	-	-	-	9	0	8	2	2	0
Livestock dealer / Procurement agent vehicle	3	0	3	0	-	-	-	-	1	0	-	-
Abattoir's vehicle	0	2	8	8	10	10	0	1	0	1	0	1
Food retailer's vehicle	-	-	0	0	1	1	-	-	-	-	-	-
Food processor's vehicle	-	-	-	-	1	1	-	-	-	-	-	-
Other Comments	-	-	-	-	-	-	-	-	6	2	17	18

NB: Figures in the table denote the proportion of respondents (total 23) who provided only their favoured and first choice transportation practice.

For farmers, the cost of buying and operating vehicles is a major financial burden as is the length of time it takes to transport animals to and from the auction. Therefore, many farmers transport only small numbers of animals to the auction in their own vehicles and rely instead on local hauliers who have the expertise to transport larger numbers of animals. As such, the quantity of produce finished and ready for sale, influences transportation practice. Some farmers explained that it is not always possible to meet hauliers' minimum specifications and that legislation regarding animal storage during transportation is, in practice, difficult to meet.

"Once you start using hauliers, you have to have quantity, hauliers are not interested in taking 20 lambs, they want 50 lambs. You can predict to a certain extent but at the end of the day, lambs are ready when they are ready".

(Interviewed Farmer)

"Specialist hauliers are the best for animal transportation as farmers' vehicles are not up to scratch"

(Interviewed Specialist Haulier)

During the restricted period when stock was sold to abattoirs via the collection centre, only specialist hauliers' and abattoirs' vehicles were used for liveweight sheep transportation. Every vehicle was required to be disinfected before collecting animals from a farm. Thus, specialist hauliers were collecting animals from farms on an individual basis and transporting them to collection centres only making repeat trips when their vehicles had been cleaned and disinfected. Specialist hauliers seemed more willing and able to carry out such requirements in contrast to farmers who were not able to invest the extra time and money. Specialist hauliers mentioned that a fall in business revenue was initially anticipated as a result of livestock movement restrictions whereas they actually experienced increased revenue.

Question 3 (see column Q3 in Table 7) investigated deadweight transportation that is from the abattoir downstream and more specifically it examined, how are carcasses transported from the abattoir to other fat lamb chain members pre- and post-FMD2001. For the latter, interviewees pointed out that abattoirs' vehicles and specialist hauliers were equally the most popular transportation practice used both pre- and post-FMD2001.

In addition, Questions 4, 5 and 6 (see columns Q4, Q5, Q6 in Table 7) examined interviewees' opinions for the best transportation practices in terms of maximising cost efficiency, management of animal welfare and consumer safety respectively,

in the pre- and post-FMD2001 periods. It is worth stressing that during the examination of Questions 4 - 6, a list of transportation practises was shown to interviewees (these are fully listed under the Transportation Practice column in Table 7) who were subsequently asked to comment upon.

The findings correlate with those from Question 1. Indeed, most chain members explained that specialist hauliers have been the most cost efficient form of livestock transportation post-FMD2001 and most of them felt that this had been the case pre-FMD2001. Additional questioning revealed that this was due to the need to implement extra hygiene management measures in liveweight transportation post-FMD2001.

> "Transportation of livestock from the farm to the abattoir is the most important move in the red meat chain"
> (Interviewed Manager from a Food Processing firm)

> "I would say a specialist haulier is the most cost effective method as long as you can fill a vehicle - wagon. Post foot and mouth, the cleaning of vehicles takes a lot more time, so it will be more cost and time efficient to send animals away with the haulier".
>
> (Interviewed Farmer)

> " Most cost effective way to transport lambs is to collect them at the collection centre for smaller lots. If they are going long distances, it is best to be collected at the collection centre by specialist hauliers for approximately 450 - 500 lambs. It is inefficient to send 20 farmers' vehicles to Wales for 450-500 lambs as an example".
>
> (Interviewed Specialist haulier)

> "There have been major changes with farmers' vehicles post FMD in a vehicle that probably has not been up to the standard and they now use haulier contractors to do the business. First class mode of transport would probably be a specialist haulier".
>
> (Interviewed Auctioneer)

Farmers and specialist hauliers were equally capable of transporting livestock to meet animal welfare management demands prior to FMD2001 (see pre-FMD sub-column under Q5 column in Table 7) and it was argued that there is no difference between these transportation practices on animal welfare management grounds. Post-FMD2001, however, it was felt that specialist hauliers were the best in this respect since they use modern and appropriate vehicles and have the necessary skills and experience to maximise animal welfare during livestock transportation (see post-FMD sub-column under Q5 column in Table 7). In contrast, most farmers use smaller and older vehicles that may not be ideal for livestock transportation, especially over long distances and time periods. The use of trains was also proposed as a possible animal transportation method.

