Cattle trade and the risk of importing animal diseases into the Netherlands

Thom Achterbosch
Dörte Döpfer (Animal Sciences Group)

Project code 20239

December 2005

Report 8.05.06

Agricultural Economics Research Institute (LEI), The Hague

The Agricultural Economics Research Institute (LEI) is active in a wide array of research which can be classified into various domains. This report reflects research within the following domain:

- ☐ Statutory and service tasks
- ☐ Business development and competitive position
- ☐ Natural resources and the environment
- ☐ Land and economics
- ☐ Chains
- ☐ Policy
- ☐ Institutions, people and perceptions
- ☑ Models and data

Cattle trade and the risk of importing animal diseases into the Netherlands
Achterbosch, T.J. and D.D.V. Döpfer
The Hague, Agricultural Economics Research Institute (LEI), 2005
Report 8.05.06; ISBN 90-8615-042-x; Price € 16.50 (including 6% VAT)
87 pp., fig., tab., app.

This study examines the risk of importing animal diseases into the Netherlands through livestock trade. It presents projections of Dutch cattle imports until 2010, and applies quantitative epidemiology to estimate the related probabilities of importing three animal diseases (foot and mouth disease, bovine tuberculosis, and leptospirosis). A key result is that trade flows involving large numbers of cattle from a large number of small-scale farms poses alarming risks to veterinary health in the Netherlands.

Orders:
Phone: 31.70.3358330
Fax: 31.70.3615624
E-mail: publicatie.lei@wur.nl

Information:
Phone: 31.70.3358330
Fax: 31.70.3615624
E-mail: informatie.lei@wur.nl

Contents

Preface

In recent years, animal disease calamities have had major repercussions on the European society and the market place. Some incidents, such as the 2001 outbreak of foot and mouth disease (FMD) in the Netherlands and surrounding countries, have been causally linked to imports of live animals. It has become a cause for the European veterinary authorities to keep track of the movements of production animals across the globe, and to monitor veterinary developments worldwide. The accession of 10 member states to the European Union in 2004 has a potentially large impact on livestock trade in the EU.

The present study combines trade analysis with quantitative risk analysis in order to reduce the uncertainty on the future risk of importing animal diseases in the Netherlands with the Ministry of Agriculture, Nature and Food Quality (LNV) of the Netherlands. A more remote purpose was to integrate methods of quantitative epidemiology and economic analysis, and to improve the exchange of data on animal diseases within the EU25.

The authors have received constructive guidance from several officials in the division of Food Quality and Animal Health of LNV: Sikko Beukema who commissioned the research and whose place was later taken by Rob Theelen, and technical experts including Wim Geluk, George Baars, and Wim Pelgrim. The authors thank the following researchers for their substantial contributions to the analysis: Siemen van Berkum and Andrzej Tabeau at LEI; Aline de Koeijer, Thomas Hagenaars and Mart de Jong at the Division of Infectious Diseases of the Animal Sciences Group.

The authors wish to thank several resource persons from the realms of business, product board and government for their cooperation with the interviews sessions and for making material available.

Dr. J.C. Blom
Director General LEI B.V.

Summary

This study examines the risk of importing animal diseases into the Netherlands through livestock trade with a focus on cattle imports.

Cattle imports into the Netherlands consist almost exclusively of newborn calves less than four weeks of age. The veal industry in the Netherlands heavily depends on animal imports for the productive stock. Cattle imports into the Netherlands are projected up to 2010 at similar volumes as the years before incidents over foot and mouth disease and BSE, i.e. annual levels between 550 and 650 thousand head of cattle. In 2004-05, a swift recovery of trade is foreseen, followed by stabilisation up to 2010. As more cattle, up to 25% of imports, will originate from the new member states of the European Union, neighbour countries' share will decline. By consequence, the distance and journey time of animal transports into the Netherlands are rising.

There is a wide range of diseases that are potentially introduced through livestock trade. Because a proper quantitative estimate of the risk should be performed on a specific disease, three examples have been selected for the analysis:

1. Leptospirosis represents an infection for which the Netherlands has a disease-free status, whereas the disease is prevalent in most trade partner countries. Moreover, in trade, no guarantees on disease status are exchanged. As a result, large numbers of imported calves are infected. Future study should assess whether the leptospirosis-free status of Dutch dairy farms is at risk.
2. There is a rare incidence of bovine tuberculosis (Btbc) in the Netherlands, and rapid detection and follow-up ensure that the disease-free status is maintained. Disease status differs among trade partners; some countries are managing endemic Btbc through control programs. There is a disease-free guarantee on imported cattle, which, however, cannot be applied to young animals. Inspection services, as presently organised, are not effective in preventing introduction of the disease in the Netherlands. There is a chance that imports of infected calves will result in an out break of Btbc in the Netherlands. This depends on the age and destination of cattle, and also on the chances that the disease will spread from one infected farm to others in the vicinity.
3. Foot and mouth disease (FMD) represents a highly infectious disease that occurs, at present, with none of the trade partners. Problems in the Netherlands arise when there is trade in live cattle in the time span between the start of an outbreak and the detection of the outbreak. This time span is referred to as the high risk period (HRP). The chances of importing FMD-infected calves depend foremost on the length of the HRP in the country of origin. In addition, the structure of livestock holdings in the country of origin is important: countries with numerous small cattle herds (farms) represent a bigger risk than more concentrated livestock economies. In case of an FMD outbreak in a small-scale livestock economy, it is highly likely that the disease is exported into Netherlands. This is alarming because most cattle consignments are

destined for the densely populated livestock areas. An outbreak in these areas in the east of the Netherlands cannot be controlled before all ruminants within a range have died.

The following are the most important recommendations for risk management:

- To support proper animal disease control with the trade partners. The political feasibility of this approach for risk management is probably low.
- Improved awareness with livestock entrepreneurs in the high-risk areas on the possible spread of animal diseases after introduction in their region.
- To maintain quarantine measures (such as those under the '21-dagen regeling') for shipments of imported animals that bear increased risk. In any case, there is insufficient knowledge on the impact that current exceptions to the general quarantine policy have on the risk of disease outbreaks.
- The impact of inspections on the spread of animal diseases during imports, transit trade and exports should be optimalised in view of estimated risk. It is recommended that both the risk of disease introduction through trade, and the risk of spread of the disease after introduction are taken into account. For example, the study argues that it is effective to step up inspections on cattle imports into the high-risk areas during months of intensive trade, especially when shipped cattle originate from a large number of farms. Assessments on disease outbreak and spread should drive a risk-based inspection system, which indicates the number, the timing and the frequency of sampling. In general, risk estimates may indicate focal points for preventive measures, and also where they may be loosened.

Samenvatting

In deze rapportage wordt verslag gedaan van een onderzoek naar het risico van insleep van dierziekten in Nederland door de handel in levend vee, met name de invoer van runderen en kalveren.

De Nederlandse kalfsvleesindustrie leunt zwaar op ingevoerde kalveren. Er is weinig reden om aan te nemen dat de invoer van kalveren (veelal dieren jonger dan vier weken) in de komende jaren zal afnemen. Wel neemt het belang van de oostelijke lidstaten van de EU als herkomstland fors toe ten koste van de buurlanden. Veetransporten zullen daardoor over langere afstand plaatsvinden.

Voor de een goede schatting van de risico's op insleep is het type ziekte van belang, de analyse van handelsdata is daarom gedaan aan de hand van drie voorbeelden:

1. Leptospirose is het voorbeeld van een infectie waar Nederland vrij van is en die voorkomt in de meeste landen waarmee we handelen en waarvoor geen garanties worden gevraagd of gegeven. We zullen daarom grote hoeveelheden door handel geïnfecteerde kalveren Nederland binnenhalen. In hoeverre dit leidt tot verlies van de vrije status van melkveebedrijven is niet bekend.
2. Bovine tuberculose (Btbc) komt in Nederland sporadisch voor en door snelle detectie en follow-up wordt Nederland vrij gehouden van deze ziekte. Andere landen hebben in het ongunstigste geval endemische Btbc met controleprogramma's. Te importeren runderen worden geleverd met garantie van Btbc vrij zijn. Introductie van Btbc in Nederland door nuchtere kalveren kan niet door huidige importcontroles worden voorkomen. De kans dat de introductie van geïnfecteerde kalveren leidt tot uitbraken van Btbc in Nederland hangt af van de leeftijd en bestemming van de runderen (veel al kalveren jonger dan 4 weken) en de kans dat infectie bij kalvermesterijen leidt tot infectie van buurtbedrijven.
3. Mond- en klauwzeer (MKZ) komt niet voor bij onze handelspartners en de problemen voor Nederland ontstaan indien er na start van de uitbraak in de het handelspartnerland en vóór de detectie van die uitbraak (de High Risk Period, HRP) handel plaatsvindt. De kans op import van MKZ-geïnfecteerde kalveren hangt af van de duur van de HRP in het land van origine en van de structuur van de veehouderij in het land van origine. Landen met veel kleine bedrijven en veel handel met Nederland zullen vrijwel zeker de infectie naar Nederland exporteren indien ze zelf een uitbraak doormaken. Dit is een alarmerende situatie omdat de meeste transporten bestemd zijn voor de zogenaamde veedichte gebieden in Nederland waar een MKZ-uitbraak niet gestopt kan worden voordat alle dieren in het gebied gedood zijn.

Uit de studie volgen verschillende aanbevelingen ter verbetering van het beleid ter preventie van uitbraken en verspreiding van dierziekten in Nederland:

- De ondersteuning van adequate dierziektebestrijding in landen waarmee we handelen is belangrijk om risico's op uitbraken en verspreiding van dierziektes voor Nederland te beperken. Dit is politiek waarschijnlijk moeilijk haalbaar.

  De kennis over de verdere spreiding van dierziekten na introductie op bepaalde bedrijven zou moeten worden verbeterd.
- De handhaving van een periode van quarantaine, zoals verplicht onder de 21-dagenregeling, lijkt cruciaal, zeker voor dieren met verhoogd risico. Momenteel ontbreekt voldoende kennis over de risico's op uitbraken ten gevolge van het huidige ontheffingsbeleid voor de 21-dagenregeling.
- De controle op dierziekten die in Nederland na bij import, doorvoer en export van levende dieren verder kunnen spreiden moet worden geoptimaliseerd aan de hand van de risico's. Daarbij moet zowel het risico van de introductie door de handel als het risico van verdere spreiding na introductie worden meegenomen. Bijvoorbeeld de controle op runderen ingevoerd in veedichte gebieden binnen Nederland en afkomstig van veel verschillende buitenlandse bedrijven tijdens periodes van intensieve handel zou moeten worden geïntensiveerd. De risico's op introductie en spreiding zouden een *risk-based* inspectiesysteem moeten aansturen door de aantallen, tijdsstippen en frequenties van bemonstering bij aankomst in Nederland te bepalen en maatregelen gericht op preventie van uitbraken afhankelijk van het risico te intensiveren.

1. Introduction

European economic integration has the potential to have large impact on the inflow of livestock into the Netherlands. The enlarged European Union bears over 92 million head of cattle that can move freely over 25 countries. Our goal is to examine the development of Dutch livestock imports on the medium term (up to 2010). The recent EU accession gives this research topical interest in view of the sudden surge of imports from Poland in the last couple of years, and the historical fact of a sudden influx of cattle from the former DDR after German reunification.

One strong reason to reduce uncertainty with regard to future livestock trade flows is the risk of importing animal diseases into the Netherlands. The new member states in Central and Eastern Europe (NMS) do not necessarily pose an increased risk for introducing infectious agents through intra-communitarian trade, given the standardisation of EU regulations on prevention of infectious diseases, detection and surveillance strategies. Nevertheless, in view of the anticipation of future risk, the following issues are examined:

- What is the impact of EU25 accession on animal flows into the Netherlands?
  The EU accession bears a strong impact on European markets. To explore how markets will respond, first we assess the factors that drive cattle imports into the Netherlands; second, we analyse how these drivers change, and what is the impact on the volume and the regional structure of cattle imports.
- What is the impact of EU accession on the risk of importing animal diseases into the Netherlands through livestock trade?
  The risk of importing infectious diseases from NMS is not different from any other EU Member State. In a quantitative risk assessment we project this hypothesis to scenarios of trade growth after the integration of the NMS into the EU, an effort that has never been done before.
- What options for risk management are available to the veterinary authorities in the Netherlands?
  The purpose is to indicate which directions current policies could take in order to support the policy objectives at the Ministry of Agriculture, Nature and Food Quality given risk and trade developments in the coming years.

Scope

This study examines the probabilities of importing animal diseases into the Netherlands without exploring the consequences of importing the diseases; a complete analysis would have to include the potential consequences in terms of the location, geographical spread and duration of possible disease outbreaks.

The research cannot cover the full scope of livestock imports and the wide variety of infectious agents. Instead, focus lies on cattle imports, which comprise the lion share of livestock imports into the Netherlands. Most attention goes out to the new EU member states (NMS), of which Poland and the Czech Republic are notable as net livestock exporters. Also we examine whether exports from Hungary and Slovakia into the EU may take off after accession. Illegal trade and transit trade are largely ignored in this study due to a lack of information.

Three animal diseases were selected for the quantitative risk assessment: foot and mouth disease, bovine tuberculosis (Btbc), and leptospirosis. For all three, the veterinary status of the Netherlands is 'disease-free'. By consequence, there are (trade) interests to preserve that status. Figure 1.1 below summarises the features of these infections in cattle.

Organisation of the report

The report is organised as follows. Chapter 2 reports on projections of Dutch cattle imports on the medium term. Chapter 3 provides a quantitative risk assessment for three animal diseases. The insights from this chapter serve as input for the risk outlook in chapter 4. Chapter 5 reviews current strategies for risk management related to live animal imports in view of the research findings. Chapter 6 concludes.

	Foot and mouth disease	Bovine tuberculosis (*mycobacterium bovis)*	Leptospirosis *(e.g. L. Hardjo)*
Type of infection	Viral	Bacterial	
Detection	Often sub-clinical at first, possibly clinical; usually detected at slaughter	Sub-clinical infection, usually detected at slaughter	Difficult to detect from symptoms (abortus and raised temperature).
Human health risk	No hazards to human health	Zoonotic potential (but transmission of BTBC from animal to human is not confirmed)	Zoonotic potential: may cause illness such as py-rexia and muscle aches, transmitted through urine and uterine contents
Epidemiology	Explosive spread among animals	Slow spread compared to FMD	
Status in livestock exporting countries	Regular outbreaks around the globe; potential risk of intro-duction is a fact	Regular incidence around the globe; potential risk of introduction is a fact	
Veterinary control in livestock exporting countries	Surveillance, monitor-ing, prevention and control strategies	Surveillance programs are required by EU legislation	Surveillance is common; animals not systematically screened before export
Status in the Netherlands	Disease-free, authori-ties are very alert; regular surveillance & monitoring	Disease-free, authorities are alert; systematic check at slaughter	99% disease-free, authori-ties are very alert and in the process of disease eradication through certi-fication program

Figure 1.1 Characteristics of the animal diseases under study

2. Prospects for cattle imports

This chapter examines the impact of the EU enlargement in 2004 and further prospects on live animal flows into the Netherlands.[1] The focus lies on imports of bovine animals from the new member states of the EU (NMS) in the years up to 2010. We provide a quantitative outlook on cattle imports into the Netherlands that allows the managers of veterinary risk to anticipate future demands on the system of import risk analysis in the Netherlands. Several recommendations are made on the matter.

The analysis draws on (i) desk study on cattle trade; (ii) expert interviews with resource persons from the realms of government, business and from the relevant product board (see Annex C for a list of respondents) whose comments will appear throughout the text; and (iii) on a modelling exercise to test selected hypotheses on the volume and the regional structure of imports into the Netherlands.

2.1 The Netherlands in EU livestock trade

The Netherlands hold a central position in European livestock trade. Imports and exports of live animals amount to several hundred million euro each year. The bulk of live animal imports into the Netherlands are ruminants, mainly cattle. In the years 1990-2000, an average of 640 thousand head of cattle was annually imported into the Netherlands. In the years 2001-02, when calamities on BSE and foot and mouth disease (FMD) strongly disrupted meat markets in Europe, imports plunged. In 2003 trade recovered (table 2.1). Dutch imports largely originate from neighbour countries (figure 2.1). The import volume of cattle from Poland doubled for three years in a row up to 40 thousand head in 2003, yet the share remains small.

Table 2.1 Dutch cattle imports 2000-02, by type (1,000 head)

	2000	2001	2002	2003
Calves	580	278	430	534
Breeding cattle	5	20	1	3
Other cattle a)	92	32	10	16
Total live cattle	677	330	441	553

a) Other cattle covers cattle meant for slaughter, and grazing cattle.
Source: PVE.

[1] A slightly altered version of this chapter was presented at the XIth congress of the European Association of Agricultural Economics, Copenhagen (23-27 September 2005).

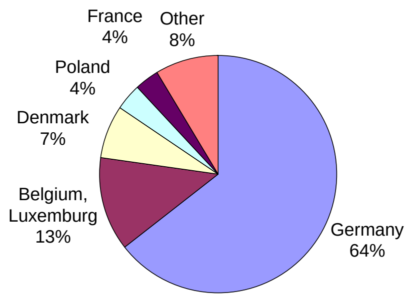


Figure 2.1 The origin of Dutch live cattle imports, 2003

Imports into the Netherlands are mostly newborn calves

Whereas Dutch cattle imports used to consist of a variety of cattle for decades, recent years have seen trade narrow down to calves only. In the 1990s some breeding cattle was imported but the Netherlands moved to a net export position in that category. Slaughter cattle comprised about 20% of imports until the mid-1990s but volumes are declining ever since. A steep rise of slaughter costs after the 2001 BSE and foot and mouth disease (FMD) outbreaks brought the inflow of slaughter cattle to a complete halt.[1]

Calves made up 97% of all cattle imports in 2003. The origin of import demand for calves lies with Dutch veal producers, a small but well-positioned subsector of intensive livestock production in the Netherlands. Calves undergo six months of fattening before slaughter. Most calves are imported as 'newborns' in order to maximise the time of fattening in the Netherlands. EU legislation permits transports of calves after 10 days.

To their surprise, the identification and registration service (I&R) of the Ministry of LNV has noticed an increasing inflow of dairy cows over one year of age from the NMS. The animals are not imported as slaughter cattle. Despite recent trends the share of animals of more than 1 year of age is nevertheless stable at 5 to 6% of imports.

Most ruminants that are imported alive into the Netherlands originate from Germany. In recent years the import volume of cattle from Poland doubled in three consecutive years, reducing the relative share from both Germany and Belgium. At lower volumes than these major players, Denmark and Ireland are origin countries of decreasing importance while the Czech Republic is on the rise.

Dutch entrepreneurs are heavily involved in the logistical services to cattle trade. There are an estimated 350 to 1,200 livestock traders in the Netherlands, and about 1,600 livestock carriers (Bex et al., 2002). One in every 10 carriers is allied to SAVEETRA, the largest organisation of livestock carriers, which claims to handle 40% of all transports in, towards and from the Netherlands.[2] The remainder of transports is done largely by mem-

[1] Compared to those in Belgium and Germany, producers in the Netherlands make large contributions to the reduction of BSE risk through destruction of high-risk parts of the carcass. This makes the slaughter of imported animals unattractive. In response, the Dutch slaughter sector is reducing capacity to 650 thousand head, which is the level of domestic cattle supply.

[2] About 25 to 40 of the 175 SAVEETRA members are involved in transports to Poland, Hungary, the Czech Republic and Slovakia, according to the organisation's secretariat.

bers of the Dutch union of cattle traders (*Bond van Nederlandse Handelaren in Vee*, NBHV), which include professional carriers, traders with own vehicles and the occasional farmer.

