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Case studies of spent hens and lambs, using newly developed calculation model

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A calculation model has been developed to compare transport of live animals with transport of meat on several sustainability aspects. The method has been applied to spent hens transported alive from the Netherlands to Poland and to lambs transported alive from Hungary to Italy.

Key words: calculation model, live animal transport, meat transport, transport costs, slaughter costs, animal welfare, emissions.

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Preface

Eurogroup for animals asked Wageningen Economic Research to develop a calculation model to compare the sustainability of live animal transport with transport of meat. This model was applied to two cases: (1) spent hens transported from the Netherlands to Poland and (2) lambs transported from Hungary to Italy.

Our special thanks go to Peter van Horne, Dora Lakner, Attila Németh, Claudio Montanari, and Kees de Roest for collecting the data. Many other respondents preferred to remain anonymous. Nevertheless, we are grateful for their willingness to provide information about these value chains and for helping to collect the necessary data. Wageningen Economic Research is responsible for the data used and the conclusions drawn.

The report focuses on the available scientific and other factual information and the content of the report is independent of its funding.

Prof.dr.ir. J.G.A.J. (Jack) van der Vorst
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Summary

S.1 Results

A calculation model was developed to compare the sustainability of transport of live animals with the transport of meat. The model takes into account transport costs, slaughter costs, costs related to technical differences, costs of emissions of CO_2, consumer preferences, animal welfare and employment.

The model was applied to two cases: spent hens transported from the Netherlands to Poland and lambs transported from Hungary to Italy.

The results of the calculation model show that the transport of spent hens from the Netherlands to Poland is cost efficient because of the huge differences in wages at slaughter between these countries. This aspect alone makes a difference of 52 eurocents per kilogram of meat. However, slaughtering these animals in the Netherlands is preferable from the perspective of animal welfare, transport costs, and environment. **See 3.1>**

The results of the calculation model show that the transport of lambs from Hungary to Italy is not cost efficient. From several perspectives (economy, animal welfare, transport costs, environment) it would be better to slaughter these lambs in Hungary. **See 3.2>**

S.2 Method

What are the sustainability effects of long-distance transport of live animals for slaughter in comparison to the long-distance transport of meat from these animals? In the case of long-distance transport of meat, the animals are slaughtered in the country of origin followed by meat transport to the country of destination. **See 2.1 >**

To answer this research question a calculation model in excel was developed. For developing the calculation model, existing models and literature were used. **See 2.3 >**

Input data for this model was gathered with questionnaires to actors in the supply chains. **See Appendix 1 >**

1 Introduction

In this chapter we will provide a short background regarding the sustainability aspects of transport of live animals and describe the aim of the research. The chapter ends with a readers' guide.

1.1 Background

Within the European Union (EU), regional production of meat is not equal to regional consumption. This is one of the underlying reasons for intra-community trade of meat and live animals between Member States. Within the EU millions of live farmed animals are transported from one to another Member State every year. Many of these animals are transported over long distance with long transport time. In 2007, the transport time of almost 7.5 million transported animals (i.e. sheep, pigs, cattle and horses), which account for 41% of all transported animals within the EU, exceeded eight hours. Meanwhile, the transport time of 1.2 million animals, which account for 6% of all transported animals, exceeded 24 hours (Baltussen, Spoolder, Lambooij, & Backus, 2009). The transport of farmed animals has for many years been a major concern of animal welfare movements and of the general public. EU legislation to address these concerns has been in place since 1991, and has been revised several times. Currently, Council Regulation (EC) No 1/2005 is the EU's legislative core for animal welfare during movements of live animals between Member States. It sets minimum requirements for fitness for transport, loading densities, journey and resting times, availability of water and feed, the truck, transport organisation, and driver. If traveling time exceeds 24 hours for pigs or horses, and 29 hours for cattle or sheep, a stop at a so-called control post is mandatory. This is a location approved by the competent authorities where animals are unloaded, receive food and water, and can rest for 24 hours before the journey continues. Council Regulation (EC) No 1255/97 sets minimum requirements for such control posts. However, EFSA, NGO and Commission reports showed that animal welfare infringements during live animal transport still exist even after the implementation of these Regulations (EFSA, 2011). Moreover, throughout the years, several reports produced by important scientific bodies and committees, such as the Federation of Veterinarian of Europe (FVE, 2008), the European Food Safety Authority (EFSA, 2011 and 2004), the Food and Agricultural Organisation (FAO, 2002), World Organisation for Animal Health (OIE, 2015 and 2009), and the Scientific Committee for Animal Health and Welfare (SCAHAW, 2002) have clearly shown that long-distance transport of live animals for slaughter should be phase out not only due to animal welfare problems, but also due to public health and food security risks.

Furthermore, fossil fuel-based transport is an important contributor to global emissions affecting climate. Transport has contributed 15% and 31% of the total man-made carbon dioxide (CO_2) and ozone (O_3) forcing respectively, with road transport as the largest contributor (Fuglestvedt et al., 2008). Thus, long-distance transport of live animals has several drawbacks.

As a potential alternative to long-distance transport of live animals for slaughtering, we consider the transport of meat of these animals. Animal welfare issues during long-distance transport of live animals would not exist without long-distance transport. Potentially, meat can be loaded more densely in a truck than animals, lowering the number of movements required for the same amount of meat. However, currently, many live animals are transported over long distances, indicating advantages for companies that do so. A sustainable approach to bring regional production of meat in equilibrium with regional consumption should simultaneously consider the advantages and disadvantages on multiple sustainability indicators of both long-distance transport of live animals to an abattoir abroad and local slaughter followed by long-distance transport of their meat.

1.2 Aim of the research

The sponsor of this project is the Eurogroup for Animals. Eurogroup for Animals wants to investigate if the Regulation (EC) No 1/2005 on the protection of animals during transport and related operations and amending Directives met its main objectives as well as what impact the practice of long-distance transport of live animals has on the environment. To meet this goal the analysis should have been carried out with a view on how to come to a transition towards a sustainable, economically viable and higher welfare approach to moving animals between their place of production and the abattoir. Eurogroup for Animals' objective is to evaluate if the transport of meat or carcasses instead of live animals is more sustainably transported on specific routes: (1) Spent hens transported from the Netherlands to Poland, and (2) sheep transported from Hungary to Italy.

To compare the sustainability of meat transportation with the live animal transportation, this study has developed a model that quantitatively estimates the advantages and disadvantages of long-distance transport of live animals for slaughter compared to local slaughter followed by transport of their meat on different sustainability indicators. Relying on the previous studies (e.g. Baltussen et al., 2009; Baltussen et al., 2010), we used the following sustainability indicators:

- Transport costs
- Slaughter costs
- Animal welfare
- Environmental impact (CO2 emissions, NOx- emission);
- Employment and other social effects.

We applied this model to two cases (spent hens for slaughter transported alive from the Netherlands to Poland and lambs for slaughter transported alive from Hungary to Italy).