> "Specialist haulier is the best way because they provide bigger vehicles"
>
> (Interviewed Farmer)

> "The train can be cost effective and animal welfare friendly mode of transport as well and for example, Ackerton auction is right off the north east railway line. You can send animals to abattoirs in the south of the country or export them via the tunnel to France. These animals can be in Paris in six hours instead of twelve hours needed via road".
>
> (Interviewed Farmer)

Consumer safety was not seen as an issue during the transportation of livestock. Indeed, most interviewees (17 out of 18, see the pre-FMD and post-FMD sub-columns under column Q6 in Table 7) opined that only when the animal is dead, does it become a consumer safety concern. Such findings contrast with popular suggestions that consumer safety is a concern from "farm to fork".

" Food risk is not an issue while the animals are alive; it is when it is dead. The animals have to be healthy to be moved from the farm"

(Interviewed Auctioneer)

Questions 7, 8 and 9 (see columns Q7, Q8 and Q9 in Table 8) examined interviewees' opinions on the optimum location for an auction in terms of cost efficiency, animal welfare and consumer safety, respectively, for the pre- and post-FMD2001 periods. Questions 10,11 and 12 (see columns Q10, Q11 and Q12 in Table 8) examined interviewees' opinions on the optimum location for an abattoir in terms of the same variables, i.e. cost efficiency, animal welfare and consumer safety, respectively, for the pre- and post-FMD2001 periods. A list of possible locations was shown to the interviewees (these are fully listed under the Possible Location column in Table 8) who were subsequently asked to comment upon.

Thus, Table 8 summarises the findings in relation to the optimum location for the auction and abattoir, pre- and post-FMD2001.

Table 8: Empirical research findings for auction and abattoir location in the fat lamb chain (pre-post FMD2001)

Possible Location	Q7		Q8		Q9		Q10		Q11		Q12	
	Pre FMD	Post FMD	Pre FMD	Post FMD	Pre FMD	Post FMD	Pre FMD	Post FMD	Pre FMD	Post FMD	Pre FMD	Post FMD
Close to farms	11	14	16	16	2	2	5	7	6	6	2	2
Close to auction	-	-	-	-	-	-	13	16	17	17	2	2
Close to abattoirs	7	9	7	7	3	3	-	-	-	-	-	-
Close to livestock dealers	1	0	-	-	-	-	-	-	-	-	-	-
Close to major retailer	2	0	-	-	-	-	2	0	-	-	1	1
Close to food Processor	1	0	-	-	-	-	2	0	-	-	-	-
Close to small meat retailer	1	0	-	-	-	-	1	0	-	-	-	-
Close to farmers' markets	-	-	-	-	-	-	-	-	-	-	-	-
Other Comments	-	-	-	-	18	18	-	-	-	-	17	17

NB: Figures in the table denote the proportion of respondents (total 23) who provided only their favoured and first choice location.

Findings highlighted that pre-FMD2001, the most cost effective location for an auction was close to the source of production since this reduces livestock transportation costs which are significant in the food chain (see Pre-FMD sub-column under Q7 in Table 8). Post-FMD2001, this was seen to generally be the case but some further support was shown for auctions being located close to abattoirs (see Post-FMD sub-column under Q7 in Table 8) as they were historically in UK. Many farmers explained that in the past, auctions and abattoirs were located close to each other in town centres. Such statements were countered by suggestions that inner city and town centre traffic congestion would now make this a less effective option and there were calls for auctions to be located close to road networks to minimise transportation costs.

"Auctions need to be close to source of production / farms. Farmers take them in small numbers such as 20s or 30s and the abattoir takes them in 400s. It is much simpler for a farmer to take 40 into a local auction and an abattoir to load them on a big wagon-vehicle and take them in 400s rather than farmers travelling miles with only 40s"

(Interviewed Farmer)

"Auctions are not cost effective for finished stock. If they were going to be used for still stock, I would suspect they need to be close to farms".

(Interviewed Manager from a Food retailer)

"I would say the ideal auction is at Carlisle. There is an abattoir within reach that is perfect. It is on the M6 motorway and you can get there to anywhere".

(Interviewed Farmer)

Regarding animal welfare pre- and post-FMD2001, most interviewees felt that auctions need to be located close to farms since this would reduce animals' potential stress during transportation (see Pre- and Post-FMD sub-columns under Q8 in Table 8). Moreover, few farmers questioned the role of the auctions in terms of animal welfare.

"The ideal way based on animal welfare grounds, is to put animals on the vehicle at the farm, drop it off at the abattoir and miss the auction out. But it is not the fairest as you haven't got any competition and the auction will get a good price for your stock".