The Validity of Cattle Trade Statistics
Before moving on, a few remarks on the quality of trade data. Two institutes in the Netherlands officially report on cattle trade statistics, and a third institute is involved in collecting trade data. Volumes reported diverge widely among the institutes, which creates uncertainty on the actual amount of imports. Table 2.2 reports on divergences between volumes reported. Each source has a specific strongpoint and weakness. Statistics Netherlands (CBS) reports official data from customs, both on exports and imports, which poorly reflect trade with other EU member states. The Identification & Registration (I&R) service of the Ministry of Agriculture, Nature and Food Quality produces trade data from their database on animal whereabouts. The data are strong on breeding cattle and cattle for fattening but weak on slaughter cattle. The Product Boards for Livestock, Meat and Eggs (PVE) estimates corrections to the official data from CBS by adjusting these to domestic cattle balances and I&R data. This trade report takes I&R data where available or PVE data as a second best.[1] For a comprehensive analysis of the ruminant sector PVE data should be preferred as it is consistent with production and slaughter data.[2]

Table 2.2 Diverging Statistics on Cattle Imports

	2000	2001	2002	2003
Source				
CBS	448.109	271.053	223.036	384.488
PVE	677.000	330.000	441.000	553.000
I&R	n.a.	n.a.	468.300	560.178
Divergence (CBS=100)				
PVE	151	122	198	144
I&R	n.a.	n.a.	210	146

2.2 Factors driving calve imports into the Netherlands?

The Dutch veal industry is second largest in the EU
Each year between 1.2 and 1.4 million calves are slaughtered for veal production. Apart from the Netherlands, major veal producers in the EU are France (1.9 mln head slaughtered in 2003) and Italy (1 mln). Total veal production amounted to 186 mln ton in 2003. By the end of 2003, the Dutch stock of meat calves counted 748 thousand head held on 3,250

[1] The quantitative risk analysis in chapter 3 made use of the ANIMO database. ANIMO is maintained by the Food and Nonfood Authority (VWA) and is fully consistent with the PVE and I&R data for the cases under study.
[2] Efforts to improve the consistency of PVE and I&R data are currently ongoing. There is an urgent need to develop a new standard to record intra-EU trade statistics in the future. Because of the use of animal passports throughout the EU25, the cattle sector is one of the few sectors where the changes in trade between EU15 and the new member states after EU enlargement can be monitored. This provides additional interest into the present enquiry.

farms. The province of Gelderland is the centre of specialised veal production. The veal industry is characterised by strong concentration. A small number of companies that are referred to as *kalverintegraties* (integrated veal producers) produce 90% of domestic veal supply. The integrated producers contract farmers, and provide them with newborn calves and feed. Calves are fed on synthetic milk for about 6 months at the end of which the integrated producer has the animal slaughtered. Producer prices for veal have been rather low in the EU since the reduction of EU-administered intervention prices for meat in the 1990s. By means of compensation, producers receive a slaughter premium under the common agricultural policy.

Veal demand on EU markets is critical to the veal sector

Dutch households consume just 10% of domestic veal production; 80% is exported to Italy, Germany and France; the remainder is exported to other destinations in Europe and the Middle East. Over the years, Dutch producers maintain a share in EU veal markets of 15 to 20%. The market share of the Dutch appears to be stable under fluctuations in total consumer demand in the EU.[1] In 2001 the marketing of veal was severely disrupted following calamities concerning BSE and foot and mouth disease (FMD). By mid-2004, veal demand has fully recovered in France and Italy, while demand in Germany remains below potential (source: PVE). To consumers, veal has become more expensive over the years relative to alternative meat products; prices in the Netherlands are about double those for beef, and about 15% over premium steak prices.

The competitiveness of Dutch veal

Intensive livestock production in the Netherlands is having difficulties facing the competition from producers in countries with more land resources and/or cheaper labour, both in the EU and abroad. It is expected that pork and poultry production will decline in the coming years (Bondt et al., 2003). While under similar pressure from foreign competition, Dutch veal producers expect to be able to uphold their share on the EU market.

Several respondents relate the strong position of Dutch veal on the EU market to the integrated organisation of production that manages both costs and quality. Dutch veal has earned a reputation for high quality, which dwells on technological advance; the advanced level of Dutch veterinary control; and is buttressed by substantial investments in quality control in recent years. The integrated producers certify their activities under systems such as IKB (general supply chain management in Dutch meat); SKV (*Stichting Kwaliteitsgarantie Kalveren*); HACCP; ISO, etc. It seems reasonable to assume that Dutch veal carries few risks to consumers and to animal health in Italy, France, and other export destinations. In addition, Dutch veal producers are ahead of the EU competition in adjusting their facilities to group housing of animals, which is compulsory under EU law from 2005 onwards.

The productive stock: newborn calves

Veal production in the Netherlands has its economic origin in the over-supply of newborn calves and milk in the dairy sector. While the Dutch dairy sector is still the main supplier

[1] The model analysis reported below found that any change in total demand for veal in the EU results in proportional changes to the volume of Dutch veal supply to the EU.

of newborn calves to the veal producers, imports have gained importance. The annual snapshots at calves supply reproduced in figure 2.2 reveal that domestic supply dropped during the 1980s, in relation to the milk quota under the EU common agricultural policy (CAP). By 2003, the dairy herd amounts to 1.5 million dairy cows, which produce about 1.4 million newborn calves. Of the total supply of newborn calves, 30% are used for replacement and 70% go into fattening. Due to the diminished scale of specialised beef production in the Netherlands, practically all of the 1 million newborns destined for fattening are supplied to the veal producers. The integrated veal producers have substantial buying power. Annually 400 to 600 thousand head (30 to 40% of supply) are imported in order to overcome shortages in the domestic supply of newborns, which has the additional effect of driving down domestic calf prices. Van der Linde (2004) ascribed the 30% drop in domestic calf prices between August 2003 and 2004 to the recent surge in imports of newborns from the new member states.[1]

Figure 2.3 compares price levels for veal (in live calve weight) across several EU-25 member states. Price levels are similar in the Netherlands and Italy. There is a price gap of over 60% in recent years between these major veal producing countries and Poland and Czech Republic, both important regions of origin for calve imports into EU-15. Changes to veal prices generally transfer into similar adjustments of the price of newborn calves (Van Leeuwen, 1998). Prices of newborn calves are structurally related to the EU intervention prices for beef, which in turn affect veal prices (De Bont et al., 2003). As EU intervention prices have come down substantially under the Mid Term Review, they offer an unsatisfactory explanation for ongoing price differences. These relate mostly to quality differences of the dairy herd in these countries. The issue of breed quality is a minor attribute in newborn calve trade. One respondent noted that Dutch importers favour Polish calves, however, the reason being their 'robust' constitution. Due to the harsh circumstances on some Polish farms only the stronger animals make it to an exported consignment. Part of the price gap is explained by the costs of transporting for surplus calves from Poland and Czech Republic to their outlets in the EU-15. Trade in newborn calves is very mobile. As one interview respondent from the realm of trade, a price difference of 3 euro (on a c.i.f. price of, say, 160 euro) can induce a trader to redirect his transport to a destination where the price is best.

[1] The analyst stresses the importance of price differences between new member states and the Netherlands. Apart from this declining price gap, the years 2003-04 saw a further recovery in EU veal demand, and eastward expansion of the EU.

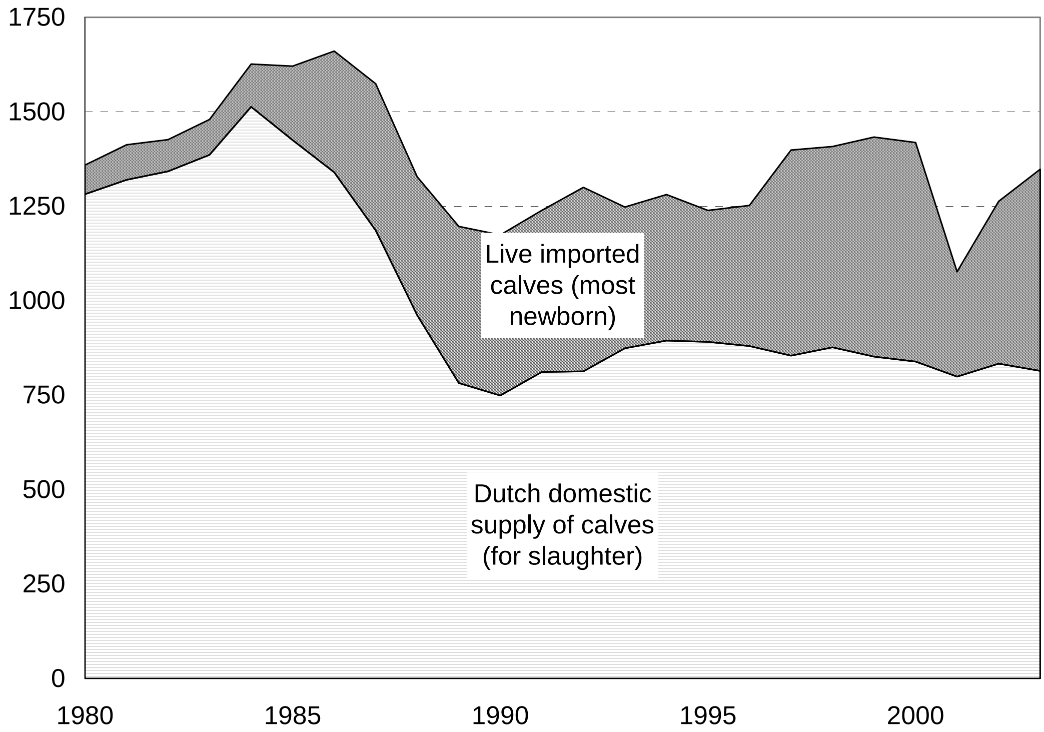
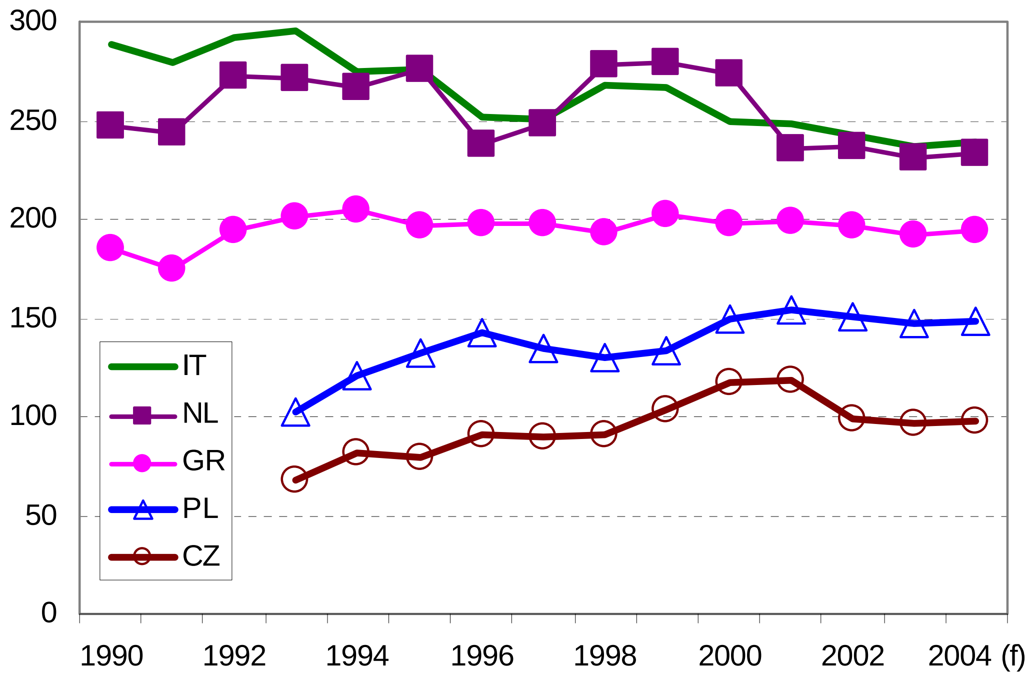


Figure 2.2 Calve supply in the Netherlands, 1980-2003 (1,000 head)



Source: AGRIS

Figure 2.3 Veal prices in selected countries (EUR/100 kg live weight)

2.3 Livestock exports from the new EU member states

Eastern expansion of the European Union on May 1, 2004 added about 10 million head of cattle and 30 million pigs to the EU livestock. The cattle stock increased by 15% to 92 million head.[1] Cattle is free to move within the common EU market. This section examines the export supply of livestock in the 10 new member states (NMS) that is available to the Netherlands and other net livestock importers in the EU15.

More than half of all cattle stock in the NMS is located in Poland (54%). The second largest cattle stock is found in the Czech Republic (14%), then Hungary and Lithuania (8%), and Slovakia (6%). Between 1998 and 2002 the cattle stock in the NMS decreased by 13%. As specialised meat production is quite uncommon in the NMS, most of the cattle stock is in the dairy sector. The section below briefly discusses meat and dairy markets in the countries that have a history of livestock exports to the Netherlands (which excludes Lithuania).

Poland

Polish agriculture stands near to self-sufficiency in dairy and beef. Beef consumption in Poland is low compared to pig meat, which is the country's favourite. Over 60% of meat consumed is pig meat. Beef consumption per capita shrank from 20 kg in 1990 to 6 kg in 2003, and remains limited despite recent welfare increases. Beef production in 2003 amounted to 275 thousand ton, down from 838 thousand ton in 1990. Animal husbandry is done at small scale in mixed farming activities. At less than 1% of farms more than 50 head of cattle in held; 85% keeps less than 10 animals (source: PVE).

After the liberalisation of price support for beef and dairy in the late 1980s, beef production became closely tied to the dairy sector. Dairy farming is done on a vast number of small-scale farms that are scattered throughout the country. Between 1990 and 2003 the dairy herd contracted by 35% to 2.9 million head, and milk production dropped by 27%. Of the total annual production of raw milk of 12 million ton, just 6.4 to 7.4 million ton (55 to 65% of raw milk production) is delivered to the dairy factories; the remainder is consumed or sold at the farm. This leaves ample space for growth of the deliveries under the annual production quota of 9.4 million ton. It remains to be seen what will happen to the size of the dairy herd as Polish diary increases the volume of deliveries.

The growth of deliveries in Polish dairy can be obtained through scale-enlargement, or via quality-enhancing inputs (improved hygiene, better feed, etc.). The key question is whether the number of diary cows will grow in the coming years, or whether local and foreign investors will increase the productivity of the available herd. It is assumed that the size of the dairy herd remains stable throughout the projection period.

Market forces in the NMS will likely increase the average scale of husbandry, especially in Poland where dairy production is in the process of undergoing a transformation. While market forces will work a bit to assemble consignments from fewer herds, the fact that newborn calves are residual to dairy farming impedes a large supply of animals from a single farm.

[1] Numbers are taken from the December 2002 count in the EU.

Recent years have seen an increase in the export supply of live cattle from Poland. While the stock declined by 11% in the years 2000-03, the number of slaughtered animals dropped by 22%. Often the animals exported are young animals that are fattened for beef or veal in the destination countries. The most important destinations are Italy (48% of exports in 2002), and Bosnia-Hercegovina (24%).

Czech Republic

In the last decennium, animal husbandry in the Czech Republic declined with exception of the pig sector. Between 1990 and 2003 the stock of beef and dairy was halved to the amount of 1.4 million head. Meat production is not specialised but related to dairy production. The contraction in the dairy herd is still ongoing at a pace of 20 thousand head annually. Milk production was reduced by 30% in the decennium after 1992, beef production shrank by 47%. As beef and dairy consumption declined as well, the Czech Republic was able to maintain near self-sufficiency in these products. The average herd size on the dairy farm is a lot bigger than in Poland. The milk is of better quality due to the abundance of cold storage; 80 to 90% of the raw milk supply is delivered to the dairies. The value of exports of live cattle varies between USD10 and 20 million since the late 1990s. In 2002, live exports amounted to USD16 million worth of mostly newborn calves that were shipped to Italy and Germany; the Netherlands were among the smaller destinations (export value USD1.3 million).

Slovakia

In the 1990s, animal husbandry in Slovakia underwent enormous change. Between 1990 and 2003, beef production reduced by 53%, pig meat supply by 20%. During the same period, poultry production stepped up by 42%. The livestock reduced to 600 thousand head in 2003, down from 1.5 million in 1990. Live cattle exports amounted to USD10 to 20 million in the last decennium, and are declining further. Italy is the most important country of destination, before the Czech Republic and Germany.

Hungary

Animal husbandry in Hungary is first and foremost an affair of pig meat production. By the end of 2003, the total stock includes about 5 million pigs and 700 thousand heads of cattle, down from 1.5 million head in 1990. Over 40% of cattle are dairy cows, and 26% are calves. The 32% share of other cattle indicates a small but substantial portion of beef production. Between 1992 and 2000 milk production was almost stable; beef production plummeted by 68%. While specialised beef production is a small sector, about 70% of slaughter capacity is up to EU standards, compared to just 35% in Poland. Hungary is the second largest exporter of live cattle in the region (after Poland). Annual exports amount to USD35 million, down from USD50 million in the 1990s. Croatia has become the major country of destination, absorbing a flow of USD23 in 2002. Other destinations for Hungarian cattle are Bosnia-Herzegovina, Rumania, Italy, Slovenia, and Greece.

2.4 Factors driving Dutch cattle imports from the new member states

Our goal is to examine the development of Dutch cattle imports on the medium term. The recent EU enlargement gives this research topical interest in view of the sudden surge of imports from Poland and the historical fact of a sudden influx of cattle from the former DDR after German reunification.

The enlargement of the EU bears a strong impact on European markets. To explore how markets will respond, requires a two-stage analysis. First, we assess the factors that drive cattle imports. These are generally the factors underlying supply and demand, as well as policies and other elements in the economic context. Second, we analyse how these drivers change, and what impact this has on volume and the regional structure of cattle imports.

From desk study and consultations of experts within the ranks of government, product board, business and research, we have found the following to be among the most important forces driving the volume and regional structure of cattle imports from the new member states (NMS) into the Netherlands:

- *Economic growth:*
    - The demand for veal in the EU15 and NMS
    - The competitive position of the Dutch producers vis-à-vis veal producers in France, Germany and Italy
    - Alternative uses for land, labour, and capital resources currently tied into the dairy sector in the NMS
- *Consumer preferences & consumer concerns:*
    - Diets in the EU shift towards convenience food
    - Investments that address concerns over food safety, animal health, animal welfare and environmental impact increase the costs of meat supply
- *The Mid Term Review of the Common Agricultural Policy:*
    - In the Netherlands policy support to veal and beef producers remains fully coupled to production
    - Income support to NMS producers is below EU15 levels
    - The size of the Dutch dairy milk herd, and in relation the milk quota and productivity improvements[1]
- *Technological and organisational change in dairy production:*
    - Milk yield per cow reduces the size of the dairy herd in the Netherlands, Czech Republic, Slovakia and Hungary
    - Growth of the raw milk deliveries to dairy plants in Poland under the EC-imposed quotum
- *Integration of the markets in the EU25:*
    - The removal of EU-administered import quota on live cattle, restricting EU imports from NMS to 231,000 head each year (excluding the quota of 169,000 head under GATT), allowing competition to address the biased position of Italian importers; as well as remaining tariff barriers between EU-15 and NMS

[1] Rising dairy prices and the desire to control the attributes of feed has induced the use of synthetic milk substitutes. Cow milk remains a substantial input in calf milk. Under MTR policies, dairy prices will drop to the extent that the price of calf milk could drop by 4 percent (de Bont et al., 2003, pp. 22).

- The speed at which (unaccountable) price differences between EU15 and NMS for beef and cattle melt away

Table 2.3 indicates the impact of each of these drivers of change. Some factors will reduce cattle imports from the NMS region; other will have a positive effect. The following sections provide a quantitative outlook on the weight of the various forces on the medium term.

2.5 Projections of cattle imports

The following sections explore the development of the Dutch imports of cattle from four Eastern new member states of the EU up to 2010: the Czech Republic, Hungary, Poland and the Slovak Republic. For this purpose, we will analyses the possible total import demand for cattle as well as the possible changes in the regional import structure, which could result from enlargement of EU15 to EU25 and different development of the world economy.

Scenarios
To take into account the possible different macroeconomic development of the economy in both the importing region and the exporting region we analyse two possible scenarios, one characterised by strong economic growth, the other by weak growth. Table 2.4 presents the selected scenario assumptions made for the Netherlands and the new member states.

The policy assumptions made for both scenarios are similar: enlargement of EU15 to EU25 and mid term review (MTR) of the common agricultural policy (CAP). As the MTR of agricultural policy is concerned, we assume the full decoupling of the domestic support for all EU15 countries with exception of Denmark, France and the Netherlands. For these three countries the cattle and sheep premiums are partly coupled. In particular, 50% of sheep and 75% of bulls premiums are coupled in Denmark; suckle cows premiums and slaughter premiums for calves are fully coupled and, 60% of other slaughter premiums and 50% of sheep premiums are coupled in France; 100% of slaughter premiums for calves and 40% for adult cattle is coupled in The Netherlands. We also assumed the modulation of direct payments, which leads to cut of direct payments by 3% in 2005, 4% in 2006 and 5% in 2007.[1] For new EU members, full decoupling of direct payments was assumed. These premiums are equal to 55% of EU15 payments in 2004 and increase gradually to 95% in 2010. We have assumed that since 2004 30% of full EU15 rate will be financed from rural developments and national funds as was agreed in the accession agreement.

For all EU25, the MTR reform of agricultural policy concerning milk and dairy sector was implemented according to the Luxemburg Agreement.

[1] For more detail please confer to the latest edition of *Landbouw-Economisch Bericht* (Berkhout and Van Bruchem, 2004, pp. 38-41). Belgium will also keep the cattle premium fully coupled to production, following a tripartite agreement of the Ministers of Agriculture of the Netherlands, Belgium and France, see MinLNV (2004).