These study responses to two main research questions:

1. What model can we use to measure or estimate the sustainability of long-distance transport of meat/carcass vs. transport of meat?
2. What is the outcome of the model if applied in two cases: 1) transport of spent hens for slaughter from the Netherlands to Poland, and 2) transport of lambs for slaughter from Hungary to Italy?

1.3 Readers' guide

In Chapter 2, the two scenarios (1) long-distance transport of live animals to an abattoir in another country, and (2) local slaughter followed by long-distance transport of the meat of these animals are defined and the calculation model is described. This chapter ends with a description of the data collection and assumptions made for the cases in the calculation model. In Chapter 3 the results regarding the sustainability of two cases are described. Chapter 4 contains a short discussion of the results and the main conclusion of the research.

2 Model

This chapter describes the model developed in the study. First, the possible two scenarios are explained, followed by the case selection and study design. The section concludes with a model description, data collection, and assumptions.

2.1 Scenarios

Several brainstorming sessions were conducted among a group of experts at Wageningen Economic Research to identify the scope of the study. Two European countries were taken as conceptual examples, assuming that the transport takes place from country 1 to country 2. Two research scenarios were defined: (1) long-distance transport of live animals raised in country 1 to an abattoir in country 2, and (2) local slaughter in country 1 of the animals raised in country 1 followed by long-distance transport of the meat of these animals to country 2 (Table 1). In both scenarios, the model starts at a farm/assembly centre in country 1 and ends at the fresh meat distribution centre or meat processing industry in country 2. To enable sound comparison between the scenarios, we assumed that start points, end points, and routes were the same in both scenarios. This assumption ignores any other options, such as exporting to a third country, including the country from where the live animals have been originally transported.

Table 1 *Research scenarios regarding long-distance transport of live animals compared to long-distance transport of meat*

Route code	From	To
Scenario 1		
A(LA)	Farm/Assembly centre in country 1	Slaughterhouse in country 2
B.1(M)	Slaughterhouse in country 2	Fresh food distribution in country 2
B.2(M)	Slaughterhouse in country 2	Processing in country 2
Scenario 2		
A'(LA)	Farm/Assembly centre in country 1	Slaughterhouse in country 1
B.1'(M)	Slaughterhouse in country 1	Fresh food distribution in country 2
B.2'(M)	Slaughterhouse in country 1	Processing in country 2

LA - live animal; M - meat.

In Table 1, A(LA) indicates the route of the live animal transport in scenario 1. This includes the long-distance transport from a farm/assembly centre in country 1 to a slaughterhouse in country 2 (so including slaughter). B.1(M) indicates the route of meat transport from a slaughterhouse in country 2 to a fresh food distribution centre in country 2, such as a supermarket. Similarly, B.2(M) indicates the route of meat transport from a slaughterhouse in country 2 to a meat processing company in country 2. Whereas, A'(LA) indicates the route of live animal transport within country 1 from a farm/assembly centre to a slaughterhouse including slaughter in scenario 2. B.1'(M) indicates the route of meat transport from a slaughterhouse in country 1 to a fresh food distribution centre in country 2, and B.2'(M) to a processing company in country 2.

2.2 Model description

The partial budgeting approach was used to estimate the costs and environmental impact. This approach is based on the principle that a small change can eliminate or reduce some costs, eliminate or reduce some returns, cause additional costs to be incurred and cause additional returns to be

received. The net effect of the change is the sum of the positive economic impact minus the sum of the negative economic impact (Dijkhuizen & Morris, 1997). A deterministic calculation model was developed in MS-Excel. The model compares the value of each indicator between the two scenarios based on the assumption that in both scenarios 1,000 kg of fresh meat arrives at the fresh market or at the processing in the country 2. The final weight at arrival considers weight loss during transport, dead on arrival, and the percentage of seriously wounded. The model has the following sections: input data for long-distance transport of live animals, input data for long-distance transport of meat, additional input data, calculations for long-distance transport of live animals, calculations for long-distance transport of meat, output with total estimated economic, social, and environmental effect. The following indicators were used in the model to explore the sustainability of long-distance transport live animals and long-distance transport of meat: Transport and slaughter costs, animal welfare, environmental impact (CO_2– and NO_x-emissions), social effects (employment, and consumer preferences). Below we present a short description of the input variables used in the model per route. A detailed description can be found in Appendix 1.

Transport and slaughter costs

The costs in scenario 1 are grouped into:

1. Transport costs of live animal transported with trucks over long distance from country 1 to country 2;
2. Slaughter costs in country 2;
3. Transport costs within country 2 of transport of carcasses to fresh food retail or processing company.

The costs in this scenario 2 are grouped into:

1. Transport costs of live animals from a farm in country 1 to a slaughterhouse in country 1;
2. Slaughter costs in country 1;
3. Transport costs of carcases in refrigerated trucks from country 1 to country 2.

Transport costs include the depreciation, maintenance, and interest costs of the trucks, fuel costs, drivers' costs, costs of control post(s), cleaning and disinfection costs, toll, animal health and animal welfare control costs, and animal health certificate costs. Slaughter costs are expressed in euro per kilogram slaughter weight. Economic impacts of technical aspects such as weight loss of animals, % animals wounded, and % of animals dead on arrival are included in the model. See Appendix 1 for all input variables of the calculation model.

The following equation was used to calculate the total costs in a scenario:

$$C = \sum Tl + S + Tshort$$

Where

C	=	total costs.
Tl	=	transport cost for the long distance. This includes depreciation, maintenance, and interest costs of the truck, costs at control posts (including salary of the driver for the extra hours), fuel costs, salary costs of the driver(s), toll, animal health certification/notification/welfare check costs for export, costs related to technical aspects, and costs of cooling/heating system on the truck.
S	=	slaughter costs.
$Tshort$	=	transport cost for the short distance. This includes depreciation, maintenance, and interest costs of the truck, fuel costs, salary costs of the driver(s), costs related to technical aspects, and toll.

Animal welfare

Several aspects of animal health and welfare, such as DOA (dead on arrival), broken bones/sick on arrival, and loss of weight after the transport of live animals, have been considered and quantified. However, not all aspects of animal health and welfare could be assessed and quantified. Therefore, a narrative literature study has been conducted to discuss the impact of deprivation of food and water, injuries, and environmental circumstances on animal health and welfare qualitatively.

Environmental impact
Environmental effects refer to CO_2- and NO_x-emission as a result of the transport. Additionally, the waste and by-product treatment have been considered when comparing the two scenarios.

Employment and other social effects
Within social effects, first we considered the change of employment in slaughterhouses when applying one or the other scenario. In scenario 1, animals are slaughtered in country 2, whereas in scenario 2 they are slaughtered in country 1. The consequences on labour need in the slaughterhouses in the countries should be considered when comparing the two scenarios. For this we have used a qualitative analysis.

The second indicator is the structure of the meat industry in terms of the easiness to adapt slaughter capacity to changed animal movements in the short run.

The third indicator is the consumer perceptions. The consumer perceptions or preferences are expressed in the price of the distinguished end products (meat of animals slaughtered in country 2 versus meat of animals slaughtered in country 1).