(Interviewed Farmer)

The majority of the interviewees (18 out of 23) opined that there was no relationship between auction location and consumer safety both pre- and post

FMD2001 (see Pre- and Post-FMD sub-columns under Q9 in Table 8). Again, this reveals that consumer safety is a matter of concern only for the deadweight chain.

Another examined area was the relationship between abattoir location and cost efficiency and most interviewees suggested that abattoirs should generally be located close to auctions or farms. Post-FMD2001, though, all interviewees recommended that abattoirs should be more closely linked with farms and live auctions (see Pre- and Post-FMD sub-columns under Q10 in Table 8).

> " In the past, abattoirs were very close to the auctions. Darlington was a prime example, the abattoir was right next door"
>
> (Interviewed Farmer)

One interviewee representing a multiple retailer remarked that it would be cost efficient to bring abattoirs, auctions and farms geographically closer to each other to reduce transportation costs. He mentioned that vehicles have the capacity to transport a larger volume of carcasses rather than live animals, a view also expressed by a specialist haulier.

> "Based on cost efficiency, the location of the abattoir should be close to farms as it reduces the cost of transport. But depending on where the abattoir is to be, it has to be reasonably cost effective to move the dead animals from the abattoir to the next chain member. In general, you can get a lot more carcasses- dead meat on a lorry than live animals".
>
> (Interviewed Manager from a Food Retailer)

In contrast, a farmer explained that it is not always realistic to expect abattoirs to be located close to auctions. He gave the example of the livestock auction at Barnard Castle which is located in the town centre and is opposed by local inhabitants who will not welcome an abattoir at the same site. Many interviewees

commented on the role of abattoirs and auctions in relation to specific issues such as competition and type of livestock.

> "If there are plenty of abattoirs for farmers to go then the competition will be there, I can foresee that being fine. But if you are allowed to move to one abattoir in an area, it will be a disaster. Auctions will be for breeding stock but not for fat - finished stock".
>
> (Interviewed Farmer)

Regarding the relationship between animal welfare management and abattoir location, most interviewees noted that abattoirs should be located closer to auctions rather than closer to deadweight chain members (including food processors and multiple retailers). They also suggested abattoirs to be close to farms to reduce animal stress (see Pre- and Post-FMD sub-columns under Q11 in Table 8). This is in line with findings relating to cost efficiency.

> "For getting the animal from the auction to slaughter, the nearer the auction is to abattoir the better it is for the animal, no doubt about it".
>
> (Interviewed Farmer)

> "Taking animals from Northumberland down to Anglesey (south of the country) on the vehicles, being slaughtered and then brought back to Midlands to a retailer's regional distribution centre and then back to Tesco Kingston Park at Newcastle is just madness and definitely, not an animal friendly practice"
> (Interviewed Farmer)

Finally, it was generally agreed that consumer safety management is not affected by abattoir location especially since modern chilled transportation is readily available (see Pre- and Post-FMD sub-columns under Q12 in Table 8).

"It does not matter when it is dead; via frozen transportation,
a carcass can be moved everywhere".
(Interviewed Manager from a Small Retailer)

From the above, it can be reasonably concluded that both auctions and abattoirs need to be located closer to livestock producers and that close linkages are required between livestock auctions and abattoirs. This was historically the case when auctions and abattoirs were based in the same geographical area as for example in Carlisle and Darlington. Such a scenario was supported by liveweight and deadweight chain members regardless of the fact that, currently, food retailers source meat from large abattoirs located far away from the source of production or even the auctions. This is a particular challenge to integration within the north east fat lamb chain since there are no major abattoirs in the region and livestock is transported to large abattoirs in neighbouring counties (e.g. Yorkshire, Cumbria) or the south of England.

6 CONCLUSIONS AND RECOMMENDATIONS

Post-FMD2001, supply chain members perceived to be a need for improved integration of physical - product and information transactions and flows between the liveweight and the deadweight supply chain and more specifically, for the auctions and abattoirs to be located closer to each other and the source of production. Such suggestions were defended on cost efficiency, animal welfare and consumer safety grounds that are major concerns to the UK food and farming industry at the present time (Curry, 2002; Institute of Grocery Distribution, 2002). Such a supply chain structure and composition would encourage, permit and develop information dissemination between its members so that they think, communicate, collaborate and act in a co-ordinated alliance with one another. The National Sheep Association called for this in their strategy as a fundamental element of the future of the UK sheep industry (MLC, 2001b). In our opinion, such integration would provide a shorter and more transparent fat lamb supply chain predicated upon a two-way flow of information between its members and culminating in a truly end market demand oriented and therefore, more efficient supply chain.