Changes to consumer tastes and consumer concerns

The analysis examines possible developments on the supply-side of the cattle and beef sector. We can, however, expect that in the period up to 2010 consumer tastes might change, that transporters will innovate, and that regulations concerning cattle trade will tighten. We explore the consequences of two of these changes on the cattle sector. First, we simulate a shift of consumer taste towards other meat products than beef, implemented as a decrease of cattle meat consumption by 1% per year throughout the projection period. Second, we implement more stringent safety and quality measures concerning cattle imports. Such measures increase the costs of trading, and it is the rise of costs that is incorporated in the analysis. A differentiation between intra-EU trade and imports from third countries allows us to include the beneficial impact of shared EU institutions in the analysis. Trade costs within EU25 increase by 1% in 2005 and again in 2007; the costs of imports from third countries into the EU25 increase by 2% in 2005 and 2007.

Approach to making projections

The complete recipe for brewing projections of cattle imports is described in a background note that is available upon request. We dwell on a range of economic modelling techniques in addition to expert opinion and secondary literature. This makes our approach to arrive at economic projections quite common (McCalla and Revoredo, 2001; Van Meijl et al., 2003). Our aim is to give a quantitative weight to the driving forces of cattle imports in the years 2004-2010 that resulted from desk study and expert interview (summarised in table 2.3, above).

Table 2.3 Factors driving cattle imports from the NMS into the Netherlands

Driver of change	Outlook, impact of change	
	Netherlands	New Member States a)
Economic growth	Veal demand responds positively to strong growth of household income. Growth assumptions are comparable for all EU veal producing countries, and have little impact on competitive positions of the industries across the EU.	Income growth will have modest impact on domestic beef demand, as prices will also go up under EU policies. Under strong growth, NMS will gradually lose competitive edge vis-à-vis EU15 countries. Under weak growth imports from NMS remain cheap.
Consumer preferences, consumer concerns	The incorporation of concerns over food safety, and animal welfare in production and transport could raise production costs and reduce veal demand vis-à-vis less costly meats. A shift of diets towards convenience food will further reduce veal demand irrespective of price movements. Dutch veal supply will contract.	Veal consumption in the NMS is practically nonexistent. Price rises of beef will contribute to the shift towards pork and poultry meat.
Mid Term Review of CAP	Meat supply declines due to modulation (reduction) of direct payments of 3-5%	Only gradual build-up of EU support levels; strong competition with EU15 exporters on domestic meat markets
- beef & veal	Veal prices remain unaltered. Income support beef/veal remains fully coupled to production in NL up to 2010. Capacity declines somewhat due to immobility of premium rights.	Beef intervention prices are introduced, which further suppress beef demand vis-à-vis pig meat and poultry. Livestock prices in the NMS converge to EU15 average, speed depends on economic growth.
- dairy	Milk prices down. NL dairy quota expansion 1-1.2% reduced supply of newborn calves; costs of calf milk decrease by 4%.	Introduction of dairy quota in the NMS. Binding (or nearly binding) for all except Poland where some consolidation of dairy farms is likely; larger companies will fill the quota; dairy herd remains stable
Technological change / Milk yield	Cow productivity improves 1.8% annually; combined with quota effect, the results is a net annual decline of the dairy herd	Annual productivity growth, in combination with quota, results in gradual shrink of the dairy herd in Czech R, Slovakia, Hungary
Integration of EU25 market (removal of quota, border tariffs)	Removal of the EU-administered quota liberalises imports from new member states. Dutch share of NMS cattle could rise when competing directly to Italian traders that historically held quota rights.	Export flow of cattle to Balkan countries could shift to EU15 importers depending on price gaps. Poland loses 10% preference margin on EU15 borders vis-à-vis other NMS, which thus become more competitive.

a) The table covers Poland, Czech Republic, Slovakia, and Hungary only.

Table 2.4 Scenario assumptions: average yearly growth rates in selected variables in 2001- 2010 period

	National income (GDP)	Employment	Population	Exogenous land yield in cattle sector
High-Growth Scenario (HGS)				
Netherlands	2.82	0.60	0.62	0.53
New member states a)	3.14 : 4.22	-0.37 : 0.25	-0.46 : 0.07	0.01 : 0.59
Low-Growth Scenario (LGS)				
Netherlands	1.37	-0.1	0.37	0.19
New member states a)	1.39 : 2.34	-0.59 : 0.06	-0.61 : -0.08	-0.32 : -0.005

a) Assumptions are country-specific. The table reports the range of assumptions for four NMS: Poland, Hungary, Czech Republic and Slovakia.
Source: EURURALIS 1.0 (CD ROM), October 2004, http:/www.dow.wau.nl/clue/europe/.

The analysis of scenarios combines two model representations of the cattle market in the EU. The one is geared towards studying agricultural relations in Europe (AG-Memod); the other, GTAP (the model of the Global Trade Analysis Project), specialises in simulating global international trade relations.

The biggest challenge in this exercise was to estimate the impact of the liberalisation of quota for cattle imports from the former EU candidate countries into the EU. Under the Europe Agreements it was agreed that cattle imports from Poland, Czech Republic, Slovakia, Hungary, Romania, Estonia, Latvia and Lithuania into the EU15 were restricted under two quota: 178 thousand newborn calves up to the weight of 80 kg, and 153 thousand head of cattle with a weight between 80 and 300 kg.[1] Commonly, the quota were filled to the maximum. Each year, the Management Committee for Beef of the European Commission allocated the import licences to traders from EU15 countries. On historical grounds, the lion share of the import licences were granted to traders from Italy (over 60%). Dutch traders accounted for about 10% of licenses, and have lobbied for a bigger share in recent years but with limited success as revealed in Figure 2.4, which shows modest growth of market share of the Dutch in EU-15 imports from Poland, Czech Republic, Slovakia and Hungary. Quota removal will have several repercussions on the volume and structure of cattle trade. In view of the similarity of veal prices in Italy and the Netherlands, we expect to find that the share of Dutch traders grows at the expense of the Italian share.

To estimate the implications of cattle imports quota removal for Dutch cattle imports, we use our desk study results concerning Dutch cattle imports in 2004. First, we eliminate in a GTAP simulation all import tariffs and export subsidies as between the EU15 countries and ten new members states (NMS) and set NMS import tariffs and export subsidies on the average level of EU15 tariffs and subsidies to implement the EU enlargement. This tariff elimination, however, alters NMS cattle exports to The Netherlands much less than we observed in our preliminary data for the first eight months of 2004. This indicates that the quota abolition could have much higher impact on the Dutch imports by country of origin than it can be achieved by simple by tariffs elimination. Therefore, on the basis of data

[1] Under GATT provisions there is a third quota for imports of young bovine animals into the EU, to the amount of 169 thousand head. While the quota is open to all countries outside the EU, until Polish accession, only newborn calves from Poland were imported under the quota.

on preliminary imports in 2004, we adjusted the imports efficiency parameters in GTAP in order to arrive at more realistic imports growth rates. Tabeau and Achterbosch (2004) describe the methodology in more detail.

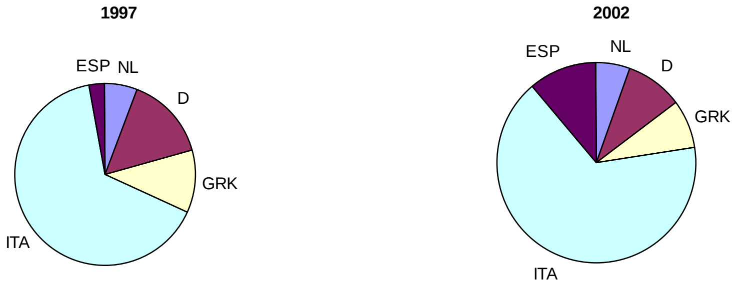


Figure 2.4 Cattle imports from Poland, Czech R., Slovakia and Hungary into EU-15 (USD), 1997 and 2002

2.6 Results

This section discusses the results of cattle import projections; full numerical detail is provided in Appendix A.

Cattle imports into the Netherlands grow

A recovery of the total imports after BSE crisis is expected but the imports is predicted to stay below the pre-crisis level. Imports will grow from around 587,000 head in 2004 to 600,000 head in 2007, and 615,000 head in 2010. As figure 2.5 shows, imports will show steeper growth in the strong-growth scenario than under weak growth, which reflects rising veal (and beef) demand in the EU.[1] Dutch veal supply will maintain its share on the EU market, despite the fact that meat production in the Netherlands competes strongly with alternative allocation of land and labour resources. Note that we have assumed that environmental policies will not put a cap on veal supply in the Netherlands until 2010.[2]

[1] The LGS versus HGS scenarios differ only by macroeconomic assumptions including Total Factor Productivity. In LGS the CEEC counties have more labour available to produce GDP compared with EU15 then in HGS. As the result, in LGS labour in CEEC is relatively less expensive than in EU15 compared with HGS. So, the relation between factor prices and so, cattle prices between CEEC and EU15 is better for CEEC in LGS than HGS. This why imports from CEEC is higher in LGS than HGS.

[2] Recent LEI research has argued that environmental policies will be critical in determining the scale of poultry and pork production in the Netherlands.

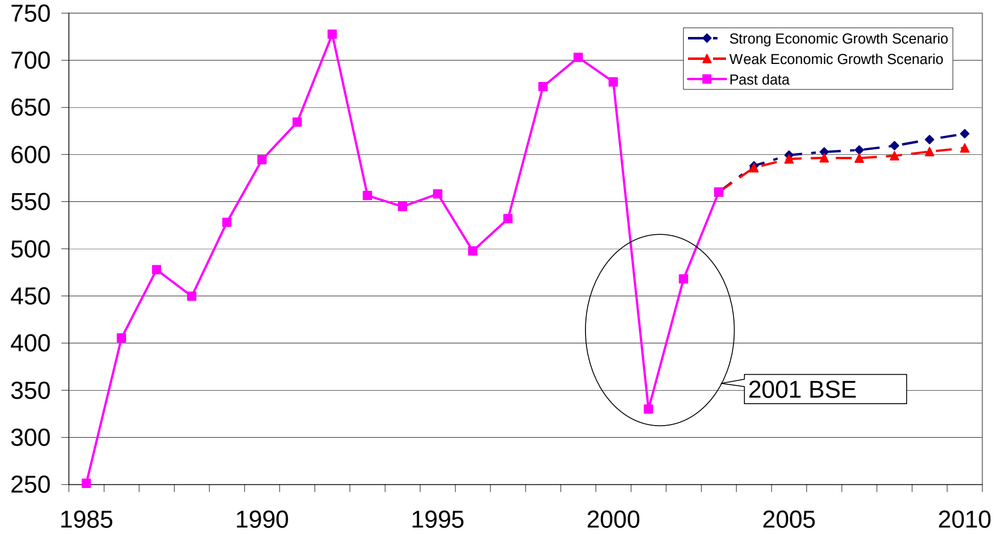


Figure 2.5 Cattle imports into the Netherlands, 1985-2010 (1,000 head)

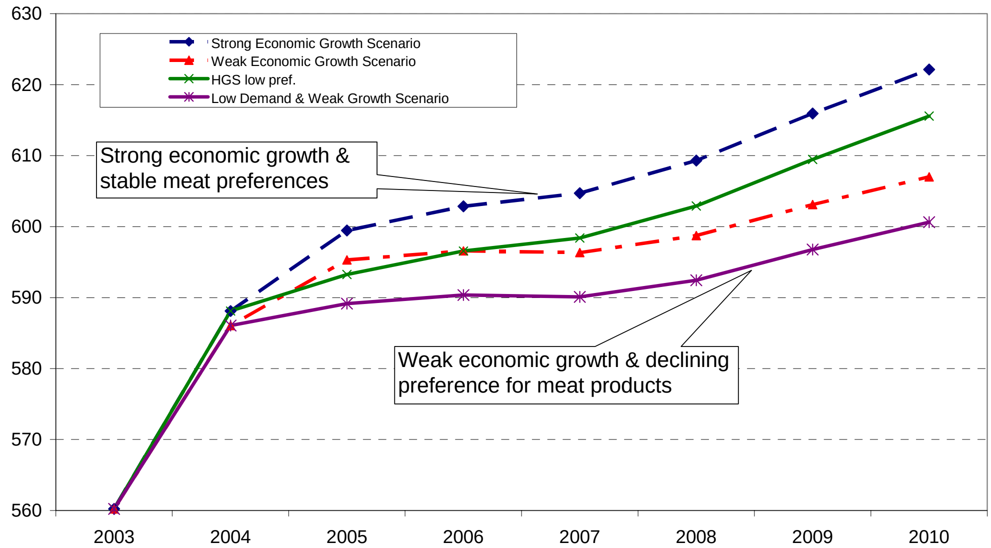


Figure 2.6 Consumer preferences and cattle imports, 2003-10 (1,000 head)

These prospects of import growth are in stark contrast to earlier estimates by Bondt et al. (2003). Based on an extrapolation of the 1992-2000 trend they projected Dutch cattle imports to decline to 400,000 head in 2007. We can explain the differences by the following reasons:

- Our data do not confirm the steeply declining trend in cattle imports between 1992 and 2000 that Bondt et al. find. Our data, which are combined PVE and I&R data, show strong growth rates between 1996 and 2000, which almost level out the declining trend between 1992 and 1996;
- Bondt et al. assumed decoupling of price support in all sectors including beef and veal, an assumption that reality proved wrong. In fact, the Netherlands was among the countries where support to beef and veal producers remains fully coupled to production until 2010. Hence, the contraction of stable capacity prospected by Bondt et al. occurs only to the extent of the 3 to 5% cut on farm payments;
- Calves account for an increasing share in cattle imports, as the Dutch milk herd shrinks and delivers decreasing amounts of calves to the stables of the integrated veal producers. About 90-95% of the Dutch veal supply is exported within the EU25 as well as countries outside the EU. Our analysis reveals that the demand for veal is robust throughout the projection period, and recovers from crisis-related low levels in 2001-02. The positive market prospects for veal products from the Netherlands on the medium term were not taken into account in the Bondt et al. analysis. We assume that the share of Dutch meat in the global market place depends largely on the costs of producing in the Netherlands vis-à-vis competitors in Italy, Belgium, Spain and elsewhere. According to the simulation results Dutch producers will up-hold their market share, albeit with more ease under weak economic growth. Consequently, cattle imports will grow.

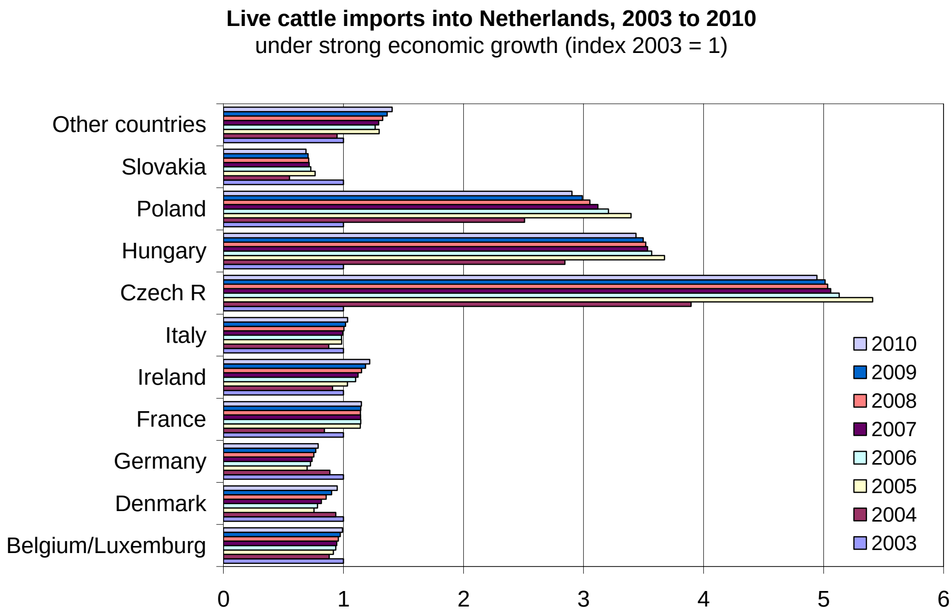


Figure 2.7 Imports into the Netherlands per country of origin, 2003-2010

There is a kink in the growth rate for aggregate cattle imports into Netherlands. Imports growth from CEEC in 2004 is caused by enlargement and in 2005 by decoupling in EU15 (lower subsidies means lower production so higher prices in EU15 compared with CEEC). Since 2006, exports prices of cattle in CEEC increase more than in EU15, because it was assumed (in EURURALIS and so in this project) that total factors productivity (TFP) increase more in EU15 than in CEEC (yearly growth rates 0.53 in EU15 versus 0.014 in Poland in HGS). In this way CEEC is loosing its competitiveness.

…But shifts in consumer tastes may reduce imports
In recent years, consumers in the EU have revealed increasingly strong preferences for poultry and pig meat. The share of beef and, to a lesser extent, veal in total meat consumption is under pressure due to a desire for reduced preparation time, and more pre-packed meals. In addition, ruminant meat consumption has suffered from several scares relating to food safety and the feed integrity in the cattle sector. It is quite likely that consumers will structurally lower the share of ruminant meat in their diet.

We explore the impact of the demand reduction on the Dutch cattle sector. In model terms this is done through a reduction in the fixed component of consumer demand by 1% for all years of the projection period. Figure 2.6 confirms that imports by veal producers are largely responsive to the prospects for the marketing of products. Reduced demand puts downward pressure on prices to which producers respond by curtailing supply. According to our results, a demand fall-out by 1% results in a proportional decline of Dutch imports.

For current purposes, we must assess the impact of shifting consumer tastes on the range of uncertainty in the projected imports. The range is consistently widened over the projection period through a 1% downward reduction on the projected imports under the weak growth scenario. The scenario that examines demand fall-out under weak economic growth provides us with a lower bound to our projections of cattle imports into the Netherlands.[1]

Imports from New Eastern Member States surge
In the early years of the projection period Dutch cattle imports from the new member states (NMS) step up, then peak in 2005, followed by a gradual decline. Total imports from the NMS grow from 40 thousand in 2003 to between 160 and 190 thousand in 2010, depending on the level of economic growth. The equivalent import share grows from 9% in 2003 to between 26 en 31% in 2010. Average annual growth in the years 2003-10 is as large as 200%. Table 2.5 reports traded volumes and import shares in 2002, and projections for 2006 and 2010 under the assumption of strong economic growth. Most adjustments occur in the years before 2006. After 2006 there is a slight reversal of effects. The share of Polish cattle will grow from 7% in 2003 to about 27% in 2005, and then declines to 25% in 2010. From 2005 onwards, Poland replaces the Belgium/Luxemburg region as runner-up country of origin.

[1] The projected imports in the demand fall-out scenario under weak economic growth differ significantly from imports in the high growth scenario at the 10 percent significance level.

Table 2.5 Cattle imports into the Netherlands by country of origin under strong economic growth, 2002-2010

	Volume ('000 head)			Share (%)		
	2002	2006	2010	2002	2006	2010
Germany	236.2	202.7	220.2	50.5	33.6	35.4
Poland	25.2	145.2	131.5	5.4	24.1	21.1
Belgium/Luxemburg	124.4	115.9	123.0	26.6	19.2	19.8
Ireland	4.7	38.3	42.3	1.0	6.3	6.8
France	32.5	41.7	41.9	6.9	6.9	6.7
Denmark	38.2	24.1	29.2	8.2	4.0	4.7
Czech R	4.6	30.1	29.0	1.0	5.0	4.7
Other countries	2.1	2.8	3.1	0.4	0.5	0.5
Italy	0.0	0.7	0.7	0.0	0.1	0.1
Hungary	0.2	0.7	0.7	0.0	0.1	0.1
Slovakia	0.2	0.5	0.5	0.0	0.1	0.1
Total	468.1	602.9	622.1	100.0	100.0	100.0

Source: 2002 data from the Netherlands Ministry of Agriculture, Nature and Food Quality: Animal Identification and Registration service; 2006 and 2010 data are LEI projections under the strong growth scenario.