2.3 Application of the model to the cases

The model developed has been applied to two cases:
1. Transport of spent hens for slaughter from the Netherlands to Poland,
2. Transport of lambs for slaughter from Hungary to Italy.

2.4 Data collection for two cases

Data were collected from various sources. First, the publically available literature (see Bibliography) was screened for the relevant issue at stake, and to find objective evidences reported by others. Second, interviews were conducted using the tailor-made questionnaire for each case (see Appendix 3). Interviews were held by telephone and in person. For the case transport of spent hens from the Netherlands to Poland, a questionnaire was used to interview a Dutch farmer, a transport company and a slaughterhouse to get data and information about transport and slaughtering of spent hens. For the case transport of live lambs from Hungary to Italy, a questionnaire was used to interview Hungarian lamb exporters and Italian slaughterhouses. Presently, only two small slaughterhouses exist in Hungary which are not able to slaughter all the lambs produced in Hungary. The following people were interviewed in Italy: a slaughterhouse and transporter. Appendix 3 provides the results of the questionnaires. In addition to the data gathered using questionnaires, scientists working on animal welfare indicators in the EU projects control posts 1 and control posts 2 (see http://www.controlpost.eu/joomla/index.php/en/) and scientists working in the project 'good and best practices for animal transport' were interviewed.

When developing the model, the following assumptions were made:
1. The costs of own truck is used instead of the costs of a hired truck.
2. We assumed no loss of meat quality during transporting chilled or frozen meat (Scenario 2).
3. The storage life (expiration date) of fresh meat is shorter (by duration of transport) in Scenario 2 than in Scenario 1, most probably increasing the food waste. Nevertheless, we assumed no difference in meat quality (see also Knowles and Broom, 1990) or in price.
4. The same type of slaughterhouse is used in both countries. This means that the same labour input for slaughtering (labour efficiency) is used in both scenarios.

Besides using interview data, transport costs were estimated using the 'Transport of Animals and Meat' (TRAM) model (Baltussen et al. 2010). TRAM is a mathematical programming model to estimate the costs of live animal transport. The input data used in the developed model are presented in Appendix 2.

3 The model applied to two cases

The results of the case transport of spent hens from the Netherlands to Poland are presented in section 3.1, and those of the case transport of lambs from Hungary to Italy in section 3.2.

3.1 Case 1: Transport of spent hens from the Netherlands to Poland

Scenario 1 represents the current practice, while scenario 2 represents a conceptual option. Spent hens are generally transported for slaughter at the end of one laying cycle at 72 weeks of age (Knowles, 1994). Annually, approximately 5.5 million spent hens are transported from the Netherlands to Poland. Road accidents and incidences, such as frozen hens at arrival, high number of dead on arrival, and a large number of hens arriving with injuries have increased concern of various groups to consider alternative options (Steendijk and Kampmann, 2014; NVWA, 2016). In the alternative scenario 2, hens are slaughtered in the Netherlands followed by the transport of their meat to the Polish market. Table 2 presents the results of the comparison of the scenarios according to the developed model (Section 2.3).

Table 2 *Comparing scenario 1 'transport of spent hens from the Netherlands for slaughter in Poland' with scenario 2 'slaughter of spent hens in the Netherlands followed by transport of their meat to Poland' a)*

Indicators	Unit	Scenario 1	Scenario 2	Difference
Costs				
Total costs	€ per kg meat in Poland	**0.88**	**1.20**	**0.32**
Among which				
Transport costs	*€ per kg meat*	*0.32*	*0.04*	*-0.28*
Slaughter costs	*€ per kg meat*	*0.55*	*1.07*	*0.52*
Transport costs after slaughter	*€ per kg meat*	*0.01*	*0.09*	*0.08*
Animal welfare				
Broken bones/sick on arrival	%	**0.9**	**0.9**	**0**
Dead on arrival	%	**0.4**	**0.15**	**0.25**
Environmental impact				
CO_2	gram per kg meat	**175.5**	**93.9**	**81.6**
Diesel use	litre per kg meat	**0.07**	**0.04**	**0.03**
NO_x	gram per kg meat	**0.66**	**0.35**	**0.31**
Social impact				
Employment b)	Number of full time employees		**-25 in Poland +25 in the Netherlands**	**0**
Structure of slaughter capacity	Slaughter capacity	**Sufficient capacity**	**Sufficient capacity**	**no bottleneck**
Consumer preferences				**No difference in quality**

a) The option that the meat is marketed in the fresh meat market (Route B.1) was ignored, because spent hens are used only frozen in the processing industry;

b) Employment is calculated considering that 5,5 million spent hens for slaughtering per year are currently exported to Poland.

Transport and slaughter costs
Regarding the costs, Table 2 shows that the costs per kilogram poultry meat are €0.32 higher in scenario 2 than in scenario 1. This was caused by the €0.52 per kg higher slaughter costs in the Netherlands. The total transport costs are in scenario 2 €0.20 per kg lower than in scenario 1. However, this cannot compensate the higher slaughter costs.

Animal welfare
The welfare of live animals is being challenged by various factors during long-distance transport to the slaughterhouse in scenario 1. These factors, among others, are: deprivation of food, often also water, injuries caused by catching and loading, and environmental circumstances during transport.

Prior to transport, end-of-lay hens are being deprived of food, but not of water. Not having food before long-distance transport prevents excessive soiling in the crates. Dutch research indicates that on average hens are deprived of food about 18 hours before the short distance transport (Niekerk et al., 2014). If the transport time is between 1 and 10 hours, hens do not receive food from 19 to 28 hours before the transportation. The research on effects of food deprivation shows that the first 24 hours of deprivation are the most stressful hours for the hens.

During the transport, birds with broken bones suffer from pain, are not able to stand up and reach water supply, are stepped upon by other birds, and are prone to die during transport. Nevertheless, the results show that the percentage of hens arriving sick or with broken bones at the slaughterhouse were the same in both scenarios. Spent hens with restricted movement tend to have an unusually fragile skeletal system (Whitehead and Fleming, 2000). Catching and loading can cause injuries to the hens. Such hens have higher risk of bruises and breaking bones when handled. Therefore, injuries and bruises mainly occur during the removal of the hens from their cages, and placing them in the crates, and during loading and unloading the truck. Knowles and Broom (1990) have found that crating and transportation has the same effect on the hens (plasma corticosterone levels) as crating alone. Thus, removing the hens from their cages, human contact, crating, and replacing in the trucks has the most traumatic effect on hens causing bone breakage and bruises.

During transport, spent hens are confined to the limited space in the crates. For shorter transports, no water is supplied. For longer transports, water supply is obligatory, and usually realised by nipple drinkers that are brought from one side into the crates. Although a lower stocking density in the crates would make it easier for hens to move to the nipple drinker, it could be a disadvantage in terms of environmental temperature. As end-of-lay hens often have feather damage, they are more susceptible to low temperatures. Especially during transport in winter time climate in the crates can drop to temperatures below their comfort zone. Weeks et al. (1997) advises temperatures of 22-28°C for end-of-lay hens during transport. When a truck is driving during winter time, the temperature will most likely be below 22°C. Despite the fact that higher stocking density helps the birds maintain their body temperature, it also prevents them from reaching the nipple drinker.