Furthermore, prior to FMD2001, it was considered that the traceability mechanisms used in and by the UK fat lamb supply chain were insufficient and inefficient, resulting in an unsustainable, complex and fragmented supply chain. Current demands on the food and farming industry require that such complexity needs to be eliminated to allow for the development of a more transparent chain. Indeed, the implementation of more effective identification and traceability mechanisms and measures was highlighted in the National Sheep Association's sector strategy (see MLC, 2001b) and such mechanisms have also been introduced to the industry post-FMD 2001.

The current high profile of and support for local food procurement is another factor likely to affect the structure and organisation of food supply chains. Whilst such activity has been a concern for a number of years, it has received much support post- FMD2001, primarily as a result of the Policy Commission report (for example, see Curry, 2002). The research reveals that the interviewees consider the establishment of abattoirs close to auctions and the source of production to be a fundamental way to underpin the sustainable development of such local food supply chains. In this way, multiple retailers might buy from abattoirs and send products directly to geographically proximate stores without using regional distribution centres that result in extra food miles. Procurement from abattoirs located close to the source of production and point of sale of the live animals would increase deadweight transportation that was suggested to be more cost effective. It would also reduce livestock transportation which was a key aspect of the fast and wide spread of FMD in the UK in 2001.

Clearly such recommendations are founded upon the perceptions of a small number of fat lamb supply chain members primarily located in the northern region of the UK. They do however provide postulates and hypotheses that may be tested by future research. Work to evaluate and validate these postulates and hypotheses may include, for example, a study of the feasibility of creating more abattoirs, located closer to the sources of livestock production.

Considering that the abattoir sector currently has excess capacity, there is an urgent need for such work to explore the viability of this suggestion, particularly in counties which finish sheep. Such developments are also likely to increase deadweight selling which is currently lower in the fat lamb supply chain compared to other livestock supply chains.

Live auctions would still be required to maintain a competitive market for breeding ewes and store animals. For the latter, Fearne (1998a) has suggested that live auctions are an alternative selling point to farmers who face difficulties in meeting the needs of multiple retailers. In sum, we would conclude that there is a need for a thorough and strategic reassessment of the role and contribution of auctions to the livestock industry. This will also underpin an efficient and effective stock transfer system between hill and lowland farms for replacement and store stock and for the sale of finished stock to the end customer. This reassessment should be in line with the one proposed earlier for abattoirs and merits further research in other English counties that were affected by FMD2001 and which have a substantial number of abattoirs, auctions and sheep farmers, for example, Cumbria and Yorkshire. Such research could also consider the socio-economic impact of livestock supply chain restructuring upon more remote agricultural communities in the northern region that are dependent on auctions as a mainstay of the local community. Live auctions are an important element of the rural environment (Lowe *et al.,* 2001) notwithstanding the need to be better regulated (Haskins, 2001).

In addition, the implementation of the 20 day rule obliges supply chain members to reassess their activities in the supply chain. Post-FMD2001, livestock dealers were seen to become suppliers and users of information between farmers, abattoirs and the rest of the supply chain rather than being engaged in the actual physical transportation which was their prime activity pre-FMD2001. In this way, livestock dealers can work more closely with live and electronic auctions that have the experience and the expertise to manage information dissemination notwithstanding the fact that more effective control is needed over livestock dealers (Lowe *et al.,* 2001).

Furthermore, specialist hauliers have been perceived to be the most appropriate providers for live and dead animal transportation in terms of cost efficiency, management of animal welfare and consumer safety.

The Red Meat Industry Forum was also established post-FMD2001 (in March 2002). It is a partnership comprised of the National Farmers Union, the Department of the Environment, Food and Rural Affairs, the Institute of Grocery Distribution and the Meat Livestock Commission. It aims to improve the structure, conduct and performance of the red meat industry (see Institute of Grocery Distribution, 2002). In view of the above, it is apparent that many UK fat lamb supply chain members consider it crucial for the structure, conduct and performance of that supply chain to be examined. Such a need is perhaps related to the fact that the fat lamb supply chain has several characteristics that are not present in other food supply chains. These characteristics include, *inter alia*, the seasonality of production, the dependencies between hill and lowland farmers, the strong preference by farmers for using live auctions and the considerable amount of liveweight sales.

As the findings were based on a representative sample of fat lamb supply chain members from the north east of England, further analysis in other regions is required to strengthen the validity of these findings and to gain an impression of the national circumstances. Further research is also required to identify and evaluate the future roles of fat lamb supply chain members post-FMD2001. Information dissemination is essential for the future success of that supply chain and many members can take up that role. However, the user of that information needs to be regulated and monitored as opportunistic practices may arise. Finally, future research is recommended for the transportation function that can probe the possible creation of a 4^{th} party logistics network in the fat lamb supply chain,

where the specialist haulier will be a key participant (see Bourlakis and Bourlakis, 2002 for 4th party logistics networks in food retail logistics).

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