Surprisingly, the flow of imported cattle from NMS is bigger under weak economic growth than strong growth. This reflects the feature that differences in factor costs between NMS and EU15 are more resilient under weak growth - stated otherwise, imports from NMS countries remain cheap under weak growth. Imports from Poland, the Czech Republic and Hungary show particularly strong growth. Figure 2.7 reports on the growth in the volume of imports per region of origin, where annual trade is indexed against the 2003 volume, which reveals the following interesting features in the projections:

- Dutch cattle imports from Poland and Hungary triple as they respond strongly to EU enlargement. Imports from the Czech Republic jump by 400-500% but the Czech import share remains limited to about 6%. Cattle imports from Slovakia were next to nothing and decline even further. Note that Hungary's trade is booming but volumes remain too small for a substantial share in Dutch cattle imports;
- The NMS bite share from traditional origin countries such as Germany, Belgium and Denmark. Nevertheless all traditional partners remain important sources of origin as not a single country experiences dramatic decline. Ireland also gains importance. Hence, the import structure broadens over the coming years;
- While imports of Czech and Hungarian cattle peak towards to the end of the projection period, Poland shows a slightly declining trend from 2005 onwards. After 2005, NMS imports diversify in term of origin and the traditional countries recover some of their losses.[1]

[1] In the LGS scenario, the Polish exports of cattle to the Netherlands decrease since 2006 whereas exports of other analyzed EU10 countries increase. It is caused by relatively high market price of Polish cattle compared with other counties and average Dutch import price. Polish price is higher than in other EU10 countries mostly due to high prices of primary factors. Land prices are relatively higher in Poland because the yield decease in Poland is much lower than in other countries (in Slovak Republic even an increase of yield is assumed). Moreover, the assumed GDP growth for Poland is relatively high compared with Czech Republic and Hungary, which creates higher pressure on factors markets compared with these countries. Only Slovakia

Causes of growth
EU enlargement in May 2004 is the prime driver of import growth from the eastern countries. The enlargement removed remaining trade barriers, notably the import quota of 500,000 head administered by the beef committee under the European Commission. By consequence of price differences between EU15 and NMS, surplus cattle is directed towards the former EU15 countries. Also, it is expected that a larger share of EU imports from NMS will flow to the Netherlands such that the Dutch share on the European input markets is more in line with the 20-25% Dutch share on output (i.e. veal) markets.

A second cause for steep growth is the (partial) decoupling of support to cattle farmers in the EU15 countries in 2005. Lower subsidies means lower production so price increases for meat in EU15 compared with NMS. As the price response for 'production cattle' is strongly correlated to veal prices (Van Leeuwen, 1998), we expect a price rise for calves in EU15 relative to NMS. This pulls even more cattle from the eastern countries into the former EU15.

After 2006, we see imports from NMS decline due to limited export supply and a loss of competitive edge. Export prices of cattle in NMS increase more than in EU15, because it was assumed that productivity increases more in EU15 than in NMS.[1] In this way the NMS gradually lose their competitiveness.

2.7 Current policies to address import risk for animal diseases

The trade of live animals across countries bears the risk of transmitting animal diseases from the country of origin to populations of people or animals in the importing country. Chapter 3 describes several routes of infection. In the Netherlands, the management of import risk, the risk of importing animal diseases through livestock imports, covers at least four elements: hygiene of transports; animal identification and registration; veterinary inspection; and quarantine. Each of these elements is discussed below.

Hygiene
In order to prevent the transfer of infectious agent through transport, carriers must abide by rules regarding hygiene.[2] In general, between each transport the vehicle must be cleaned and decontaminated on a designated station. Cattle transports depart from the Netherlands - usually without cargo - accompanied by a certified proof of cleaning. Upon return in the Netherlands, after unloading cargo, the vehicle is cleaned again. Occasionally, carriers find the opportunity to handle additional cargo outside the Netherlands.[3] For specific countries,

---

has higher GDP growth than Poland by contrary to Poland and other analyzed EU10 countries the employment growth is assumed for Slovakia.

[1] The assumptions on total factor productivity were taken from the EURURALIS analysis. Yearly growth rates are 0.53 in EU15 versus 0.014 in Poland in HGS.

[2] Hygiene is denoted in Dutch regulation as *reiniging & ontsmetting* (RO).

[3] The interior of the transport vehicles is equipped to a specific type of animal in terms of boxes, layers, etc. By consequence there are large coordination costs to the handling of cargo outside the Netherlands. The suggestion of a respondent within government that carriers handle packed goods on their outbound itinerary was not confirmed by the Saveetra secretariat.

where there is increased risk of picking up highly infectious agents, such movements result in additional hygienic obligations.[1]

In general the respondents support the continuation of current hygiene policies. According to a representative of the carriers, the re-decontamination is problematic in some of the NMS where the national government has not designated official washing stations.[2]

Animal identification and registration (I&R)

In theory, the veterinary authorities register all animal movements between EU member states. Within the EU an animal passport is the vehicle that allows to trace animals to their origin. In the Netherlands, these passports are managed by the Identification and Registration (I&R) service of the Ministry of Agriculture, Nature and Food Quality. The core of the procedure is as follows:

Step 1: The exporter notifies the planned shipment in ANIMO-Traces on the basis of the identification number in the country of origin. If imports originate from third countries, animal registration is done at EU border posts (before Polish accession to the EU, for most Polish cattle this was done at Frankfurt a. d. Oder);

Step 2: Upon unloading at assembly centres in the Netherlands, foreign passports are submitted to the veterinary authorities. Inspectors then undertake a conformity check on earmarks and documents, and a veterinary check on the clinical health of the animal;

Step 3: 'Hermerken': issue a Dutch animal passport, register the animal in the I&R database (sex; colour; age; farm of origin and farm of destination; carrier registration plates etc.), and apply earmarks to the animal. Naturalisation is not done if the imported animal is taken straight to the slaughterhouse.

Although the final destination of imported cattle is traceable in I&R data, the transport within the Netherlands is not registered in the I&R database, except in case the animal is exported.[3]

Veterinary inspection

Regular veterinary checks are undertaken before transport in the country of origin, and upon arrival in the Netherlands. In addition, Dutch authorities apply spot checks, that currently consist of document checks in 5% of the transports while no physical checks including sampling of animals for disease are conducted (personal communication K. Steijn, Food and Non Food Authority (VWA), 2004). Directive 905/425/EEC allows for 10% non-discriminatory spot-checks in the country of destination. The Dutch authorities are currently not doing any physical checks for animal diseases upon arrival of livestock

[1] At the time of the interview these countries were Slovakia and Italy, in relation to outbreaks of swine vesicular disease (SVD) in Slovakia and classical swine fever (CSF) in Italy.

[2] All EU countries should provide official washing stations. At a shortage of such stations washing is possibly done below EU standards. Of additional concern to the carriers is the inability to have their cleaning activities certified on the governmental level.

[3] It may well occur that a consignment of imported cattle is dispersed over several farms. In the process, some of the veterinary information on the original health certificate is lost. A health certificate from the veterinary service in the country of origin accompanies a consignment of animals. Theoretically, the I&R service could register the dispersion of consignments, but at the time of the survey this was not being done.

transports except for the cases where animals with clinical signs of disease are detected as required by Directive 64/432/EEG.

In addition to the veterinary checks there are road checks by the AID, inspection service of the Ministry of ANFQ. The purpose of these inspections is to enforce several regulations on (animal) transports related to maximum carrier weight; animal welfare; travel time etc.

Quarantine

Cattle farms that have purchased ruminants are kept closed for 21 days under the *21-dagen regeling*.[1] Imported livestock is kept under quarantine on designated assembly centres, often a large farm owned by a trade house.[2] Under the 21-days rule, those farms are closed after receiving the imported livestock for 3 weeks before the cattle is released and transported to a farm in the Netherlands.

While there is little discussion in the Netherlands on the need for a quarantine policy, various livestock holders have questioned the limited flexibility of current policies. During an interview an executive at one of the major veal producers expressed that the company would prefer to have quarantine take place at the contract farm.

The animal movements on contract farms follow the all-in-all-out principle, i.e. one consignment of calves fills an empty stable and after 6 months is taken to slaughter in one batch. Because of this, so the producer claims, contract farms are able to organise a quarantine that is equally effective and trustworthy as assembly centres, while causing less disruption to day-to-day business. On-farm quarantine requires public trust in private actions. Trust could, in theory, dwell on the comprehensive certification structures in veal production of which *Stichting Kwaliteitsgarantie Vleeskalveren* (SKV) and IKB-Kalveren (*Integrale Ketenbeheersing)* are the most relevant.

2.8 Policies governing animal transports over the long distance

The outlook is for a recovery of cattle imports to their highs from the late 1990s and for increased trade from the new member states. This section examines whether the outlook is consistent with the changes that occur to policies and institutions governing cattle trade over the projection period.

In recent years, the transport of cattle over the longer distance has provoked intense debate on both national and EU platforms. Some consider such animal movements out of line with the EU-wide efforts to prevent the spread of animal diseases, and to raise the welfare of production animals. Others point to the notion that animal transports are part and parcel of the pan-European food market. The livestock carriers themselves oppose to the notion that transport is a source of risk and animal maltreatment. At the Agricultural Council of November 2004, the political debate in the EU culminated in an agreement on stricter

[1] The so-called '21 days quarantaine measure' (*Regeling aanvullende voorschriften besmettelijke dierziekten*) became valid Dutch legislation on 15-09-2004 and implements Decision 2001/327/EC by the European Council: concerning restrictions to the movement of animals of susceptible species with regard to foot-and-mouth disease and repealing Decision 2001/263/EC.

[2] According to the policy '*Regel voor het bijeenbrengen van dieren*'.

welfare rules for the transport of animals over long distances. Below the import outlook results are reviewed in view of this agreement.

Journey time and distance
More trade results in more transport. An increased supply of newborn calves from Poland and other eastern European countries reduces the demand for animals from neighbour countries. By 2006 the share of our neighbour countries has reduced to just over 50%, while that of the NMS will have risen to 25%. Cattle transports from Belgium and Germany into the province of Gelderland, the centre of veal production in the Netherlands, span 200 and 500 kilometres, on average. A transport from Poland, say from the Warschau area, stretches over 1,200 kilometres and about 18 hours. Prague, the capital of the Czech Republic, is 800 kilometres and about 12 hours away. Some tentative calculations with these numbers on the data in table 2.6 reveal that the average distance over which import animals are transported to the Netherlands will increase from 509 kilometres in 2002 to 694 in 2006 (if both scenarios are equally likely), a 36% rise.[1]

The journey distance for animal transport in the EU is currently unrestricted. Journey times are limited to 19 hours for very young animals, and 29 hours for cattle including a compulsory 1-hour stop. Travelling times for drivers are limited to 22 hours. It is common opinion that the limits are poorly enforced.

Despite a call from European Parliament to restrict the transport of live animals to 500 kilometres and 8 hours, the November 2004 agreement left current policies on journey time and distance requirements unchanged. For livestock carriers that service the new member states, the journey time for drivers remains to be the binding regulation. While the debate on a more restrictive maximum to journey time and distance will proceed, an EU agreement on the matter is not to be expected in the coming years. Meanwhile, efforts will focus on the enforcement of animal transport rules. Carriers should prepare to have satellite navigation tools implemented in their vehicles by 2009. Transparency and private disciplinary rules should provide them with incentives to align their behaviour 'on the road' to the public interest.

Animal welfare
There are basic rules for animal welfare during transport. One respondent stated that the maximum load for the vehicles restricts the density of animals. In addition, there are rules regarding the supply of water, feed, and fresh air. According to the respondents who represent carriers and integrated veal producers, animal welfare concerns should be addressed through the conditions during transport, rather than the journey time and distance. To some extent traders have an operational interest in improving the conditions during transport, as far as these reduce stress with the animals. The respondents from the realms of business seek to employ technology in order to improve animal welfare during transport such as the use of closed cabins with air control.

We conclude that animal welfare rules and policies governing transport will not impede more trade. Provided that the Dutch livestock carriers that service the new member

[1] Starting from January 2005, haulage vehicles are subject to toll collection on the motorways in Germany. This affects all imports from the NMS into the Netherlands.

states will maintain their investments in technological improvements of animal conditions, the expected expansion over the projection period of animal transports from the east is feasible within the policy context, and likely to occur.

2.9 Conclusions

The recovery of Dutch cattle imports continues until 2006

The study examined the growth and regional structure of cattle imports into the Netherlands in the coming years. Still recovering from the low levels of 2001 when BSE and FMD crisis disrupted meat markets, total imports of live cattle into the Netherlands will grow to around 600.000 head in the coming years.

The share of NMS cattle rises

Dutch imports from Poland, the Czech Republic and Hungary triple after EU-accession. The new member states deliver at least 25% of Dutch imports by 2006. After 2006, the growth of Dutch imports from the NMS slows down. Trade growth is most resilient, however, in case of sluggish economic development in the NMS.

Already in 2004 Poland becomes the second most important country of origin for cattle imports into the Netherlands, after Germany but replacing Belgium as runner up. The flow from the Czech Republic also increases, up to levels of Ireland, France and Denmark. Trade with some of the minor countries is resilient, i.e. the import structure broadens. The uncertainty in the projections - measuring up to 30,000 head in 2010 - is due to macroeconomic growth in the EU25, productivity growth, and developments in consumer tastes and consumer concerns. The uncertainty increases further if the demand outlook on the EU market is more positive than we assumed. The surge in imports from the new member states is stronger under weak economic growth, basically because imports remain cheap under an economic slowdown.

EU animal welfare policies will not impede more trade

More trade and more distant countries of origin result in more transport over longer distance. The average distance over which an imported animal is transported will rise from 509 kilometres in 2002 to an estimated 694 kilometres in 2006, a 36% rise. The transport of animals over longer distances is subject to debate with respect to the welfare of transported animals. An agreement of the European Council in November 2004 leaves journey time and distance requirements untouched, and focuses on better enforcement of existing rules. Provided that the Dutch livestock carriers that service the new member states will maintain their investments in technological improvements of animal conditions, the expected expansion over the projection period of animal transports from the east is feasible within the policy context, and likely to occur.

3. Quantitative Risk Assessment

3.1 Introduction

This chapter provides a quantitative risk analysis of introducing animal diseases into the Netherlands through the legal imports of cattle.[1] Also, we aim to generate arguments in favour of risk-based inspection for infectious animal diseases within the European Union.

Focus lies on some of the new EU member states (NMS). The NMS do not *a priori* pose an increased risk for introducing infectious agents through intra-communitarian trade, given the standardisation of the EU regulations, detection and surveillance strategies of infectious diseases. It is therefore necessary to compare the country-specific risk of disease outbreaks with the risk for introducing infectious agents through the intra-communitarian trade. The research for chapter 2 (Phase I) yields the information about trading patterns to be used for the risk assessment (phase II), which is summarised in table 3.1. It describes four NMS: A, B, C, and D (reported anonymously).

3.2 The general structure of a quantitative risk analysis

The general structure of the risk analysis according to the WHO recommendations is shown in figure 3.1.

Hazard identification

During the hazard identification, the hazards are described as to which infectious agents (FMD virus, BTBC, leptospirosis in cattle, semen and milk) are studied, where do they originate from, when did the last outbreaks take place in the 4 NMS under study (countries A,B,C,D), which geographical characteristics play a role in the trading patterns and what are the control measures against infectious diseases and their effectiveness in the countries of origin. This information is summarized in figure 3.2.

[1] We gratefully acknowledge the help of all partners in the process of data collection and the analysis and Dr. Armin Elbers for his friendly comments.

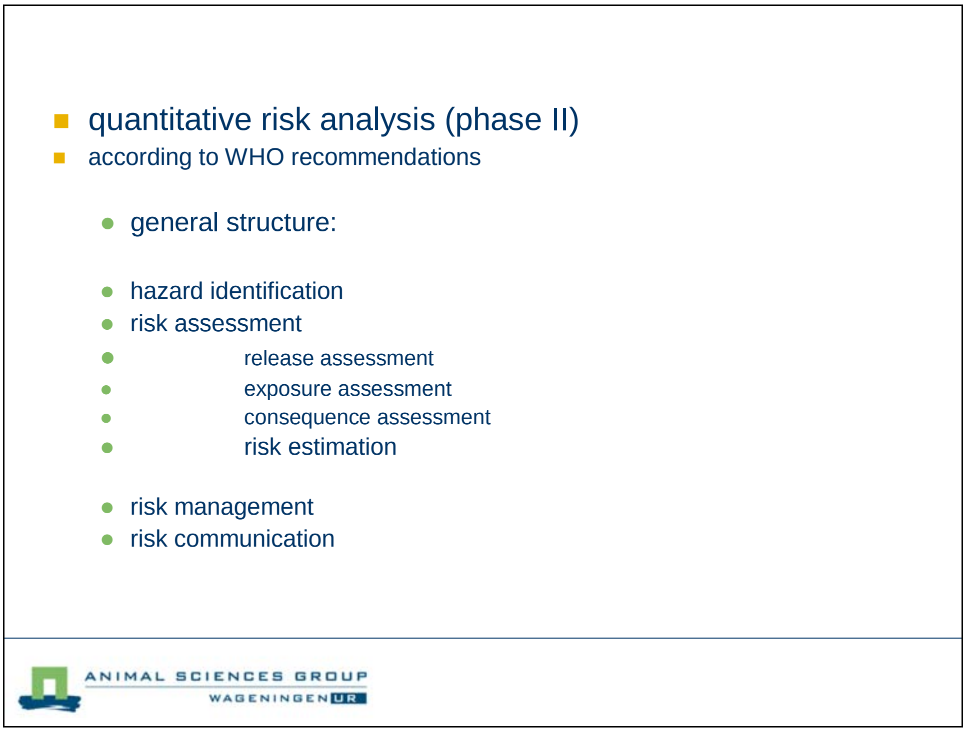


Figure 3.1 Structure of a risk analysis according to the WHO recommendations

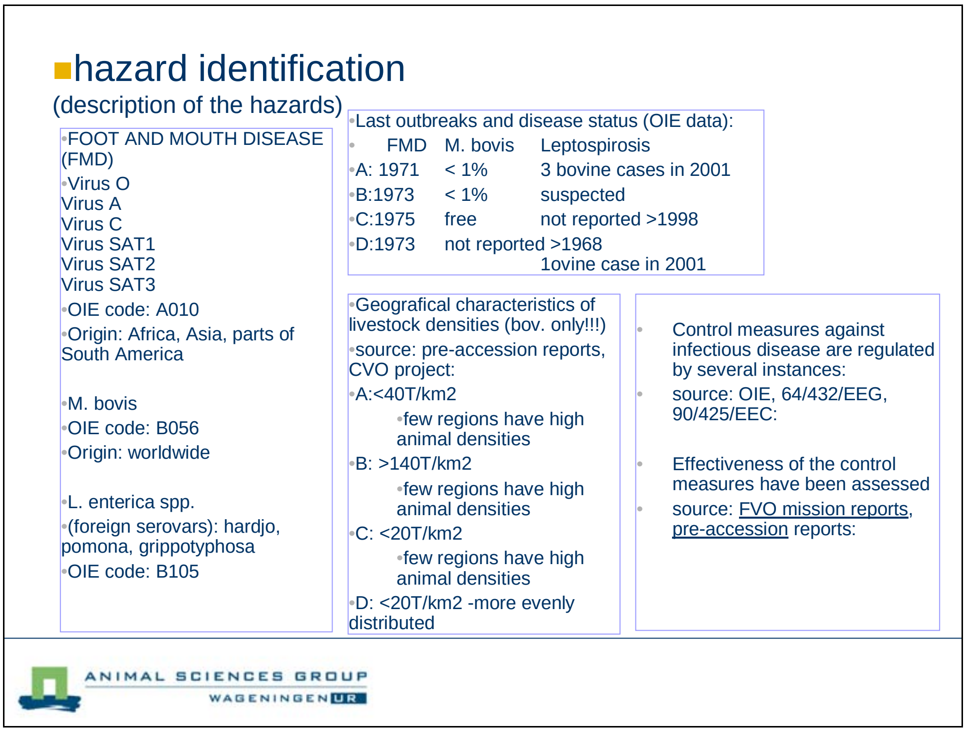


Figure 3.2 Hazard identification in the four NMS under study

Risk assessment
The components of a risk assessment as part of a risk analysis are shown in figure 3.3. Release and exposure assessment were taken together and scenario pathways developed for livestock, semen and milk products separately.

Initially, it was assumed that the consequences of introducing infectious agents into the Netherlands through trade would be negative (outbreaks are possible), but it was beyond the scope of this study to assess the consequences quantitatively. The details of particular consequences will be discussed at the end of the three quantitative risk assessments separately and in chapter 4 where recommendations for minimizing risks of introduction and the consequences are given.

Risk estimation is to ask: what can go wrong, how likely is that to happen and what are the consequences of the failure? For the purpose of the quantitative risk estimation of the two endemic diseases BTBC and leptospirosis, scenario pathways were developed and the distributions for risks simulated using Markov Chain Monte Carlo Simulation by means of a Gibbs sampler (Spiegelhalter et al., 2000; Vose, 2000), and expected values of the distributions returned by the simulations including their 95% confidence intervals.

Risk analysis was done exemplarily for the following countries and infectious agents:

FMD: country A
Bovine tuberculosis: country A
Leptospirosis: country C

Note: the risk assessments for semen and milk were not carried further than the theoretical framework (see figures 3.10, 3.11 and appendix B because of expected negligible risks of introduction of infectious agents under study into the Netherlands. The volumes of semen and milk products imported into the Netherlands from the four NMS are very small and no fresh milk is imported from the four NMS under study. The processed milk that does enter the Netherlands from the 4 NMS under study has received a treatment that has inactivated all pathogens under study (see appendix B2.5).

The necessity to re-elaborate on the scenario pathways for milk and bovine semen in more detail may arise urgently in the near future given the expected expansion of trade volumes from the NMS as shown in chapter 2.

Risk communication
Risk communication is accomplished exemplarily using this report. Possible additional vehicles for the dissemination of the research findings include a consultation with the stakeholders to livestock trade in the Netherlands and the EU.