The number of hens dead on arrival was higher when transported to the slaughterhouse in country 2 (relatively longer distance), compared to transporting to slaughterhouse in country 1. Dead on arrival mainly occur due to extremes of temperature and humidity occurring within the load (Knowles, 1994; Petracci et al., 2006).

Environmental impact
Regarding the environmental impact, Table 2 shows that diesel use, CO_2, and NO_x emissions were about 85% higher in the case of long-distance transport of animals compared to long-distance transport of meat. This was because one consignment with a truck carries about five times more meat when carrying carcasses than when carrying live animals. This was partly compensated by a refrigerated truck using about 20% more diesel than a truck transporting live animals.

Employment and other social effects
Regarding the social impact, we notice a shift of employment for 25 full-time employees from Poland to the Netherlands when switching from scenario 1 to scenario 2. This is associated with the labour in the slaughterhouses.

Regarding the structure of the slaughter capacity for spent hens, enough slaughter capacity exists in the Netherlands as well as in Poland. Thus, both scenarios are technically possible within a short run. Long-distance transport could have impact on the freshness of the meat, which could shorten the shelf life if sold in supermarkets. However, the freshness becomes irrelevant if the meat is transported frozen. This is the case of spent hens meat which is exported frozen to Africa. Therefore, consumer preference is not a factor that impacts our assessment of spent hens.

Conclusion
Scenario 1 (long-distance transport of spent hens from the Netherlands to slaughter in Poland) is not sustainable from animal welfare, animal health and from environmental perspective, with increasing risks of bruises, broken bones, stress, dead on arrival as well as higher CO_2- and NOx- emission. It must also be taken into account that, due to a lack of data, not all the animal-welfare aspects were considered and that the health of the animals transported as well as of other animals as a result of any extra risk of transmission of pathogens linked with animal movement, was not assessed and quantified.

From a social cost-benefit analysis perspective it can be concluded that the long-distance transport of live hens from the Netherlands to Poland is beneficial only from a cost perspective given the aspects taken into account.

Considering all aspects of sustainability it is impossible to arrive to one conclusion, in economic sense the transport of live animals is sustainable and in environmental and animal welfare sense not.

3.2 Case 2: Transport of lambs from Hungary to Italy

Scenario 1 in Case 2 represents the current practice, while scenario 2 represents a conceptual option. In Hungary, sheep breeding has a long-standing tradition and a unique status in livestock farming. After the change of regime and privatisation in 1990, the state-owned slaughterhouses were sold to Italian companies. Shortly after privatisation, the Italian partners closed all the slaughterhouses in Hungary. Only two small slaughterhouses with low capacity are currently operating in Hungary. Currently, Hungary does not have sufficient slaughter and processing capacity for all sheep produced and the majority of the stock (80-90%) is being exported alive to be slaughtered and processed abroad. The livestock farming of sheep in Hungary produces almost exclusively one product, lamb. In 2015, about 573.000 lambs were exported through 2300 consignments (Traces, 2015), 90-95% of which was transported to Italy. This means that Hungary is currently exporting 80-90% of his jobs related to the slaughtering of lambs outside its borders. It would be by implementing scenario 2 that these jobs could be created, and unemployment rates would decrease in Hungary.

Table 3 presents the results of the comparison of the scenarios according to the developed model (Section 2.3).

Table 3 *Comparing scenario 1 'transport of lambs from Hungary for slaughter in Italy' with scenario 2 'slaughter of lambs in Hungary followed by transport of their meat to Italy'*

Indicators	Unit	Scenario 1	Scenario 2	Difference
Costs				
Total	**€ per kg meat in Italy**	**1.16**	**0.67**	**0.49**
Among which				
Transport costs	*€ per kg meat*	*0.44*	*0.10*	*0.34*
Slaughter costs	*€ per kg meat*	*0.69*	*0.51*	*0.18*
Transport costs	*€ per kg meat*	*0.02*	*0.07*	*-0.05*
Animal welfare				
Broken bones/sick on arrival	%	**0.5**	**0.05**	**0.45**
Dead on arrival	%	**1.0**	**0.05**	**0.95**
Environmental impact				
CO_2	gram per kg meat	**256**	**148**	**108**
Diesel use	litter per kg meat	**0.07**	**0.04**	**0.03**
NO_x	gram per kg meat	**0.96**	**0.55**	**0.41**
Social impact				
Employment	Number of full time employees		-20 in Italy and + 20 in Hungary[1]	
Structure of slaughter capacity	Slaughter capacity		No slaughter capacity available in Hungary	

Note: The option that the meat is being utilised in the processing industry is ignored, as the meat is consumed only as fresh.

Transport and slaughter costs

As Table 3 shows, the transport of live lambs from Hungary to Italy has the disadvantage that the total costs of slaughter and transport is about €0.49 per kg meat higher compared to the transport of the same amount of meat of lambs from Hungary to Italy.

Animal welfare

Regarding the animal welfare issues, in general, animal transport has impact on stress levels and induces risks for animal welfare. Faulty design of accessories in the trucks, such as gaps between the inner wall and hydraulic decks, gaps in-between the partitions, reach to ventilation vents, and no access to water troughs, is one of the causes of stress and suffering of animals (Eyes on Animals, 2016). These technical issues might cause injured, stressed, dehydrated, or weak animals at the end of the transport. The longer the transport duration, the higher the risks that transport will become a welfare issue. Longer transport means longer periods of food and water abstinence, more risks for discomfort and more risks for exposure to changing climate and weather conditions. Not only the duration of transport, but also the transport conditions, climate differences, and the conditions and needs of the animals are factors for reduced welfare. Finally, the transport of un-weaned young lambs may cause a cumulative stress because of separation from the mother, refrain from suckling and feeding, and because of not being used to the new drinking system in the trucks.

Environmental impact

The environmental impact of transporting live lambs from Hungary to Italy is higher than the environmental impact of slaughtering these animals in Hungary and transport the meat to Italy:

1. The total CO_2 emission is 108 gram per kg meat higher;
2. The NO_x emission is 0.41 gram per kg meat higher;
3. Diesel use is 0.03 litres per kg meat higher.

[1] No data available: It has been assumed that 3 persons can slaughter 50 sheep per hour (http://www.slaughterhousequipments.com/sheep-slaughter-lines.html). For 573.000 sheep and 1600 hours per person per year the employment is about 21.5 persons for the slaughtering part.

Employment and other social effects
Regarding the social impact, we notice a shift of employment for 20 full time employees from Italy to Hungary when switching from scenario 1 to scenario 2. This is associated with the labour in the slaughterhouses.

Regarding the structure of the slaughter capacity for lambs there is not enough capacity available in Hungary. The option to slaughter these lambs in Hungary is presently not available.

In sum, all indicators showed a favourable value for transport of meat compared to transport of live animals.

Sensitivity
Part of the higher costs in the scenario with transport of live animals is related to the weight loss of the lambs (8% in our calculations) and costs for certification of the consignment (€525.80 per consignment). A sensitivity analysis with lower values (3% and €250 accordingly) showed that there are still higher costs for transport of live animals (€1.03 per kg meat) compared to transport of meat (€0.67 per kg meat).

Conclusion
Transport and slaughter costs and the environmental impact are far higher when live animals are transported from Hungary to Italy than when fresh meat is transported. Scenario 1 (the transport of Hungarian lambs for slaughter in Italy) is therefore not efficient from a cost perspective neither sustainable from an animals welfare nor from environmental point of view. From a social cost-benefit analysis perspective it can be concluded that the long-distance transport of lambs from Hungary to Italy is not sustainable at all: costs are higher, animal welfare is worse, the risk of spread of animal diseases increase and the environmental impact is higher. It must also be taken into account that the risk of transmission of pathogens resulting from the animal movement is higher when the length of the transport increases. However, this risk has not been assessed due to the lack of data.

4 Discussion and conclusion

Discussion

The question regarding the long-distance transport of live animals or meat has different sustainability aspects:

- Transport costs;
- Slaughter costs;
- Animal welfare;
- Environmental impact (CO2 emissions, NOx- emission);
- Employment and other social effects.

Not all listed aspects could be assessed, quantified and integrated in the developed calculation model regarding transport of live animals versus meat. Part of the animal welfare aspects such as deprivation of food and water, animal health and consumer preferences regarding meat are not in the present model, mostly due to a lack of data. The developed calculation model can be extended with additional indicators, when these are deemed relevant for the comparison of the scenarios.

Environmental effects of transport have been calculated but are not an integral part of the developed model. The reason is that the monetised impact of CO_2 emissions on the scenarios is limited. Given a price of USD 128 per tonne of CO_2 (USIAWG, 2013), costs would be €0.002 per kg meat lower when transporting meat than when transporting live animals in the case of spent hens. Similarly, costs of lamb meat transport would be €0.012 per kg meat cheaper than the costs of live lamb transport.

Regarding the employment, the net effect at EU level is more or less zero, because employment in one country will decrease with more or less the same amount as employment in the other country will increase. There are three expected changes in employment if meat is transported instead of live animals:

a. additional labour to slaughter the animals in the country where the animals are reared;
b. additional labour to process the by-products of the slaughterhouses which is mostly done in the country where slaughtering takes place;
c. less labour for drivers to export live animals, more labour for drivers to export meat.

For the two cases considered, the labour related to slaughter can have the largest impact that can be expected. The impact on labour in by-product processing and transportation is small. The impact on employment for most of the EU countries is more or less the same because labour efficiency and the equipment used in large(r) modern slaughterhouses are comparable in all EU Member States.

Factors, such as differences in markets, technical aspects, and legal rules for animal transport among animal species impede generalisation of the results to other animal species. Nevertheless, the methodology and Excel model can be applied to other animal species transported for slaughter by changing the inputs of the model based on the specifications of these animal species. However, gathering the necessary input data for the model can be cumbersome.

Conclusion

The calculation model developed can be applied for other animal species for slaughter, although data gathering can be cumbersome. The current study analyses ‘transport of meat vs. transport of live animals focusing on the transport costs (including monetised animal welfare aspects) and slaughter costs.

Long distance transport of spent hens from the Netherlands to slaughter in Poland is not sustainable from animal welfare, animal health and from environmental perspective, with increasing risks of bruises, broken bones, stress, dead on arrival as well as higher CO2- and NOx- emission. It must also be taken into account that, due to a lack of data, not all the animal welfare aspects were considered

and that the health of the animals transported as well as of other animals as a result of any extra risk of transmission of pathogens linked with animal movement, was not assessed and quantified. From a social cost-benefit analysis perspective it can be concluded that the long-distance transport of live spent hens from the Netherlands to Poland is beneficial only from a cost perspective given the aspects taken into account.

From a social cost-benefit analysis perspective it can be concluded that the long-distance transport of lambs from Hungary to Italy is not sustainable at all; costs are higher, animal welfare is worse, the risk of spread of animal diseases increase and the environmental impact is higher. Information is presently lacking about the willingness to pay for fresh slaughtered lambs and their origin by Italian consumers and further research is needed to check this.

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Appendix 1 Input data of the calculation model per scenario

Scenario 1: Transport of live animals from country 1 to country 2

Route A(LA): Animals transported from a farm / assembly centre in country 1 to a slaughterhouse in country 2		
Factor	**Value**	**Unit**
Type of truck	EURO V	
Number of animals per truck		animals
Weight of an animal at farm		kg
Maximum weight of live animals per truck (e.g. DAF)		kg
Total weight of the loaded truck		tonnes
Distance between farm in Hungary and slaughterhouse in Italy		km
Investment (purchase price) of livestock truck		euro per truck
Depreciation costs of livestock truck		euro per km
Maintenance costs of livestock truck		euro per km
Interest costs for livestock truck		euro per km
Fuel consumption of the truck		l diesel/km
Diesel price		euro per l
Driving speed		km/hour
Salary costs of a driver in C1		euro per hour
Minimum travel time before control post		hours
Rest time at control post		hours
Maximum time to travel before long rest		hours
Rest time after 28+1 hours travel		hours
Distance until 1st control post		km
Distance until 2nd control post		
Costs control posts		euro
Extra costs at control post		euro
Cleaning and disinfection time		hours per consignment
Toll		euro per consignment
Animal health certification/notification/welfare check costs for export		yes/no
Animal health certification/notification/welfare check costs for export		euro per consignment
Cooling/heating system present on the truck with live animals		yes/no
Costs cooling/heating system		euro per consignment
Weight loss during **long** transportation		%
Weight of an animal arrived at slaughterhouse		kg
DOA		%
Seriously wounded		%
Broken bones		%
Slaughter costs in C2		euro per kg slaughter weight
% of the live weight as carcass		%
% of the carcass as meat		%
% of the meat sold as fresh meat		%
% of the meat is sold for further processing		
Does the truck for live animal transportation return to country 1 empty?		empty/ not empty
How much the nett cost is reduced if the truck returns with other goods back to C1?		%

Route B1 (M): Meat transported from the slaughterhouse in C2 to the fresh meat market in C2		
Factor	**Value**	**Unit**
Truck needed for fresh meat transportation	Mechanically refrigerated	
Distance between slaughterhouse and fresh meat market		km
Total weight of the loaded truck		tonnes
Investment (purchase price) of refrigerated truck		euro per truck
Depreciation costs of refrigerated truck		euro per km
Maintenance costs of refrigerated truck		euro per km
Interest rate for refrigerated truck		euro per km
Fuel consumption of the truck (without fridge)		km/l diesel
Additional fuel use for the cooling installation		%
Fuel consumption of the truck (with fridge)		km/ l diesel
Diesel price in C2		euro per litre
Driving speed		km/hour
Salary costs of a driver in C2		euro per hour
Toll for the truck within country 2		euro per consignment