Risk management
Recommendations for risk communication and for the management of the risks are summarised in chapter 4.

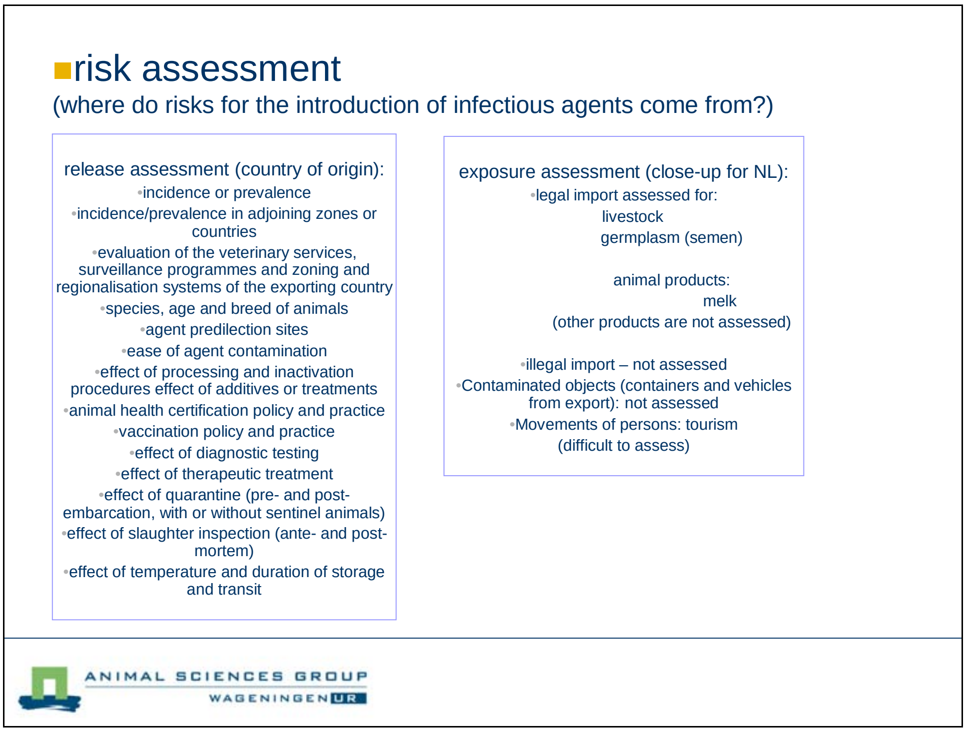


Figure 3.3 Risk assessments to evaluate where the risks for introduction of infectious agents come from

Quality of data for the risk analysis

It has been almost impossible to collect data about the infection status from the four countries in the study. In case of such a lack of data, it was decided to use the data reported to the OIE, ADNS and literature. The quantitative risk analysis could only be conducted exemplarily, because of this lack of data and time. The greatest problem was estimating the herd prevalence and total prevalence or incidence of bovine tuberculosis and leptospirosis in the countries of origin.

If a quantitative risk analysis is to yield concise risk estimates, it is essential to improve the animal disease notification system internationally, including the notification of total numbers of herds and animals present, total number of herds tested, number of animals tested per herd, number of herds found positive, number of animals found positive per herd. At this point in time, this type of information can only be collected directly in close collaboration with and consent of the countries under study.

The attempt of collecting more data has not been accomplished due to a lack of resources and time.

Table 3.1 Livestock imports from the study countries into the Netherlands in 2003

Country of origin (year)	Total import (head)	Through-traffic to (head) (country)	Total remaining in NL (head)	From # of places for departure	To # of places in NL	Type of cattle	# of consignments average # of animals/consignment
A (2002)	27.507	3.212 (IL)	24.295 (ANIMO)	19 (14 for cattle remaining in NL)	53 for cattle remaining in NL	beef except for 3 head of breeding animals	169 total of which 18 through-traffic 161 animals/consignment (excl. through-traffic and breeding stock) 99.9% are calves <3 months of age
B (2003)	332	0	332	3	6	beef breeding	8 total of which 2 w. breeding stock average of 33 animals/consignment excl. breeding stock (66 breeding animals/consignment)
C (2003)	3.960	0	3.960	9	20	beef breeding	37 total of which 1 w. 18 head breeding stock average of 110 animals/consignment excl. breeding stock
D (2003)	708	0	708	2	5	beef	8 average of 89 animals /consignment

Source: ANIMO, Food and Non Food Authority, the Netherlands.
Note: For the purpose of this risk analysis, the ANIMO data will be used. For the data used in phase II, the ANIMO data are very similar to the I&R data.

3.3 Risk analysis for foot and mouth disease

Background information and assumptions for the FMD risk analysis
The structure of the risk analysis for the risk of introducing foot and mouth disease (FMD) virus into the Netherlands is illustrated in figure 3.4 and all background information and assumptions will follow in the text. Despite of the doubts about the validity of qualitative risk analysis as conducted by Gallagher et al (2002) their study serves as background information for the risk of introducing FMD virus into the 4 NMS under study, the expected number of primary outbreaks in the 4 NMS between 2000 and 2005, the routes of introduction into the 4 NMS in relation to the routes under study. During the current quantitative risk analysis though, an exponential outbreak model was developed to model the number of expected infected farms per day after a primary outbreak, the probability of 0 infected consignments per day of the High Risk Period (HRP, see below) depending on the chance of an infected farm shipping animals during the HRP.

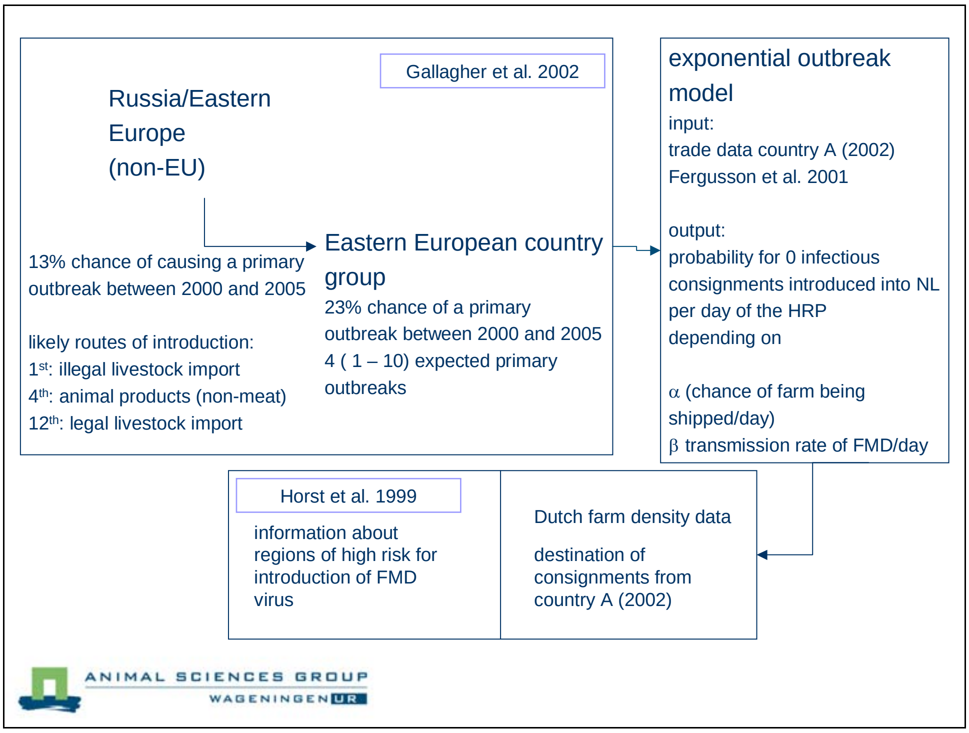


Figure 3.4 Structure of the risk analysis for introducing FMD virus through imports from NMS with special reference to country A

Gallagher et al. (2002) reported a qualitative risk analysis for the introduction of FMD virus into Europe from third countries where 1 outbreak is expected every 5 years originating from Balkan countries and Turkey and secondly from the Russian/European group of countries (see below).

The four NMS studied during this project belonged to a total of 8 countries in the Eastern European Country groups according to Gallagher et al. (2002). Their mean percentage probability of having a primary outbreak of FMD was calculated to be 23%, while experiencing on average 4 primary outbreaks (95% C.I.: 1-10) between 2000 en 2005.

The four NMS under study have common borders with the so-called Russia/Eastern Europe group in Gallagher et al. 2002. The Russia/Eastern Europe group of countries was considered to be second in rank after Turkey and estimated to have a mean percentage probability of 13% for being a source of a primary outbreak for FMD in a European group (among which the Western European group including The Netherlands and the Eastern European group including the four NMS under study). The highest mean percentage probability of being the route of introduction of FMD into a European group country was the illegal import of livestock estimated to be 21%. The legal import of animal products other than meat ranked 4th and was estimated to have a mean percentage probability of 6% for being the route of introduction of FMD virus into European countries from non-European countries, while the legal import of livestock ranked 12th and had a mean percentage probability of 4% only.

The model for spread of FMD virus during the High Risk Period (HRP)

The High Risk Period (HRP) is the interval of time (days) between the first infection of a susceptible animal (bovine only in this study) with FMD virus in one country and the first detection of that virus causing a primary outbreak.

The HRP for country A was assumed to be between 21 and 30 days, although in the stakeholders questionnaire a HRP of about 6 days was filled in for the four countries under study. During the UK outbreak of 2001, an infectious period of T= 18 days was assumed for the UK (Fergusson et al., 2001).

A simple exponential model (see equation 1) has been developed to model the spread of FMD virus after the first infection of an animal has occurred. The first infection is the start for the so-called primary outbreak. It was assumed that mostly the so-called long distance spread (f.e. contacts between farms by f.e. transportation of animals) plays a role during the HRP (short-distance spread depends on spatial structures of the population[1] and besides the fact that we did not have the geographical information necessary, short-distance spread plays a greater role after the termination of the HRP) and that no measures of disease combat have been initiated because the outbreak has not been detected yet.

From figure 1 in Ferguson et al. (2001) roughly 220 farms were counted that became infected during the first 18 days of the 2001 FMD outbreak before interventions could take place.

Using an exponential model for the spread of the infection right after introduction of the virus:

$$f(T) = e^{ß T}$$

[1] A farm density of 8.56 farms with animals susceptible for FMD virus infections/km^2 has been assumed for a densely populated area in country A in the CVO project (see report of the CVO project, personal communication T. Hagenaars), wich is very high, but understandable given the low average number of cattle/farm in country A. There were 17,895 sheep farms and 760,569 swine farms in country A in 2002. They are susceptible for FMD virus too and take part in the spread of the infection.

and $e^{ß\,18}$ = 220 farms, we calculated the transmission rate ß = Ln(220)/18 = 0.3 farms infected by one infected farm per day during the HRP. This rate is calculated based on the population of any animal species susceptible for FMD virus including sheep, goats and pigs.

The probability of Q_n infectious transports for export from an infected farm per day of the HRP was calculated using equation (2).

$$Q_n(T) = \frac{1}{n!}\left(\frac{\alpha\, n_0}{\beta}\right)^n \left(e^{\beta T}-1\right)^n \left(e^{-\frac{\alpha\, n_0}{\beta}\left(e^{\beta T}-1\right)}-1\right) \qquad \text{equation (2)}$$

T: the HRP in days
n : number of infected consignments from an infected farm
n_0 : number of farms infected at the start of the primary outbreak
α : probability that a consignment for export to the Netherlands takes place from any farm per day

Total number of cattle herds in country A: 935193 head with an average of 6 head/farm, notice:

Total number of consignments from country A to the Netherlands in 2002: 150 (mean: 12.58 consignments per month, 95% C.I.L 2.2 - 22.87 per month), see figure 3.5.

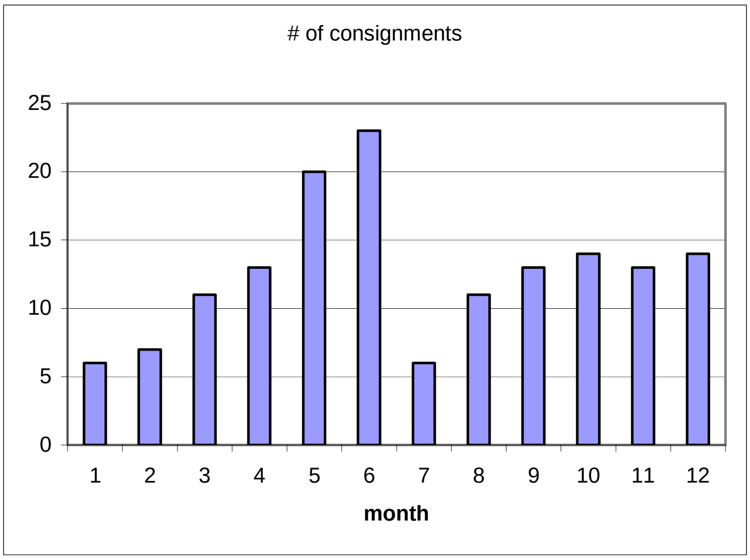


Figure 3.5 Number of consignments per month from country A to the Netherlands in 2002 (mean: 12.58 consignments per month, 95% C.I.L 2.2 - 22.87 per month)

How many farms contribute to a consignment?

Number of farms contributing to 1 consignment:
1 (for an average of 161 head/consignment);
1.62 (for 100 head/farm and consignment);
16.2 (for 10 head/farm and consignment); and
80.5 (for 2 head/farm and consignment).

Number of farms contributing to 150 consignments:
243 (100 head/farm and consignment);
2430 (10 head/farm and consignment); and
12148 (2 head/farm and consignment).

Note. The average number of cattle consignment is 161 head for country A in 2002

The probability for a consignment being exported from any farm per day is α. We calculated 5 different values of this parameter to show the dependency on the number of consignments, the number of farms contributing x head of cattle to one consignment and the fact that it is very likely that only the fraction of the larger farms will ship animals for export:

$\alpha_{161} = (150/935193)/365 = 4.4 * 10^{-7}$
$\alpha_{100} = (243/935193)/365 = 7.1 * 10^{-7}$
$\alpha_{10} = (2430/935193)/365 = 7.1 * 10^{-6}$
$\alpha_{2} = (12148/935193)/365 = 3.6 * 10^{-4}$

It can be seen in figure 3.6 that after a HRP of 30 days there is still a 99% probability of having 0 infectious consignments per day of the HRP. But given the small herd sizes and the changing number of consignments per month, it is more appropriate to make up an assumed scenario and re-calculate the results. It is unlikely that all the small farms will export cattle into the EU, so only a fraction of the farms, those are very likely the larger farms, will contribute to the consignments exported into the Netherlands.

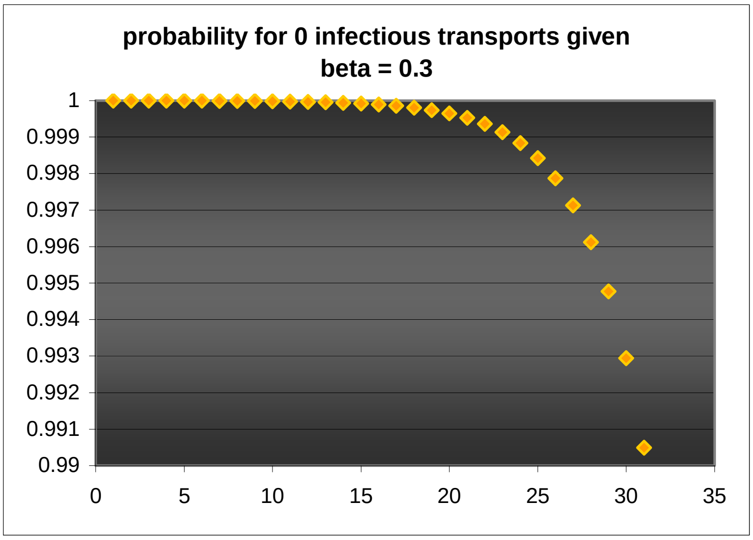


Figure 3.6 Probability for 0 infectious consignments from an infectious farm given 150 consignments per year in country A with an average of 12.58 consignments per month (that is to say that one farm ships per consignment only) and the expected number of farms infected by one infectious farm beta = 0.3

Imagine a *worst case scenario* during an intensive month for export with >20 consignments (assume: twice the average, f.e. the month of June 2002) per month, where only 25% of the larger farms (>10 head/ farm and consignment[1]) export and assuming that only ¼ of all farms is so large that they can ship >10 cattle at once then the average probability for a consignment shipped from any farm per day is calculated as:

$$\alpha_{\text{scenario}} = ((2430/(935193/4))/365) * 2) = 5.7\ 10^{-5}$$

The probability for 0 or 1 infected consignments from an infected farm and the expected number of infectious consignments after a HRP of 21 and 28 days given a realistic case scenario is illustrated in figure 3.7. The exponential spread model predicts f.e. 3557 farms infected after 28 days without any control measures in place yet. This number includes any farm with animals susceptible for FMD virus infection (sheep, goats, pigs etc.). It can be seen from panel (a) in figure 3.7 that the probability of 1 or more infectious transports is >1% after a HRP of >15 days and close to 70% after a HRP of 30 days. From panel (b) it can be concluded that the highest probability of 1 infectious consignment is 0.36 (SD: 0.19) after a HRP of 29 days. The graphs in panels (c) and (d) show that after a HRP of 21 days there is a probability of <10 % for having 1 infectious consignment imported into the Netherlands, while after 28 days there would be already 2 or even 3 or more of them being imported with probabilities of >1%. It is clear that the length of the HRP is crucial for minimizing the risk of importing infectious consignments.

---

[1] Note that given the structure of cattle farms in country A it is realistic to assume that <15% of the farms could contribute 10 calves to one consignment at once. In other words, this worst case scenario is still rather mild.

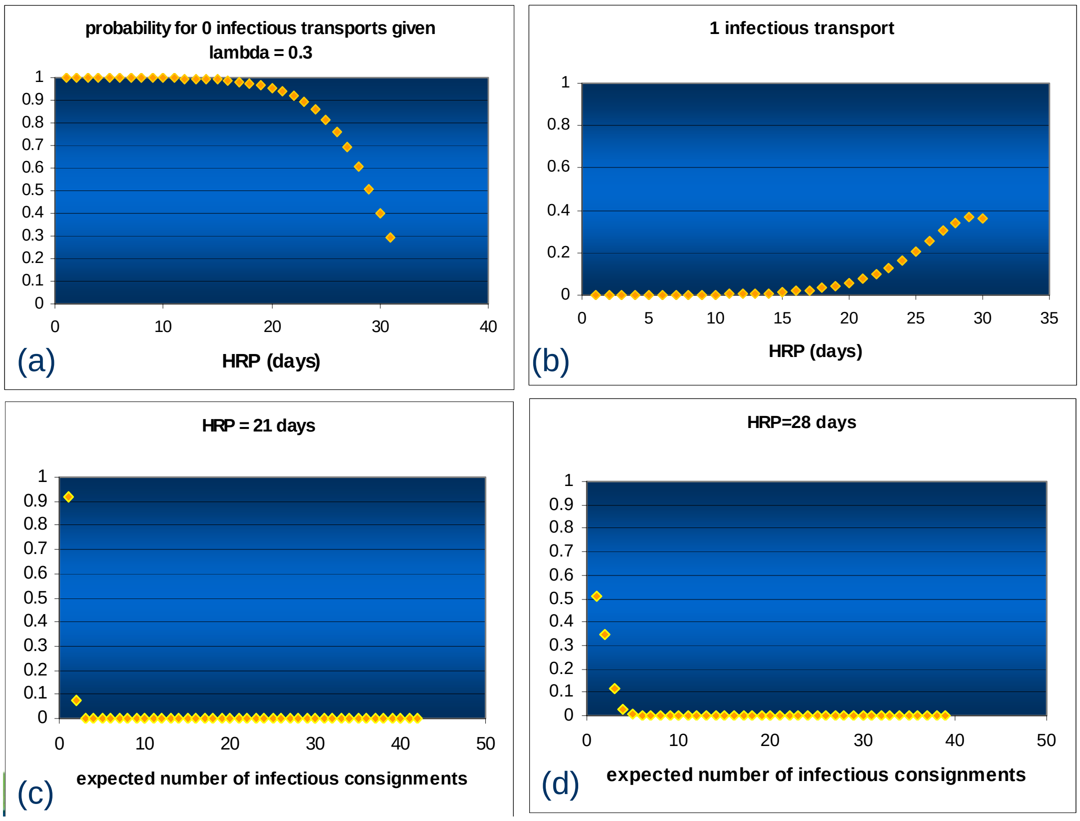


Figure 3.7 Probability for 0 (a) or 1 (b) infected exports and the expected number of infectious consignments after 21 days (c) and 28 days (d) given a scenario of intensive exports/month (twice average), larger farms shipping only assuming that ¼ of the farms is large enough as to be able to ship 10 head at once and a beta = 0.3 (number of farms infected by 1 infectious farm/day)

It is very likely that the animals are re-distributed over several Dutch farms in smaller batches over more locations later on, but it was beyond the scope of this study to gather information about the final destination of the imported animals within the Netherlands. The I&R system could provide this information by tracing all animals. Figure 3.8 illustrates the geographical location for the first destination of the consignments in the Netherlands, which often is an assembly station where animals are kept under quarantine for 21 days. From the map, it is evident that most of the consignments introduced into the Netherlands have their destination in the area of the more densely populated livestock areas. If an infectious consignment arrived there, it is likely that there will be a major outbreak of FMD virus infections in this area as has been stated by the CVO project before and that the standard EU measures will not be able to call this outbreak to a halt before it reaches the borders of the densely populated livestock areas. It is beyond the scope of this study to quantify the size of the outbreak. The reason for the deviation of the high risk regions in this study as compared to the risk reported by Horst et al. in 1999 (the dark areas in figure 3.8) is that the report by Horst et al. classifies introduction through personal movement and animal products as being more important for the introduction of FMD virus than the legal import of livestock.