Route B2 (M): Frozen meat transported from slaughterhouse in C2 to further processing in C2		
Factor	**Value**	**Unit**
Truck needed for frozen meat transportation	Mechanically refrigerated	
Amount of transported meat		kg
total weight of the loaded truck		tonnes
Distance between slaughterhouse and processing company in C2		km
Investment (purchase price) of refrigerated truck		euro
Depreciation costs of refrigerated truck		euro per km
Maintenance costs of refrigerated truck		euro per km
Interest rate for refrigerated truck		euro per km
Fuel consumption of the truck		km/l diesel
Additional fuel use for the freezing installation to keep the meat frozen		%
Fuel (diesel) consumption of the truck		km/l diesel
Diesel price		euro per litre
Driving speed		km/hour
Cleaning and disinfection time		hours per consignment
Salary costs of a driver in country 2		euro per hour
Toll		euro per consignment

Scenario 2: long-distance transport of meat from country 1 to country 2

Route A'(LA): Animals transported from a farm/ assembly centre in C1 to a slaughterhouse in C1		
Factor	**Value**	**Unit**
Type of truck	EURO V	
Number of animals per truck		animals
Weight of an animal at farm		kg
Maximum weight of live animals per truck (e.g. DAF)		kg
total weight of the loaded truck		tonnes
Distance between farm in C1 and slaughterhouse in C1		km
Investment (purchase price) of livestock truck		euro per truck
Depreciation costs of livestock truck		euro per km
Maintenance costs of livestock truck		euro per km
Interest costs for livestock truck		euro per km
Fuel consumption of the truck		l diesel/km
Diesel price		euro per l
Driving speed		km/hour
Salary costs of a driver in C1		euro per hour
Cleaning and disinfection time		hours per consignment
Toll		euro per consignment
Animal health/welfare control		euro per kg slaughter weight
Cooling/heating system present on the truck with live animals		yes/no
Costs cooling/heating system		euro per consignment
Weight loss during **short** transportation		%
Weight of an animal arrived at slaughterhouse		kg
DOA		%
Seriously wounded		%
Broken bones		%
Slaughter costs in C1		euro per animal slaughtered
% of the LA weight as carcass		%
% of the carcass as meat		%
% of the meat sold as fresh meat		%
% of the meat is sold for further processing		
Does the truck for live animal transportation return to country 1 empty?		empty/not empty

Route B1 (M): Meat transported from the slaughterhouse in C1 to the fresh meat market in C2		
Factor	**Value**	**Unit**
Truck needed for fresh meat transportation	EURO V, mechanically refrigerated	
Distance between slaughterhouse in C1 and market in C2		km
Amount of fresh meat transported		kg
total weight of the loaded truck		tonnes
Investment (purchase price) of refrigerated truck		euro per truck
Depreciation costs of refrigerated truck		euro per km
Maintenance costs of refrigerated truck		euro per km
Interest rate for refrigerated truck		euro per km
Fuel consumption of the truck (without fridge)		km/l diesel
Additional fuel use for the cooling installation		%
Fuel consumption of the truck (with fridge)		km/ l diesel
Diesel price		euro per litre
Driving speed		km/hour
Cleaning and disinfection time		hours per consignment
Salary costs of a driver in C1		euro per hour
Toll		euro per consignment
Weight loss		%
Does the truck return to country 1 empty?		yes/no
If no, what other goods are transported back to country 1?		
If yes, what are the reasons to send the truck empty?		

Route B2 (M): Frozen meat transported from slaughterhouse in C1 to further processing in C2		
factor	**value**	**unit**
Truck needed for frozen meat transportation	Mechanically refrigerated	
Distance between slaughterhouse in country 1 and processing in country 2		km
Amount of transported meat		kg
Total weight of the loaded truck		tonnes
Investment (purchase price) of refrigerated truck		euro
Depreciation costs of refrigerated truck		euro per km
Maintenance costs of refrigerated truck		euro per km
Interest rate for refrigerated truck		euro per km
Fuel consumption of the truck		km/l diesel
Additional fuel use for the freezing installation to keep the meat frozen		%
Fuel (diesel) consumption of the truck		km/l diesel
Diesel price		euro per l diesel
Driving speed		km/euro
Cleaning and disinfection time		hours per consignment
Salary costs of the driver(s) in C1		euro per hour
Toll		euro per consignment
Weight loss during the transport		%
Does the truck return to country 1 empty?		yes/ no
If no, what other goods are transported back to country 1?		
How much is the net cost reduced if the truck returns with other goods back to country 1? %		

Appendix 2 Technical data regarding long-distance transport of live animals

A2.1 Spent hens from the Netherlands (country 1) to Poland (country 2)

Table A2.1.1 *Long-distance transport of live spent hens*

Route A(LA) : Animals transported from a farm / assembly centre in country 1 to a slaughterhouse in country 2		
Factor	**Value**	**Unit**
Number of animals per truck	8,400	spent hens
Distance between farm/assembly centre in country 1 and slaughterhouse in country 2	950	km
Duration of a consignment	**12.88**	hours
Max km a driver may drive per day	**880**	km
Number of drivers	**2**	driver(s)
Number of control posts	**0**	number
Salary extra hours at control post	**€ -**	euro per consignment
Depreciation costs of livestock truck	**€ 71.25**	euro per consignment
Maintenance costs of livestock truck	**€ 47.50**	euro per consignment
Interest costs for livestock truck	**€ 16.15**	euro per consignment
Fuel consumption of the truck	**317**	litre diesel
Fuel consumption of the truck	**€ 405.02**	euro per consignment
Salary costs of the driver(s)	**€ 759.63**	euro per consignment
Toll	**€ 69.00**	euro per consignment
Animal health certification/notification/welfare check costs for export	**€ 246.00**	euro per consignment
Costs cooling/heating system if any	**€ -**	euro per consignment
Number of healthy animals arrived	8,215	spent hens
Weight healthy animals arrived	13,547	kg
Carcass weight	8,535	kg
Slaughter costs in country 2	**€ 2,816.39**	euro per consignment
Meat	**5,121**	kg
used for fresh meat consumption	**0**	kg
used for further processing	**5,121**	kg
Waste/by-product	**9,159**	kg
Net cost is reduced if the truck returns with other goods back to country 1?	0	%
Fuel consumption	**317**	litre per consignment
CO_2	**283,733**	g/per consignment
NOx	**1,064**	g/per consignment

Route B2 (M): Frozen meat transported from slaughterhouse in C2 to further processing in C2		
Factor	**Value**	**Unit**
Distance between slaughterhouse and processing company in country 2	170	km
Duration of the consignment	**3.43**	hours
Number of drivers	**1**	driver(s)
Depreciation costs of refrigerated truck	**€ 12.75**	euro per consignment
Maintenance costs of refrigerated truck	**€ 8.50**	euro per consignment
Interest rate for refrigerated truck	**€ 2.89**	euro per consignment
Fuel (diesel) consumption of the truck	**101**	liter diesel
Fuel (diesel) consumption of the truck	**€ 100.53**	euro per consignment
Salary costs of the driver(s) in country 2	**€ 63.43**	euro per consignment
Toll	**€ 10.00**	euro per consignment
Frozen meat transported on average in the truck	20,000	kg
What impact does the transport have on the quality of the frozen meat?		
Fuel consumption	**79**	l per consignment
CO_2	**85,452**	g/per consignment
NO_x	**320**	g/per consignment