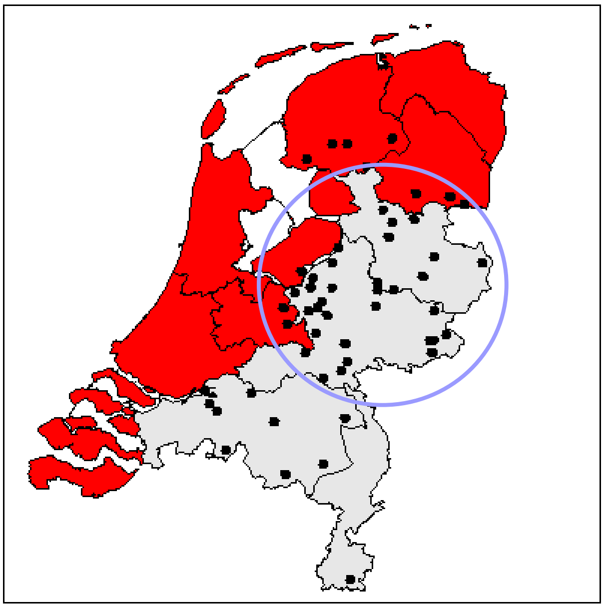


Figure 3.8 The geographical location for the destination of the consignments imported into the Netherlands (black dots); the dark areas indicate the regions of higher risk for introducing FMD virus as reported by Horst et al. 1999, while the circle indicates the highly populated livestock areas where most of the animals susceptible for FMD virus are located and consignments from NMS are often destinated to.

Horst et al. (1999) calculates the risks for virus introduction from different regions (geographical clusters) in Europe and the Eastern European countries among which the four NMS in this study. These countries were reported to belong to the cluster of countries that have the highest risk of introducing FMD virus into the Netherlands. Within the Netherlands, the western and northern regions are most prone to outbreaks of FMD virus according to Horst et al. (1999). According to this reference, it is likely that there will be several outbreaks of FMD virus in the EU in the next 5 years. Gallagher et al. (2002) predicts 1 outbreak of FMD between 2000 and 2005 in the UK based on qualitative risk assessment. The Balkan group of countries (Albania, Bosnia Herzegovina, Bulgaria, Croatia, Greece, Macedonia, Romania, Slovenia, Turkey) was considered to be the most likely group within or adjacent to the EU to have a primary outbreak of FMD and also most likely to have the highest number of primary outbreaks. Turkey was considered to be the country outside Europe which was most likely to be the source of an outbreak within Europe as a whole, and the illegal importation of livestock was considered to be the most likely route of introduction of FMD into Europe (Gallagher et al., 2002).

Conclusion on FMD import risk

The risk of introduction of FMD virus into the Netherlands through trade of livestock with country A is relatively small (<1%) if the HRP in the country of origin is <15 days, but increases rapidly if the HRP is >15 days. If herds shipped 2 cattle/consignment only, because only the small farms ship, then the probability of an infected consignment entering the Netherlands will be non-null (>1%) after a HRP of 8 days already (data and graphs are not shown, but this type of reasoning is a candidate for the demonstration module that is to be developed).

Given the past experiences with FMD outbreaks in the Netherlands and the UK, it is assumed that 21 days are a realistic value for the HRP in the countries under study (the special case of country A in 2002 was studied, but the other countries have comparable scenarios). Given the fact that animals start shedding FMD virus before they show clinical signs of FMD (on average 4 days before), it is likely that the entire consignment is infected by the time it arrives in the Netherlands and that it will not be detected immediately. In the case of a primary outbreak of FMD in the NMS under study and a HRP of 21 days, there is a probability of almost 10% of importing 1 consignment consisting of on average 161 FMD infected animals into the Netherlands. It is most likely that this infected consignment will be introduced into a Dutch densely populated livestock area (see figure 1) where a possible outbreak could not be contained before all susceptible animals were culled in those areas as discussed in the CVO project.

In the case of a prolonged HRP of 28 days in the country of origin, the probability of introducing FMD infected cattle after a primary outbreak of FMD in f.e. country A rises to almost 50% and implies the possibility of more than one (up to 4) infected consignment arriving in the Netherlands without being detected. The introduction implies the possibility of a major outbreak of FMD in a Dutch densely populated livestock area (DPLA). Unfortunately, the exact consequence assessment of the FMD virus introduction was beyond the possibilities of this study. Multiple outbreaks in the Dutch DPLA would paralyse the Netherlands for an indefinite period of time and could cause outbreaks of FMD that will not be contained until all cattle and susceptible animals in those areas were culled and destroyed.

Non-discriminatory spot checks and sampling of consignments as laid down in Directive 90/425/EEC could be used to intensify inspections during the months of more intensive import activities (May and June), when the number of consignments/month is high and intensify them for consignments meant to be received in the Dutch densely populated livestock areas. During those months of intensive import activities, it could be appropriate to motivate consignments where only large farms shipped many animals at once.

3.4 Risk analysis for the endemic diseases Bovine tuberculosis and leptospirosis

In conducting quantitative risk analysis it is common practice to develop scenario pathways and estimate the probabilities for the events along the pathways. The present analysis covers three scenario pathways for livestock (cattle) imports into the Netherlands.

Risk analysis were done exemplarily for the following countries and infectious agents:

- Bovine tuberculosis: country A;
- Leptospirosis: country C.

Scenario pathways
Figure 3.9 summarises the pathway for introducing an infectious agent such as Bovine tuberculosis and leptospirosis while being imported from the country of origin into the Netherlands, when the introduction goes via livestock imports. The approaches chosen to quantify the probabilities along the scenario pathways are described in Appendix B1. The results are provided below.

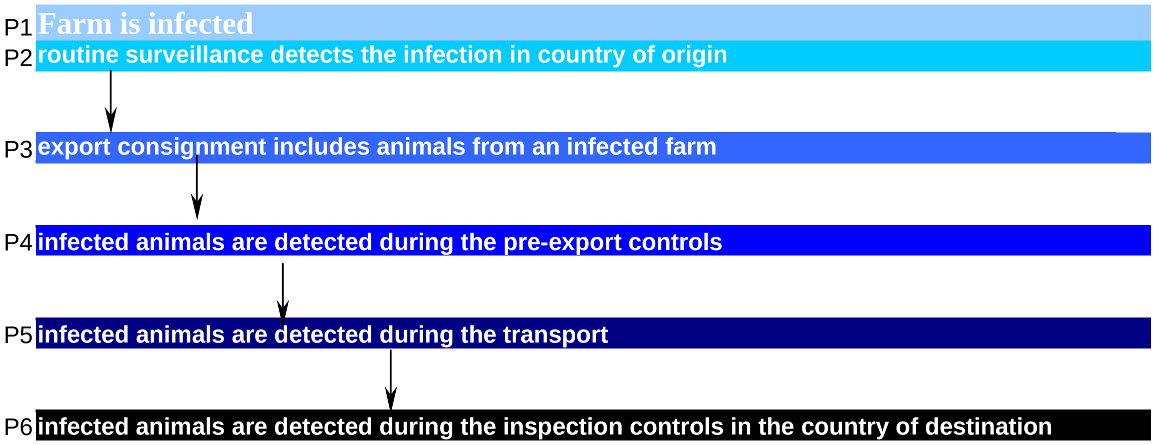


Figure 3.9 Scenario pathway for livestock

3.4.1 Bovine tuberculosis

The approaches and background information for the risk estimation of introducing Bovine tuberculosis through the import of cattle from country A are described in Appendix B1. Conclusions of the risk estimation are as follows:
The Netherlands have a bovine tuberculosis-free status and according to the EU regulations this status is kept as long as <1% of all cattle farms are positive for BTBC on a yearly basis.

If the consequence assessment for the introduction of BTBC from NMS suggests that the intra-communitarian trade will cause >1% of all cattle farms positive per year, that BTBC free status will be lost and actions would become urgently necessary. Even if all positive animals reported to the OIE for country A in 2002 were spread maximally over 255 farms, the BTBC-free status would not be endangered in the country of origin and still, 2 to 10 positive consignments would be exported into the Netherlands per year, given the more plausible scenarios where many farms export few cattle at once.

The 2 to 10 infected consignments each carry 7 positive animals on average, which will not remain alive long enough to cause outbreaks of BTBC in the Netherlands (they need to stay in a susceptible herd for at least 5 years and beef calves live for about 6 months only). They could be infectious though and have a zoonotic potential. So, the risk of introduction of BTBC infected animals is non-zero, but based on previous modelling studies (see Roermund et al., 2003), the impact for animal and human health is probably negligible. It is beyond the scope of this study though to model the expected number of infections caused by the infected cattle imported while they remain alive in the Netherlands.

One thing is for sure: the 10% non-discriminatory spot checks as laid down in Directive 90/425/EEC will very likely miss the infected consignments and most of the infected animals upon entry, because they are too young to be tested anyways.

3.4.2 Risk assessment for Leptospirosis

The pathway that was developed for leptospirosis through the scenario of cattle import is the same as shown in in figure 3.9. In Appendix B1, the quantitative risk estimation for livestock imported from country C into the Netherlands in 2003 being the source for introducing leptospira spp. is specified and the conclusions are as follows.

The Netherlands employ a certification system for the disease-free status for bovine leptospirosis and 99% of the cattle farms are free of leptospirosis as is reported by the Dutch Animal Health Service (2004).

If the consequence assessment for the introduction of leptospirosis from NMS suggests that the intra-communitarian trade will corrupt this certification system, then is would be urgently advisable to take actions such as speeding up the process of establishing a surveillance and eradication system against leptospirosis in the countries of origin. It is expected that all consignments originating from country C in 2003 carry infected animals younger than 3 months of age (expected number of infected animals imported annually: 1883; in 2003, they would be distributed over 36 consignments). Those young animals are more likely to become shedders as soon as maternal immunity drops around 6 to 8 weeks of age so that they could infect others including humans. It is beyond the scope of this study to assess the risk of spreading leptospirosis to other premises than the farms receiving the imported cattle. Given the zoonotic potential of the infected animals, the number of infected animals imported annually is unacceptable and yet, this cannot be controlled using the 10% non-discriminatory spot shecks laid down in Directive 90/425/EEC.

It would be advisable to assess the consequence of corrupting the Dutch certification system against leptospirosis by introducing this high number of infected animals through intra-communitarian trade. The same is true for other infectious diseases, that are currently being erradicated in the Netherlands (BHV1, Johne's disease, BVD/MD etc.) and for diseases with a zoonotic potential (salmonellosis, colibacteriosis etc.).

3.5 The other scenarios: introduction of diseases through germplasm or milk imports

A basic theoretical framework for the risk assessments for semen and milk is laid down in figure 3.10. It is expected that there are neglegible risks of introduction of infectious agents under study into the Netherlands, hence the avenue was not further explored. The volumina of semen and milk products imported into the Netherlands from the four NMS are very small anyways and no fresh milk is imported from the 4 NMS under study. The processed milk that does enter the Netherlands from the 4 NMS under study has received a treatment that has inactivated all pathogens under study.

The necessity to re-elaborate on the scenario pathways for milk and bovine semen in more detail may arise urgently in the near future given the expected explosion of trade volumes from the NMS as shown in phase I. The risk of importing either of the three infectious agents through milk or processed milk products is considered negligible.

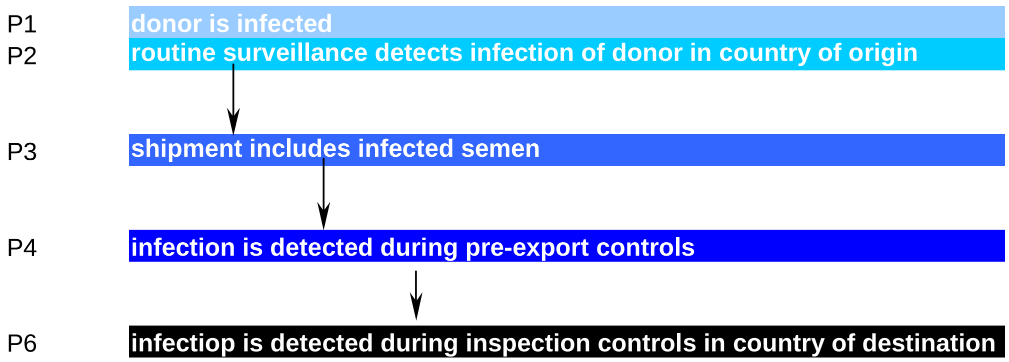


Figure 3.10 Scenario pathway for bovine semen

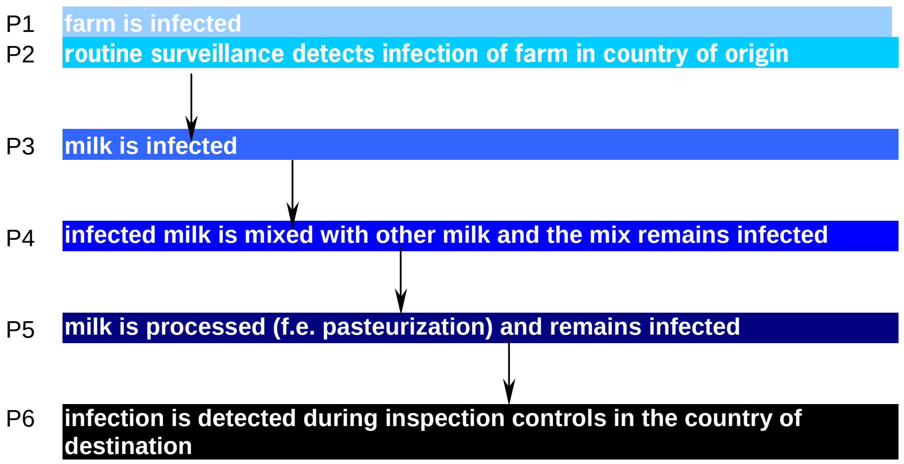


Figure 3.11 Scenario pathway for milk and milk products[1]

---

[1] During the HRP of an FMD outbreak, raw and pasteurised milk will pose a risk for the transmission of FMD for the country of origin and the country of destination after intra-communitary trade of milk and its products. There are currently no exports of fresh or pasteurised milk into the Netherlands from the 4 NMS under study and the milk products imported in small volumes are all processed so that FMD virus should have been inactivated. OIE Terrestrial animal code appendix 3.6.2, article 3.6.2.5 includes the recommendations for the inactivation of FMD virus in bovine milk. Bovine tuberculosis: M. bovis is expected to be destroyed during the heat-treatments required by EU directive 92/46/EEC as long as the process of the treatments are executed according to the regulations (temperature of 71.7 degrees C for at least 15 seconds). The same is true for the infectious agents causing bovine leptospirosis. In the case of a higher flow rate through

4. Conclusion and recommendations

4.1 Conclusions

This study examines the risk of importing animal diseases into the Netherlands through livestock trade. The International Organization for Animal Health (OIE) defines 'import risk analysis' as follows:

> '…the principal aim of import risk analysis is to provide importing countries with an objective and defensible method of assessing the disease risks associated with the importation of animals and their products.'[1]

The definition underscores the close relation between trade and risk related to animal disease. This report examines both aspects with quantitative techniques.

Cattle imports into the Netherlands consist almost exclusively of newborn calves less than 4 weeks of age. The veal industry in the Netherlands heavily depends on animal imports for the productive stock. Cattle imports into the Netherlands are projected up to 2010 at similar volumes as the years before incidents over foot and mouth disease and BSE, i.e. annual levels between 550 and 650 thousand head. In 2004-05, a swift recovery of trade is foreseen, followed by stabilization up to 2010. As more cattle, up to 25% of imports, will originate from the new member states of the European Union, neighbour countries' share will decline. By consequence, the distance and journey time of animal transports into the Netherlands are rising.

There is a wide range of diseases that are potentially introduced through livestock trade. Because a proper quantitative estimate of the risk should be performed on a specific disease, three examples have been selected for the analysis:

1. Leptospirosis represents an infection for which the Netherlands have a disease-free status, whereas the disease is prevalent in most trade partner countries. Moreover, in trade, no guarantees on disease status are exchanged. As a result, large numbers of imported calves are infected. Future study should assess whether the leptospirosis-free status of Dutch dairy farms is at risk;
2. There is a rare incidence of bovine tuberculosis (Btbc) in the Netherlands, and rapid detection and follow-up ensure that the disease-free status is maintained. Disease status differs among trade partners; some countries are managing endemic Btbc through control programs. There is a disease-free guarantee on imported cattle, which, however, fails to apply to young animals. Inspection services, as presently organised, are not effective in preventing introduction of the disease in the Netherlands. There is a chance that imports of infected calves will result in an outbreak of Btbc in

---

the heaters (plate heaters followed by tubes) pasteurisation will be incomplete, especially or Bovine tuberculosis.

[1] See the forthcoming publication by OIE 'Introduction & qualitative risk analysis' Volume I.

the Netherlands. This depends on the age and destination of cattle, and also on the chances that the disease will spread from one infected farm to others in the vicinity;

3. Foot and mouth disease (FMD) represents a highly infectious disease that occurs, at present, with none of the trade partners. Problems in the Netherlands arise when there is trade in live cattle in the time span between the start of an outbreak with a trade partner and the detection of the outbreak. This time span is referred to as the high risk period (HRP). The chances of importing FMD infected calves depend foremost on the length of the HRP in the country of origin. In addition, the structure of livestock holdings in the country of origin is important: countries with numerous small cattle herds (farms) represent a bigger risk than more concentrated livestock economies. In case of an FMD outbreak in a small-scale livestock economy, it is highly likely that the disease is exported into Netherlands. This is alarming because most cattle consignments are destined for the so-called highly densely populated livestock areas. An outbreak in these areas in the east of the Netherlands cannot be controlled before all ruminants within a range have died.

4.2 Recommendations to further reduce the import risk for animal diseases

Based on the discussions above, this section advises on the prevention of veterinary risk on the basis of estimated probabilities of importing animal diseases. Note that we did not examine the consequences of importing the diseases; a complete analysis would have to include the potential consequences in terms of the location, geographical spread and duration of possible disease outbreaks. While a full analysis provides a more complete start of a policy analysis on the management of import risk related to livestock trade, to our opinion the quantitative risk estimates presented in this study already contribute much detail to the debate.

(1) Managing the expanding flow of trade
First, it is suggested to opt for controlled growth of cattle transports over long-distance rather than reduction of transport. On repeated occasions, the *Raad voor Dierenaangelegenheden*[1] has advised to reshape meat production and consumption into a regionalized affair, thereby removing long-distance cattle transports all together. Our results show that the economic incentives for live cattle imports into the Netherlands are strong enough that any transport policy or welfare policy to distort these will be difficult to implement. However, the Dutch veal industry is sensitive to the amount of payments that it receives under the common agricultural policy (CAP) of the EU. The agreement of the Dutch Minister and his colleagues from France and Belgium to keep producer support fully coupled to veal production until 2010 provides incentives to the veal producers in the Netherlands for the continued growth of calve transports over long distance. A complete eradication of support will reduce Dutch veal production by more than 50%, and end live bovine imports into the Netherlands. The less disrupting alternative is to opt for controlled growth of animal im-

[1] The Dutch Council for Animal Affairs is a forum of experts within the Ministry of ANFQ that advises on matters concerning animal health and animal welfare.

ports. One way to achieve this is through more stringent policies that address animal welfare concerns during transport.[1] Another is to prepare national and international stakeholders in the veal industry for the decoupling of payments in the veal sector after 2010 in order to support the objective of reduced live animal transports.

Second, it is recommended to address the illegal trade of livestock and animal products into the EU. This report assessed the risk only of legitimate trade flows, i.e. those that occur under approval and administration of national veterinary authorities. Other studies stress the risks relating to illegal trade. More effort should be invested into elucidating illegal trade throughout Europe. The identification and registration (I&R) service at the Ministry of ANFQ is in the best position to monitor suspicious import flows, and should notify these to the risk analysts.