Table A2.1.2 *Transport of meat of spent hens from the Netherlands to Poland*

Route A(LA) : Animals transported from a farm / assembly centre in coumtry 1 to a slaughterhouse in country 1		
factor	**value**	**unit**
Number of animals per truck	8,400	hens
Distance between farm/assembly centre in country 1 and slaughterhouse in country 2	170	km
Duration of a consignment	**3.62**	hours
Max km a driver may drive per day	**715**	km
Number of drivers	**1**	driver(s)
Depreciation costs of livestock truck	**€ 12.75**	euro per consignment
Maintenance costs of livestock truck	**€ 8.50**	euro per consignment
Interest costs for livestock truck	**€ 2.89**	euro per consignment
Fuel consumption of the truck	**57**	litre diesel
Fuel consumption of the truck	**€ 72.48**	euro per consignment
Salary costs of the driver(s)	**€ 106.65**	euro per consignment
Toll	**€ -**	euro per consignment
Costs cooling/heating system if any	**€ -**	euro per consignment
Number of healthy animals arrived	8,270	hens
Weight healthy animals arrived	14,059	kg
Carcass weight	8,857	kg
Slaughter costs in C1	**€ 5,314.17**	euro per consignment
Animal health/welfare control	**€ 380.85**	euro per consignment
Meat, among which	**5,314**	kg
used for fresh meat consumption	**0**	kg
used for further processing	**5,314**	kg
Waste/by-product	**8,966**	kg
fuel consumption	56.7	litre per consignment
CO_2	**50,773**	g/ per consignment
NO_x	**190**	g/ per consignment

Route B2 (M): Frozen meat transported from slaughterhouse in country 1 to further processing in country 2		
factor	**value**	**unit**
Distance between slaughterhouse and processing company in country 2	1,200	km
Duration of the consignment	**16.00**	hours
Number of drivers	**2**	driver(s)
Depreciation costs of refrigerated truck	**€ 90.00**	euro per consignment
Maintenance costs of refrigerated truck	**€ 60.00**	euro per consignment
Interest rate for refrigerated truck	**€ 20.40**	euro per consignment
Fuel (diesel) consumption of the truck	**515**	litre diesel
Fuel (diesel) consumption of the truck	**€ 658.94**	euro per consignment
Salary costs of the driver(s) in country 1	**€ 944.00**	euro per consignment
Toll	**€ 69.00**	euro per consignment
Weight of frozen meat arrived in country 2	20,000	kg
What impact does the transport have on the quality of the frozen meat?		
Fuel consumption	**514.8**	litre per consignment
CO_2	**560,102**	g/ per consignment
NO_x	**2,100**	g/ per consignment

A2.2 Lambs from Hungary to Italy

Table A2.2.1 *Transport of lambs from Hungary to Italy*

Factor	Value	Unit
Number of animals per truck	700	lambs
Distance between farm/assembly centre in country 1 and slaughterhouse in country 2	1,000	km
Duration of a consignment	**13.50**	hours
Max km a driver may drive per day	**880**	km
Number of drivers	**2**	driver(s)
Number of control posts	**0**	number
Salary extra hours at control post	**€ -**	euro per consignment
Depreciation costs of livestock truck	**€ 75.00**	euro per consignment
Maintenance costs of livestock truck	**€ 50.00**	euro per consignment
Interest costs for livestock truck	**€ 17.00**	euro per consignment
Fuel consumption of the truck	**333**	l diesel
Fuel consumption of the truck	**€ 426.67**	euro per consignment
Salary costs of the driver(s)	**€ 471.42**	euro per consignment
Toll	**€ 219.00**	euro per consignment
Animal health certification/notification/welfare check costs for export	**€ 525.80**	euro per consignment
Costs cooling/heating system if any	**€ -**	euro per consignment
Number of healthy animals arrived	690	lambs
Weight healthy animals arrived	16,049	kg
Carcass weight	8,024	kg
Slaughter costs in country 2		
Slaughter costs in country 2	**€ 2,758**	euro per consignment
Meat, among which	**4,012**	kg
used for fresh meat consumption	**4,012**	kg
used for further processing	**0**	kg
Waste/by-product	**13,698**	kg
Net cost is reduced if the truck returns with other goods back to country 1?	0	%
Fuel consumption	**333**	litre per consignment
CO_2	**896,000**	g/per consignment
NO_x	**3,360**	g/per consignment

factor	value	unit
Distance between slaughterhouse and fresh meat market	450	KM
Duration of the consignment	**6.43**	Hours
Number of drivers	**1**	Driver(s)
Depreciation costs of refrigirated truck	**€ 33.75**	Euro per consignment
Maintenance costs of refrigirated truck	**€ 22.50**	Euro per consignment
Interes costs for refrigirated truck	**€ 7.65**	Euro per consignment
Fuel (diesel) consumption of the truck	**178**	liter diesel
Fuel (diesel) consumption of the truck	**€ 244.13**	Euro per consignment
Salary costs of the driver(s) in C2	**€ 115.71**	Euro per consignment
Toll	**€ 50.00**	Euro per consignment
Weight of fresh meat transported on average in the truck	**20000**	KG
fuel consumption	**178**	l per consignment
CO_2	**662400**	g/per consignment
NO_x	**2484**	g/per consignment

Table A2.2.2 *Transport of meat of lambs from Hungary to Italy*

Factor	Value	Unit
Number of animals per truck	700	lambs
Distance between farm/assembly centre in country 1 and slaughterhouse in country 2	450	km
Duration of a consignment	**7.92**	Hours
Max km a driver can drive per day	**715**	km
Number of drivers	**1**	driver(s)
Depreciation costs of livestock truck	**€ 33.75**	euro per consignment
Maintenance costs of livestock truck	**€ 22.50**	euro per consignment
Interest costs for livestock truck	**€ 7.65**	euro per consignment
Fuel consumption of the truck	**150**	l diesel
Fuel consumption of the truck	**€ 192.00**	euro per consignment
Salary costs of the driver(s)	**€ 138.34**	euro per consignment
Toll	**€ 35.00**	euro per consignment
Costs cooling/heating system if any	**€ -**	euro per consignment
Number of healthy animals arrived	699	lambs
Weight healthy animals arrived	17,692	kg
Carcass weight	8,846	kg
Slaughter costs in country 1	**€ 2,237.76**	euro per consignment
Animal health/welfare control	**€ -**	euro per consignment
Meat, among which	**4,423**	kg
used for fresh meat consumption	**4,423**	kg
used for further processing	**0**	kg
Waste/by-product	**13,287**	kg
fuel consumption diesel	150.0	litre per consignment
CO_2	**403,200**	g/ per consignment
NO_x	**1,512**	g/ per consignment
Long-distance transport of meat		
Distance between slaughterhouse in country 1 and market/slaughterhouse in country 2	**1,000**	km
Duration of the consignment	**13.50**	hours
Number of drivers	**2**	driver(s)
Depreciation costs of refrigerated truck	**€ 75.00**	euro per consignment
Maintenance costs of refrigerated truck	**€ 50.00**	euro per consignment
Interest costs for refrigerated truck	**€ 17.00**	euro per consignment
Fuel (diesel) consumption of the truck	**396**	l diesel
Fuel (diesel) consumption of the truck	**€ 506.88**	euro per consignment
Salary costs of the driver(s) in country 1	**€ 471.42**	euro per consignment
Toll	**€ 219.00**	euro per consignment
Weight of fresh meat arrived in country 2	**19,200**	kg
Fuel consumption	**396**	litre per consignment
CO_2	**1,088,000**	g/ per consignment
NO_x	**4,080**	g/ per consignment