(2) Reducing the high-risk period in the EU25 livestock sector

The risk assessment has revealed that if the high risk period (HRP) exceeds 15 days, the chance of importing an FMD infected animal are non-negligible. There is every reason to believe that none of the EU25 countries is be able to detect an infected animal within less than 21 days after start of the outbreak. The HRP is determined by the effectiveness of inspection and detection given the speed and quality of laboratory tests. An important avenue to reduce the risk of outbreak and spread of animal diseases in the Netherlands would be to support such services for proper animal disease control with the trade partners. As the political feasibility for bilateral activities is probably low, reductions of the HRP are best promoted at the level of EU25.

General measures to shorten the HRP are for example to promote awareness for list A diseases and the risk for outbreaks in veterinarians, animal health inspectors and animal owners, including public awareness.[2] Other avenues for improvement involve animal identification systems, traceability and movement certification systems. In addition to the general measures listed above, the quantitative risk analysis suggests several particular measures to reduce the HRP.

First, create special risk awareness for the Densely Populated Livestock Areas (DPLA). There is a need to create special awareness on the areas and seasons that feature enlarged risks. The awareness on the seasonal character of intensive import of livestock should be raised in a campaign that emphasises the risks in the densely populated livestock areas in the East of the Netherlands. Possible elements of a campaign include limit values for the number of transports/ month beyond which increased disease outbreak alertness is necessary; a limit value for the number of farms contributing to each consignment (see below) and possible testing of consignments if the limit values are surpassed.

Second, to reduce the number of farms that contribute to a consignment. The quantitative risk analysis found that the number of farms that contribute to an imported consignment bears a strong impact on the probabilities of importing infected cattle: the fewer the number of farms that cattle originate from, the smaller the import risk of infectious agents. Market forces in the NMS will likely increase the average scale of husbandry,

---

[1] At their November 2004 meeting the Agriculture Council of the EU agreed to make animal welfare during transport subject to more stringent regulation.

[2] This should include outbreak simulation training, up-to-date contingency plans, rapid cow-side test, diagnostic capacity, vaccine stocks and procedures for vaccination in the case of an outbreak.

especially in Poland where dairy production is in the process of undergoing a transformation. While market forces will work a bit to assemble consignments from fewer herds, the fact that newborn calves are residual to dairy farming impedes a large supply of animals from a single farm. Such findings motivate policies that reduce the number of farms contributing to a consignment. One option is to reject or test consignments if more than a threshold value of farms have contributed. Another option is to conduct pre-export controls for these above-threshold consignments in the country of origin before shipping for export.
Third, to relocate assembly centres outside of the densely populated livestock areas (DPLAs). Imported livestock is kept under quarantine for 21 days on designated assembly centres, often a large farm owned by a trade house. Figure 1 reveals that most of the assembly centres for imported cattle in the Netherlands are located in the DPLAs. To relocate the assembly centres out of the DPLAs will contribute to reducing the risk of an outbreak of a highly infectious disease. Possible destinations can be found in Groningen and Drente for imports from the Germany, Poland and further East; and in Zeeland for imports from Belgium and Luxemburg. If all animals in one consignment are restricted to the premises of an assembly centre during 21 days, a possible outbreak is contained to that station, and spread of the disease is prevented. If more than one consignment is infected and distributed over more than one farm, then the potential outbreak could be multifocal, and potentially disastrous. While farms can probably be trusted to organise a quarantine - given that they have strong private interests in the matter - the more critical issue is to confine the consignments upon arrival on as few premises as possible in order to prevent the infection from spreading. A re-location on government notice is a heavy intervention in markets that bears resemblance to the policy of 'reconstruction' in Dutch agriculture. We present the option to suggest the depth of reform that is needed if the policies on preventing disastrous outbreaks of list A diseases are taken to their full meaning. A serious appraisal of this relocation policy will require an assessment of the consequences of relocation on disease outbreaks, as well as an evaluation of economic and political feasibility.[1]

Fourth, to make more strategic use of the spot checks. The Dutch authorities could make more effective use of non-discriminatory spot checks of livestock trade. Currently, the number of inspections implemented by the AID is below the EU-imposed maximum of 10% of all livestock consignments. The authorities might consider some refinement to the sample strategy in order to increase the effectiveness of inspections, rather than their number. One option is to focus on the months of increased risk, e.g. the summer months, or periods of intensive imports from selected countries. Another option is to focus on consignments destined for the densely populated livestock areas.

(3) Improved risk assessment

The impact of inspections on the spread of animal diseases during imports, transit trade and exports should be optimalised in view of estimated risk. It is recommended that both the risk of disease introduction through trade, and the risk of spread of the disease after introduction are taken into account. This implies the challenge of preparing consequence

[1] At least one of the two biggest veal producers in the Netherlands opts for another alternative to the 21-days rule: quarantine of calves directly on the farm. This is in his interest because the producer can directly start fattening program, provide feed himself, and skip the transport between the assembly centre and the farm. From an epidemiological point of view we advise against on-farm quarantine.

assessments of the risk related to livestock imports into the Netherlands, in order to determine the spatial and economic impact of outbreak, and to evaluate the benefits and costs of measures that reduce the likelihood and the effect of an outbreak.

The study argues that it is effective to step up inspections on cattle imports into the high-risk areas during months of intensive trade, especially when shipped cattle originate from a large number of farms. These are examples of improvements in the effectiveness of inspection resources available on imports, transit trade and exports. It is recommended that both the risk of disease introduction through trade, and the risk of spread of the disease after introduction are structurally taken into account. Assessments on disease outbreak and spread should drive a risk-based inspection system, which indicates the number, the timing and the frequency of sampling. In general, risk estimates may indicate focal points for preventive measures, and also where they may be loosened.

References

Bex, P.M.H.H., S. Verheij, P.M. de Vries and M.C.M. Jaspers, *Eindrapportage nulmeting administratieve lasten Ministerie van LNV - wetgevingsdomein veterinair*. Cap Gemini Ernst & Young, Utrecht, 2002.

Berkhout, P. and C. van Bruchem, *Landbouw-Economisch Bericht 2004.* LEI, Den Haag, 2004.

Bondt, N. e.a., *Ontwikkelingen in de vleesindustrie tot 2007.* Rapport nr. 5.03.07. LEI, Den Haag, 2003.

De Bont, C.J.A.M. et al., *Vleeskalveren en Hervorming Gemeenschappelijk Landbouwbeleid*. Rapport nr. 6.03.09. LEI, Den Haag, 2003.

Leeuwen, M.G.A. van, *De prijzen van kalfsvlees en nuchtere kalveren, een analyse voor de Europese Unie.* LEI, Den Haag, 1998.

McCalla, Alex F. and Cesar L. Revoredo, *Prospects for global food security: a critical appraisal of past projections and predictions.* IFPRI, Washington DC, 2001.

Ministry of Agriculture, Nature and Food Quality, *Brief aan het Parlement betreffende de 'Implementatie van het hervormde GLB in Nederland'.* (Letter to Parliament). 23 april 2004.

OECD, *Economic Outlook No. 76.* OECD, Paris.

PVE (Productschappen Vee, Vlees en Eieren), *Vee, vlees en eieren in cijfers. Statistisch jaarverslag.* Zoetermeer, 2004.

Raad voor het Landelijk Gebied en de Raad voor Dierenaangelegenheden, *Dierziektebeleid met draagvlak: Advies over de bestrijding van zeer besmettelijke dierziekten.* Amersfoort/Den Haag, 2003.

Tabeau, A.A. and T.J. Achterbosch, *Cattle import projections for the Netherlands*. Unpublished memorandum. LEI, Den Haag, 2004.

Van der Linde, A.-M., 'Import zit prijs dwars'. In: *Boerderij* 89 (2004) 46.

Van Meijl et al., *Prijzen op agrarische wereldmarkten: een verkenning van projecties.* LEI, Den Haag, 2003.

World Bank, *Global Economic Prospects: Trade Regionalism, and Development*. The World Bank, Washington DC, 2004.

Appendix A Projections of live cattle imports into the Netherlands

Table A1.1 Strong Growth Scenario

(1,000 head)	2003	2004	2005	2006	2007	2008	2009	2010
Belgium/Luxemburg	124.0	109.2	113.6	115.9	117.1	118.7	120.7	123.0
Denmark	30.8	28.8	23.2	24.1	25.1	26.4	27.7	29.2
Germany	279.2	247.6	194.8	202.7	206.1	210.1	214.9	220.2
France	36.5	30.7	41.6	41.7	41.7	41.6	41.8	41.9
Ireland	34.7	31.6	35.9	38.3	39.0	40.0	41.1	42.3
Italy	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7
Czech R	5.9	22.9	31.7	30.1	29.7	29.5	29.4	29.0
Hungary	0.2	0.6	0.7	0.7	0.7	0.7	0.7	0.7
Poland	45.3	113.6	153.8	145.2	141.2	138.2	135.4	131.5
Slovakia	0.7	0.4	0.5	0.5	0.5	0.5	0.5	0.5
Other countries	2.2	2.1	2.9	2.8	2.8	2.9	3.0	3.1
Total	560.2	588.1	599.5	602.9	604.7	609.3	615.9	622.1

Table A1.2 Low Growth Scenario

(1,000 head)	2003	2004	2005	2006	2007	2008	2009	2010
Belgium/Luxemburg	124.0	108.7	106.0	106.2	106.1	106.4	107.0	107.6
Denmark	30.8	28.3	18.1	18.5	18.9	19.4	19.9	20.5
Germany	279.2	248.3	201.5	203.3	204.7	206.4	208.9	211.3
France	36.5	32.1	29.3	29.5	29.7	29.7	29.9	30.1
Ireland	34.7	30.6	41.0	41.4	41.7	42.2	42.8	43.3
Italy	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7
Czech R	5.9	22.3	34.7	34.6	34.4	34.6	34.9	35.1
Hungary	0.2	0.6	0.7	0.7	0.7	0.7	0.8	0.8
Poland	45.3	112.2	159.7	157.9	155.6	154.8	154.3	153.6
Slovakia	0.7	0.4	0.6	0.6	0.6	0.6	0.6	0.6
Other countries	2.2	2.0	3.2	3.2	3.2	3.3	3.3	3.4
Total	560.2	586.1	595.3	596.6	596.3	598.7	603.1	607.0

Table A1.3 Imports from new member states, under two scenarios

	2003	2004	2005	2006	2007	2008	2009	2010
Total (1,000 head)								
Strong Growth	52.1	137.4	186.8	176.6	172.1	169.0	166.0	161.7
Low Growth	52.0	135.4	195.7	193.8	191.3	190.7	190.6	190.1
Share in Dutch imports (%)								
Strong Growth	9.3	23.4	31.2	29.3	28.5	27.7	27.0	26.0
Low Growth	9.3	23.1	32.9	32.5	32.1	31.9	31.6	31.3

Appendix B The quantitative estimation of the risk of introducing livestock diseases

The purpose of this appendix is twofold. First, it provides detail on the methodology of the quantitative risk assessment. Second, it gives background information on the epidemiology of FMD, BTBC and leptospirose, and an overview of relevant EU regulations regarding the prevention of introducing livestock diseases.

B1 Epidemiological Models and Data

B1.1 Background information about the detection of the diseases in the study

Background information for FMD Detection

An example for a serological test used for the detection of FMD antibodies is the Ceditest for the FMD O serotype, sensitivity: 98.2%, specificity 98.9% for bovine samples (Jacobs et al., 2002).

In the Netherlands, all livestock consignments imported from third countries are serologically tested for FMD antibodies and all consignments from the NMS used to be tested until May 1st of 2004 (pers. Communication K. Stein, VWA 2004). No true positive test results were found since the FMD outbreak in 2001.

Sensitivity for clinical inspections during the early stages of FMD is supposedly low (sens: <0.1). Ruminants are infectious before they show clinical signs of disease (Blood and Radostits, 1989).

Background information for BTBC Detection

Intradermal tuberculinisation: sensitivity is controversial: 68-95% (Monaghan et al., 1994) or 32-99% reviewed by O'Reily and Daborn, 1995). A mean sensitivity of 83.3% is reported in low-prevalence herds (Norby et al., 2004).

The sensitivity of this test depends essentially on the potency of the tuberculin used and the key for interpretation applied during the testing. If those are below the international standards, the intradermal tuberculinisation as a monotest has an even lower sensitivity than the average reported.

Background information for the detection of leptospirosis

MAT: (microaglutination test, a serovar specific test, sensitivity: 67% for individual diagnosis in aborting cattle.

The MAT sensitivity is much higher for herd diagnosis if at least 10 animals/herd are sampled as recommended by the OIE terrestrial animal code (Ellis,1986; Hathaway et al., 1986; Cole et al., 1980); f.e. with a herd prevalence as low as 0.31 (real-world herd prevalences should be much higher, f.e. 80% even in the endemic case) the herd sensitivity is still 90% if a minimum of 10 animals is being sampled as recommended by Hathaway et al. (1986).

Herd sensitivity is calculated as:

$$\sum_{n}^{10} 10!/(n!*(10-n) * p^{n} * (1-p)^{(10-n)} * (1-(1-\text{sensitivity}_{TEST})^{n}$$

An MAT herd sensitivity of 90% will therefore be used as worst case scenario for the risk analysis.

ELISA: individual test diagnosis has a sensitivity of 84.6% (95% CI: 85.6%-90.8%), but the less sensitive MAT is used more commonly for screening purposes (Woodward et al., 1997).

B1.2 Approaches for the risk estimation of endemic diseases

For the purpose of the quantitative risk estimation of BTBC and leptospirosis, scenario pathways were developed and the distributions for risks simulated using Markov Chain Monte Carlo Simulation by means of a Gibbs sampler (Spiegelhalter et al., 2000; Vose, 2000), expected values of the distributions returned by the simulations including their 95% confidence intervals.

Approaches for calculating probabilities of events, simulating distributions, medians, calculating expected values and variance during the risk estimations are:

(A)

Probability of no events in a set of n trials
$p = (1-p)^{n}$

Probability of at least 1 event in n trials:
$q = 1 - (1-p)^{n}$

(B)

Binomial distribution:
$X \sim Bin(n,p)$
$P(X = m) = \binom{n}{m} p^{n} (1-p)^{(n-m)}$

n: total population
m: number sampled
p: proportion positives (prevalence)

Expected number of positive trials out of the total tested (for large n!):
$EX = n\,p$
Variance:
$Var\ X = n\,p\,(1-p) = n\,p\,q$

(C)

Beta distribution:
$X \sim Beta(a,b)$

$$P(X) = \frac{1}{B(a,b)} x^{(a-1)}(1-x)^{(b-1)}$$

Expected value:

$$EX = \frac{a}{(a+b)}$$

Variance:

$$\text{Var } X = ab\ (a + b)^{-2}\ (a + b + 1)^{-1}$$

From Vose (2000):
a = number of positive events + 1
b = number of animals tested – number of positive events + 1

(D)

Calculation of herd sensitivity of a test when n cattle are tested out of a total population Nt using a test with sensitivity s<100% (an imperfect test) and herd prevalence p:

$$\text{herd sensitivity} = \binom{Nt}{n} p^n\ (1-p)^{(Nt-n)}\left(1-(1-s)^n\right)$$

(E):

Calculation of the probability (1 - Q_1) that any farm (infected or non infected) contributing shipments of x cattle to 1 consignment exported to the Netherlands send at least one shipment including infected animals so that the consignment is infected given an average herd prevalence pp<100% and a proportion q of infected herds in the population.
(pp = 70% for BTBC, Emmerzaal et al. 1994).

$$Q_1 = p^n + \binom{n}{i}\left(p^{(n-i)}\right)q^i\left(pp^x\right)^i$$

p^n is the probability that only non infected farms ship cattle for 1 consignment while the rest of the terms for Q1 calculates the probability that none of the infected herds will ship infected animals

with:
n: farms shipping per consignment exported
x: number of animals shipped per farm for 1 consignment
1-pp: herd prevalence of infection in population
pp: proportion of non infected animals per herd
q: proportion of infected herds in the population
p: proportion of non infected herds in the population
i: running number of trials until reaching n total

for y consignments the total probability 1 - Q_{1y} of at least one consignment being infected is calculated as:

$$Q_{1y} = y\ Q_1$$

With: y : number of consignments exported during a certain period.

The methods described above were applied for the conduction of the risk estimation the scenario pathways as shown in the main text (figures 3.9 to 3.11). Distinctions were made between input for the risk estimation, assumptions, approaches, output and comments at each step of the calculations.

B1.3 The quantitative risk estimation for livestock imported from country A into the Netherlands in 2002 being the source for introducing bovine tuberculosis (M. bovis)

P1 P2	Farm is infected Routine surveillance detects infection in the country of origin				
	input	assume	approach	risk estimation output	comments
	country A (2002): 5.420.987 total cattle population (110.078 beef calves) 935.193 total number of bovine herds (average 6 head/farm)	Calves <3 m old are representative for the infection status of the population	(C) with Beta(2,311731)	Expected proportion of infected farms in 2002: 0.0000064 (SD: 0.0000045)	
			0.0000064 * 311731=	Expected number of infected farms out of the farms tested in 2002: 2 (max. 5)	
	1/3 of population >6 weeks is tested using the intradermal monotest (1)	Sensitivity of the intradermal monotest on low prev. herds is on average 83.3% , min 68%, max. 95% (3), (4)	only 1/3 of the farms were tested, so -→	6 (max. 14) infected farms total are expected in 2002	A worst case scenario would assume that the 255 positive animals originate from 255 different farms.
	i.e. 311731 herds / year are tested		(A) calculate the probability of missing 6 out of 311731	p_{miss} = 0.99988, that is to say that the 6 farms are missed by routine surveillance with almost certainty.	
	1 herd (255 animals) was found to be infected (2)	All animals reported originated from 1 herd	(C) with Beta(256,311477)	<u>Worst case scenario:</u> 255 positive animals are from 255 different farms: Expected proportion of infected farms in 2002: 0.000821 (SD: 0.0000513)	
			0.00008212 * 311731=	Expected number of infected farms out of the farms tested in 2002: 256 (max. 288)	
			only 1/3 of the farms were tested, so -→	768 (max. 864) infected farms total are expected in 2002	
			(A) calculate the probability of missing 768 out of 311731	p_{miss} = 0.150404, that is to say that there is a 15% chance that the routine surveillance system will	Need to inquire data to calculate

				miss all of the 768 infected farms.	the exact prevalence of BTBC in NMS and make recommendations for the routine surveillance system
P3	**Export consignment includes animals from infected farms**				
	input	assume	approach	risk estimation output	comments
	24295 beef cattle exported from A to NL in 2002 (s. table 1), (5) 150 consignments of beef cattle average of 161 cattle/consignment (99.9% of cattle <3 months old) 1 consignment of 3 head of breeding cattle (we neglected them because BTBC is a low prevalence disease,	cattle/farm shipped for 1 consignment: 100 10 2 herd prevalence is 70% (4)	Number of farms contributing to 150 and to 1 consignments respectively (6): 243; 1.62 2430; 16.2 12145; 80.5 (E): make a difference between “shipment” from a farm and the “consignment” (consisting of shipments) exported into the Netherlands Positive animals are spread maximally over farms	Case 1 probability that 1.62 infected or non infected herds ship 100 animals each and that at least 1 shipment is infected so that the consignment is infected: 0.0000128 expected number of infected consignments out of 150 total in 2002: 0.001925 (SD: 0.0439), i.e. 1.9 infected consignments every 1000 years <u>[Worst case with 768 infected farms in country A in 2002:</u> probability that 1.62 infected or non infected herds ship 100 animals each and that at least 1 shipment is infected so that the consignment is infected: 0.00164 (very small!) expected number of	Data about geographical clusters of farms shipping cattle for export could be included in the calculations at this point. The first case is not realistic, because the farms are on average too small to ship 100 animals at once. Stop calculation here! In 99.9% of the cases, we are drawing calves from the population of calves really! So, 10 calves per farm should come from large farms only.

				infected consignments out of 150 total in 2002: 0.24627, i.e. 2.5 % chance of 1 infected consignment every year. (SD: 0.4958), i.e. max 1.24 infected consignments per year.]	Note!
		Fraction of larger farms (>100 head/farm) is 0.25 of the total population. It may be a fraction of 15% only (see phase I p.22)	(E): It is more plausible that the larger farms (>100 head) will ship at least 10 animals at once and that not all of the very small farms will export cattle. 0.0000099748* 150	Case 2 probability that 16.2 infected or non infected herds ship 10 animals each and that at least 1 shipment is infected so that the consignment is infected: 0.0000099748 expected number of infected consignments out of 150 total in 2002: 0.0014961 (SD: 0.122231) interpretation: 1.5 infected consignments every 1000 years would be exported to NL…	More plausible case Note, this rate for the more plausible case is very low!
			(B): ~dbin (0.7,10) assuming that n=10 cattle are shipped from each farm and that the herd prevalence is p=70% (4). $7*16.2*0.0000064/(1-(1-0.0000064)^{16.2})$ $(1-(1-0.0000064)^{16.2})$ is probability for min 1 pos farm in 1 cons, i.e. that cons is positive Positive animals are spread maximally over	expected number of infected animals (10 shipped per farm) per shipment from an infected farm: 7 animals (SD: 1.45, 95% C.I.: 4 - 10) and expected number of infected animals in an infected consignment if 16.2 farms contribute to each consignment : 7.000341 animals/consignment (7/161=0.0435, i.e. prevalence in inf consignment, which is) <<18% (s.below) Worst case with 768 infected farms in country	This reflects the fact that it is expected that only 1 positive farm will ship at once, but if it ships then it is expected that 7 positive animals will be shipped.