Appendix 3 Questionnaire

	SCENARIO 1: LIVE ANIMAL TRANSPORTATION	Remarks
1.	Are animals transported through a collection centre from farm to slaughterhouse in country 1?	yes -> answer B2, C, D, E; no -> answer A, C, D, E
A	**Questions regarding animals transported directly from a farm to a slaughterhouse in another Member State (route A(LA))**	
2.	What is the average weight loss of an animal during transport to the slaughterhouse in country 2?	% of the starting weight
3.	What is the mortality rate (%) during the transport?	% of the animals loaded at beginning
4.	What percentage of animals arrive at slaughterhouse in country 2 with serious wounds?	% of the animals loaded at beginning
5.	What percentage of animals arrive at slaughterhouse in country 2 with broken bones?	% of the animals loaded at beginning
6.	What are the slaughter costs in country 2?	unit/slaughtered animal
7.	How many FTEs are engaged per slaughter line in country 2?	fte per slaughter line
8.	What is the labour productivity (number of animals slaughtered per person per hour) in country 2?	animals slaughtered per hour
9.	What is the hourly wage in country 2?	Euro
10.	What % of the carcass weight at slaughter is meat?	%
11.	What % of the meat is sold as fresh meat?	%
12.	What % of the meat is sold for further processing?	%
B2	**Questions regarding animals transported from an assembly/collection centre to a slaughterhouse in another Member State (route B.2(LA))**	
13.	What is the average weight loss of an animal during transport to the slaughterhouse in country 2?	% of the starting weight
14.	What is the mortality rate (%) during the transport?	% of the animals loaded at beginning
15.	What percentage of animals arrive at slaughterhouse in country 2 with serious wounds?	% of the animals loaded at beginning
16.	What percentage of animals arrive at slaughterhouse in country 2 with broken bones?	% of the animals loaded at beginning
17.	What are the slaughter costs in country 2?	unit/slaughtered animal
18.	How many FTEs are engaged per slaughter line in country 2?	fte per slaugther line
19.	What is the labour productivity (number of animals slaughtered per person per hour) in country 2?	animals slaughtered per hour
20.	What is the hourly wage in country 2?	Euro
21.	What % of the carcass weight at slaughter is meat?	%
22.	What % of the meat is sold as fresh meat?	%
23.	What % of the meat is sold for further processing?	%
C	**Questions regarding the meat transported from the slaughterhouse to the fresh meat market (route C.1(M))**	
24.	What type of truck is needed for fresh meat transportation from slaughterhouse in country 2 to supplier in country 2?	
25.	what is the age of the normally used truck?	EURO IV, V, VI
26.	What is the investment (purchase price) in the normally used truck in country 2?	euro
27.	What is the depreciation % per year?	%
28.	What are the maintenance costs of the truck?	euro per year
29.	what is the fuel (diesel) consumption of the truck?	km/l diesel
30.	What are the costs per year (depreciation, maintenance, interest) for a cooling installation per truck?	euro per year
31.	What is the additional fuel use for the cooling installation to keep the meat cool?	l diesel/trip
32.	What is the average distance between slaughterhouse and fresh meat market in country 2?	km
33.	How long is the average duration of the consignment?	hours

34.	Are 1 or 2 drivers present on the truck?	
35.	What are the salary costs of the driver(s)?	euro per hour
36.	How much is the toll for the truck during the trip?	euro per consignment
37.	How many kilogram fresh meat are transported on average in the truck in country 2?	kg
38.	What impact does the transport have on the quality of the fresh meat?	
D	**Questions regarding the meat transported from the slaughterhouse to the frozen meat market (route C.2(M))**	
39.	What type of truck is needed for frozen meat transportation from slaughterhouse in country 2 to supplier in country 2?	
40.	what is the age of the normally used truck?	EURO IV, V, VI
41.	What is the investment (purchase price) in the normally used truck in country 2?	euro
42.	What is the depreciation % per year?	%
43.	What are the maintenance costs of the truck?	euro per year
44.	What is the fuel (diesel) consumption of the truck?	km/l diesel
45.	What are the costs per year (depreciation, maintenance, interest) for a freezing installation per truck?	euro per year
46.	What is the additional fuel use for the freezing installation to keep the meat frozen?	l diesel/trip
47.	What is the average distance between slaughterhouse and frozen meat market in country 2?	km
48.	How long is the average duration of the consignment?	hours
49.	Are 1 or 2 drivers present on the truck?	
50.	What are the salary costs of the driver(s)?	euro per hour
51.	How much is the toll for the truck during the trip?	euro per consignment
52.	How many kilogram frozen meat are transported on average in the truck in country 2?	kg
53.	What impact does the transport have on the quality of the frozen meat?	
E	**Questions regarding by-products (bones, offal, feathers, fur, blood, horn, wool, skin) transported from the slaughterhouse to the processing industry (route C.3(M))**	
54.	What type of truck is needed for by-products transportation from slaughterhouse in country 2 to supplier in country 2?	
55.	what is the age of the normally used truck?	EURO IV, V, VI
56.	What is the investment (purchase price) in the normally used truck in country 2?	euro
57.	What is the depreciation % per year?	%
58.	What are the maintenance costs of the truck?	euro per year
59.	What is the fuel (diesel) consumption of the truck?	km/l diesel
60.	Is a cooling/freezing installation needed on these trucks to control the product quality?	
61.	If yes, what are the costs per year (depreciation, maintenance, interest) for such an installation per truck?	euro per year
62.	What is the additional fuel use for such an installation?	l diesel/trip
63.	What is the average distance between slaughterhouse and by-products processing industry in country 2?	km
64.	How long is the average duration of the consignment?	hours
65.	Are 1 or 2 drivers present on the truck?	
66.	What are the salary costs of the driver(s)?	euro per hour
67.	How much is the toll for the truck during the trip?	euro per consignment
68.	How many kilogram by-products are transported on average in the truck in country 2?	kg
69.	What impact does the transport have on the quality of the by-products?	

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