			farms (E): 0.01305 * 150 $7*16.2*0.00082122/(1-(1-0.00082122)^{16.2})$	<u>A in 2002:</u> probability that 16.2 inf or non inf herds ship 10 animals and that at least 1 shipment is infected so that the consignment is infected: 0.013056, i.e. 1.3% chance that at least 1 consignment is infected per year. expected number of infected consignments out of 150 total in 2002: 1.958, i.e. about 2 infected consignments every year; (SD: 1.39026), max 4.739 infected consignments per year.] expected number of infected animals in an infected consignment if 16.2 farms contribute to each consignment : 7.04379 animals/consignment (7/161=0.0435, i.e. prevalence in inf consignment, which is) <<18% (s.below)	Note, if the positive animals are spread maximally over farms this rate is 100x higher!!! (note: country prevalence is still <1% pos herds (i.e. country A could still be officially BTBC free!!!) The truth is situated between the more plausible case and this scenario, where any farm can ship including the many small farms.
			(E): 0.000265 * 150 (B): ~dbin (0.7,2) assuming that n=2 cattle are shipped from each farm and that the herd prevalence is p=70% (4).	Case 3 probability that 80.5 infected or non infected herds ship 2 animals each and that at least 1 shipment is infected so that the consignment is infected: 0.000265 then expected number of infected consignments out of 150 total in 2002: 0.03975, i.e. 3.9 % chance that 1 consignment is infected per year; (SD: 0.19935) expected number of infected animals (2 shipped per farm) per shipment from an infected farm: 2 animals (SD: 0.5721,	

			2*80.5*0.0000064/ (1-(1-0.0000064)$^{80.5}$)	95% C.I.: 0 - 2) and expected number of infected animals in an infected consignment if 80.5 farms contribute to each consignment : 2.00051 animals/consignment (2/161=0.0124, i.e. prevalence in inf consignment, which is <<18%, i.e. detection limit (s.below)	
			Positive animals are spread maximally over farms. (E):	[Worst case with 768 infected farms in country A in 2002: probability that 80.5 infected or non infected herds ship 2 animals each and that at least 1 shipment is infected so that the consignment is infected: 0.064126	If the many small farms ship few animals each and the positive animals are spread maximally between farms then there will be 2 - 10 infected consignments from country A exported into the Netherlands per year. This adds up to max. 70 positive animals exported in 2002.
			0.064126*150	expected number of infected consignments out of 150 total in 2002: 9.618878, i.e. about 10 infected consignments per year (SD: 3.00034), max 15.6688 infected consignments per year.], i.e. 6.44% of all consignments are positive	
			2*80.5*0.00082122/ (1-(1-0.00082122)$^{80.5}$)	expected number of infected animals in an infected consignment if 80.5 farms contribute to each consignment : 2.066 animals/consignment (2.066/161=0.01283, i.e. prevalence in inf consignment, which is <<18%, i.e. the detection limit (s.below)	
				max total of exported	

			9.657*2.066	infected animals: 19.95 infected animals in 2002	
P4	**infected consignments are detected during the pre-export controls**				
	input	assume	approach	risk estimation output	comments
	No data available From P3: Plausible case 1: 16.2 farms ship 10 animals per consignment and probability of at least 1 infected consignment is: 0.00010265 or expected number of infected consignments out of 150 total in 2002: 0.015397 (SD: 0.12408) Worst case: 768 infected farms in A in 2002, then 1.958 infected consignments per year 2002 (max. 4.739) From P3: Plausible case 2: probability that 80.5 infected or non infected herds ship 2 animals and that at least 1 shipment is infected so that the consignment is infected: 0.0005194	10% of consignments are re-tested using the intradermal monotest and 10 animals/ consignment are tested	There is an entire spreadsheet (BTBC_16.2f_consignment_sens) necessary for this calculation! (D)	Case 1: The expected number of infected consignments (given country prevalence of 0.0000064) is so small that the infected consignments will probably not be detected if 10 animals are tested per consignment even if 100% of consignments will be re-tested. (f.e. probability of detecting a positive consignment given that there is 1 pos. one amongst the 150 total is: 0.0042 %, sampling 10 animals out of 15 consignments, i.e. 10% of consignments, using the monotest) Case 2 and 3: The expected number of infected consignments (given country prevalence of 0.0000064) is so small that the infected consignments will probably not be detected if 10 animals are tested per consignment even if 100% of consignments will be re-tested. Worst case 2 and 3: The max. 10 infected consignments/year have such a low % of infected animals/consignment (<18% infected	The import certificates from country A state that the animals originate from BTBC-free herds. There were no data available about export controls.

	expected number of infected consignments out of 150 total in 2002. 0.07791, i.e. 7.8 % chance that 1 consignment is infected per year; (SD: 0.27906) Worst case: 768 infected farms in A in 2002, then 9.6570, i.e. about 10 infected consignments per year (SD: 3.0059), max 15.6688 infected consignments per year.		An acceptable test should have a sensitivity of >80%	animals/consignment, i.e. a herd sensitivity of <80% for detecting the consignment as infected using the intradermal monotest, when 10 animals/consignment are tested) that the consignments will not be detected as infected during pre-export controls with 99.99% chance, i.e. almost certainty of missing them.	
P5	**infected animals are detected during the transport**				
	input	assume	approach	risk estimation output	comments
	No data available	The animals are not checked during transport for intra-communitarian trade!			
P6	**infected animals are detected during the inspection controls in the country of destination**				
	input	assume	approach	risk estimation output	comments
		10% of consignments may be re-tested by non-discriminatory spot-checks including sampling		The consignments are not re-tested upon arrival in the Netherlands 5% of consignments are subjected to a document check, but physical vetchecks are not done and no samples are taken in the country of destination (8)	

		and testing for BTBC (7).		Even if the 10% of consignments were tested during non-discriminatory spot checks according to the EU Directive 90/425/EEC (7) then given the low % of infected animals/consignment all the animals /consignment would have to be tested in order to make a chance of detecting the consignment as infected. See comment too, because that would not be realistic anyways!	Most of the animals introduced through intra-communitarian trade are too young to (have) be(en) tested for BTBC, because they are about 2 week-old calves, so-called NUKA's They must originate from BTBC free herds in the country of origin. (9). But the surveillance system will miss most of the infected herds. If BTBC infected animals were introduced as NUKA's or beef cattle into Dutch farms, then they would have to stay >6 months there alive (about 5 years) in order to cause outbreaks of BTBC according to (10) The risk

[redacted]					management may want to improve the surveillance system in the country of origin before engaging in testing the animals upon entry into the Netherlands.

(1) source: FVO mission report 3197/2001
(2) OIE handistatus reports 2002
(3) source: Norby et al. 2004 and Monaghan et al. 1994
(4) using approach (D) and assuming a heard prevalence of 70% in the endemic state as reported by Emmerzaal et al. (1999), it can be shown that the infected herds will be detected with almost certainty if a minimum of 10 animals per farm is tested with the intradermal monotest and if the truly infected farms are part of the population tested for the routine surveillance system in 2002.
(5) source: ANIMO data and I&R data (Dutch cattle identification and registration system) 2002
(6) (f.e. 24295/100 =243 and 24295/(100*150)= 1.62
(7) Council Directive 90/425/EEC
(8) pers. communication VWA 2004
(9) Council Directive 64/432/EEC, Annex A and 92/65/EEC Article 6
(10) Roermund et al. 2003

Assumptions about BTBC

Animals take 8-65 days after birth before they show a maximal immunoresponse, which is the base for the intradermal test (Kleeberg 1960). So, testing 2-weekold NUKA's would not generate reliable test results and the EU directives require testing of animals older than 6 weeks only. We assume that none of the calves younger than 6 weeks has been tested.

We assume that the NUKA's represent the general population in their prevalence of infection though, because they have been fed non-pasteurized pooled milk on the holdings of origin. This milk and vertical transmission are the sources of infection with BTBC.

The execution of the intradermal monotest is described in Council Directive 64/432/EEC, Annex B, 19-21.

Inspection of carcasses at slaughter has a sensitivity of 10% (Bakker en van Zijderveld personal communication, see report van Roermund 2003).

The four countries under study have a very low incidence of monotest positive cattle. One out of the four is officially free of bovine tuberculosis.

The definition for tuberculosis-free is given in Council Directive 64/432/EEC, Annex A I. below.

If a herd is endemically infected with BTBC then the herd prevalence is very likely to be up to 70% (Emmerzaal et al. 1999)

B1.4 The quantitative risk estimation for livestock imported from country C into the Netherlands in 2002 being the source for introducing leptospira spp.

P1 P2	Farm is infected Routine surveillance detects infection in the country of origin				
	input	assume	approach	risk estimation output	comments
	country C (2003): 398.158 total cattle population (dairy cattle) 3.875 total number of bovine herds (2721 with >20 cattle/farm and 1154 with <20 cattle/farm; average 146 head/farm on large farms and 11 head/farm on small farms) (1) according to the officials the routine testing was stopped in 2000 (1) 11 herds out of 21 (51.9%) tested were found positive in 1995 (2)	Country prevalence did not change since 1995 (2) Sensitivity of the MAT test is 67% (3) Sensitivity of the ELISA test is 84.6% on average (max 90.8%) (4)	(C) with Beta(11,12) 0.478 * 3875 = (D) as long as the herd prevalence >0.45 and 10 animals per herd are tested, the herd sensitivity using ELISA is >99%	Expected proportion of infected farms in 2003: 0.478 (SD: 0.102, 95% C.I.: 0.284 – 0.678) (more decimals: 0.477935) Expected number of infected farms in 2003: 1852 (all farms) 1302 (large farms) 552 (small farms)	It has been reported in 2000 that there is a routine surveillance system in place in country C, but the authors of this study could not find any evidence for it. (5) Need to inquire data to calculate the exact prevalence of leptospirosis in NMS and make recommenda tions for the routine surveillance system
P3	Export consignment includes animals from infected farms				
	input	assume	approach	risk estimation output	comments
	3.942 beef cattle exported from C to NL in 2003 (s. table 1), (6)	cattle/farm shipped for 1 consignme	Number of farms contributing to 36 and to 1 consignments respectively (8):		If there were data available

	36 consignments of beef cattle average of 110 cattle/consignment 1 consignment of 18 head of breeding cattle (neglected during the RA)	nt: 100 10 2 herd prevalence is 80% (7)	39; 1.1 394; 11 1971; 55 (E): not realistic, because average farm sizes are much smaller!!! Assumed 2 contributing farms for the calculations! 0.7274486*36	probability that 1.1 infected or non infected herds ship 100 animals and that at least 1 shipment is infected so that the consignment is infected: 0.7274486 expected number of infected consignments out of 36 total in 2003. 26.188 (SD: 2.672), i.e. 26 infected consignments per year; i.e. 72.74% of all consignments	about geographical clusters of farms shipping cattle for export then that could be incorporated in the calculations at this point. In 99.9% of the cases, we are drawing calves (<3m) from the population of calves really! So, 100 calves per farm should come from very large farms only. Which is not realistic in country C Note!
		Fraction of larger farms (>100 head/farm) is 0.25 of the total population.	(E): It is most plausible that the larger farms (>100 head) will ship at least 10 animals at once and that not all of the very small farms will export cattle. 0.9977976 * 36 (B): ~dbin (0.8,10) assuming that n=10 cattle are shipped from each farm and that the herd prevalence is p=80% (7). 8*11*0.478/ $(1-(1-0.478)^{11})$	probability that 11 infected or non infected herds ship 10 animals and that at least 1 shipment is infected so that the consignment is infected: 0.9977976 expected number of infected consignments out of 36 total in 2003: 35.92 (SD: 0.281) interpretation: all exported consignments are infected every year … expected number of infected animals (10 shipped per farm) per shipment from an infected farm: 8 animals (SD: 1.26, 95% C.I.: 5 - 10) and expected number of infected animals in an infected consignment if 11 farms contribute to each consignment : 42.097 animals/consignment (42/110=0.3827, i.e. prevalence for inf	

			42.097 *36	consignment, expected total number of infected animals in 36 consignments: 1515.5	
			(B): ~dbin (0.8,2) assuming that n=2 cattle are shipped from each farm and that the herd prevalence is p=80% (7). $2*55*0.478/(1-(1-0.478)^{55})$ 52.58 *36	probability that 55 infected or non infected herds ship 2 animals and that at least 1 shipment is infected so that the consignment is infected: 0.999969 expected number of infected consignments out of 36 total in 2003: 35.998887 (SD: 0.03335) interpretation: all consignments that would be exported to NL include positive animals… expected number of infected animals (2 shipped per farm) per shipment from an infected farm: 2 animals (SD: 0.5721, 95% C.I.: 0 - 2) and expected number of infected animals in an infected consignment if 11 farms contribute to each consignment : 52.58 animals/consignment (52.58/110=0.478, i.e. prevalence for inf consignment, which is >detection limit 18% (s.below) expected total number of infected animals in 36 consignments: 1882.08	
P4	infected consignments are detected during the pre-export controls				
	input	assume	approach	risk estimation output	comments
	No data available	There are			The import

	And no evidence for pre-export controls was found	no pre-export tests conducted to detect leptospirosis			certificates from country C are not required to make a statement about the leptospirosis status of the animals. The regulations (9) state that animals should be free of clinical signs of disease.
P5	infected animals are detected during the transport				
	input	assume	approach	risk estimation output	comments
	No data available	The animals are not checked during transport for intra-communitarian trade!			
P6	infected animals are detected during the inspection controls in the country of destination				
	input	assume	approach	risk estimation output	comments
		10% of consignments may be tested by non-discriminatory spot-checks including sampling and testing for leptospirosis (10).	Assume there are physical spot-checks in 10% of the consignments, where 10 animals/consignment are tested for leptospirosis using the	The consignments are not re-tested upon arrival in the Netherlands 5% of consignments are subjected to a document check, but physical vetchecks are not done and no samples are taken in the country of destination (8) if the 10% of consignments (4 of 36 consignments) were tested during non-discriminatory spot checks (and all are positive) according to the EU Directive 90/425/EEC (10)	Most of the animals introduced through intra-communitarian trade are

			MAT (individual sensitivity: 67%; (3)) There is an entire spreadsheet needed for this calculation (available upon request)	then there is a 19.35 % probability of detecting all 4 positive consignment and a 80.65 % chance of missing 1 of the positive consignments; the individual herd sensitivity for detecting 1 positive consignment is 98%	about 2 week-old calves, so-called NUKA's Those young animals are more likely to develop clinical disease that may be detected, but this cannot be quantified. They are more likely to shed the infectious agent and infect others after loosing maternal immunity (>6-8 w of age). If leptospirosis infected animals were introduced as NUKA's or beef cattle into Dutch farms, then they would be able to cause outbreaks of leptospirosis in the receiving herds The risk management may want to improve the surveillance

					system in the country of origin rather than engage in testing the animals upon entry into the Netherlands.

(1) official instances in the country of origin and CVO project 2004
(2) literature report from 1995 quoted anonymously (available upon request)
(3) Ellis et al. 1986
(4) Woodward et al. 1997
(5) Proceedings of an international congress from 2000 ; quoted anonymously (available upon request)
(6) source: ANIMO data and I&R data (Dutch cattle identification and registration system) 2003
(7) Blood and Radostits 1989
(8) (f.e. 3940/100 =394 and 3940/(100*36= 1.1)
(9) EU Directive 64/432/EEC
(10) Council Directive 90/425/EEC

Data and assumptions about leptospirosis

The mean herd prevalence cattle aborting due to leptospirosis was calculated using a beta distribution for the abortion rate in cattle. According to literature (Morrow, 1986; Ellis, 1983; Knott and Dadswell, 1970), at least 10% and up to 50% of the animals abort due to Leptospira (<10% are true for L. hardjoe, the most pathogenic in cattle, but abortion rates can be up to 30% during acute outbreaks and for L. hardjoe and up to 50% cattle aborting are recorded for cattle due to L. pomona and L. serjoe).

Using a mean of 0.3 with a variance of 0.01, dbeta ~ (6,14) has a median rate of 0.29 for aborting cattle (95% C.I.: 0.13 - 0.51). The estimate for the mean percentage of infected cattle would be more than 3 times as much per herd.

Of the MAT positive cows with abortion, 80% of the fetusses will be infected (Ellis et al., 1982).

Data and assumptions for country C

According to the information provided by country C, the surveillance testing for leptospirosis had been done once per year in breeding bulls until 2000. It was reported in 2000, that a surveillance system supporting zoonosis prevention, reduction and eradication included leptospirosis and bovine tuberculosis was established, but data nor information could be collected by the authors of this study.

Given the lack of information, a guess for the number of herds infected per country per year was made for country C based on literature (due to the anonymous reporting, the source cannot be quoted, but is available upon request). In one study from 1995, 11 out of

21 farms (52.4% of the farms were positive of which 91 out of 1239 animals tested positive) examined by serological screening were positive for leptospira.

Herd sensitivity for the serological test is assumed to be close to 100%, because all animals per consignment slaughtered were tested.

The detected leptospira consisted of a blend of L. grippotyphosa (61.8% of animals tested), L. serjoe (18.9%), L. iceterohaemorrhagiae and L. copenhageni (5.7%) in conjunction with L. canicola, L. bulgarica and L. hardjoe. It is reported that no leptospira could be recovered form urine nor did the animals show clinical signs of acute leptospirosis.

Given the fact that the authors failed to find evidence for a surveillance program to monitor or eradicate bovine leptospirosis in country C since 2000, it is assumed that this prevalence is representative for the endemic state of country C still today. This could be an underestimate though.

A mean herd abortion prevalence was estimated as described above (mean 0.3, 95% C.I. 0.13 - 0.51).

The risk analysis for country C is conducted under the assumption that all cattle exported to the Netherlands from country C originated from local dairy herds. This could be incorrect, but there is no information about other types of holdings available.

Number of dairy herds in 2003: 3875 (2721 (70.2%) above 20 head and 1154, (29.8%) with less than 20 head of cattle.

Mean herd size in 2003: 146 head in the larger dairy herds, 11 head in smaller dairy herds.

It is assumed that leptospirosis is randomly spread over all dairy farms independent of their size.

If 52.4% of the herds were infected with leptospirosis, that would imply 2031 herds (1,426 large herds and 605 small herds) infected in 2003.

Given an average herd number of 146 head for 70.2% of the herds and 11 head for 29,8% of all herds while assuming 100% true sero-prevalence per herd (all animals infected in the endemic state) this results in:
20,8196 infected animals on 1,426 larger infected herds and 6,655 infected animals on 605 smaller infected herds for any type of leptospira in 2003.

3.960 animals were imported into the Netherlands in 2003, of which all remained in the Netherlands. Of those, there was 1 consignment with 18 head of breeding stock (neglected during the RA) and 36 consignments with on average 110 animals/consignment of beef cattle.

B2 Overview of relevant regulations

B2.1 EU regulations and other international animal health regulations concerning the risk analysis

With regard to animal health:

- Council Directive 64/432/EEC on animal health problems affecting intra-Community trade in bovine animals and swine.
- Council Directive 72/462/EEC on health and veterinary inspection problems upon importation of bovine animals and swine and fresh meat from third countries.
- Council Directive 89/556/EEC of 25 September 1989 on animal health conditions governing intra-Community trade in and importation from third countries of embryos of domestic animals of the bovine species.
- Council Directive 90/425/EEC of 26 June 1990 concerning veterinary and zootechnical checks applicable in intra- Community trade in certain live animals and products with a view to the completion of the internal market.
- Council Directive 91/496/EEC of 15 July 1991 laying down the principles governing the organization of veterinary checks on animals entering the Community from third countries and amending Directives 89/662/EEC, 90/425/EEC and 90/675/EEC, Article 8 (a) and 23 (b).
- Council Directive 92/65/EEC laying down animal health requirements governing trade in and imports into the Community of animals, semen, ova and embryos not subject to animal health requirements laid down in specific Community rules referred to in Annex A (I) to Directive 90/425/EEC.
- Annex II of Council Directive 97/78/EC laying down the principles governing the organisation of veterinary checks on products entering the Community from third countries and safeguard measures implemented in case of a serious hazard to animal health.
- Council Directive 97/78/EC laying down the principles governing the organisation of veterinary checks on products entering the Community from third countries and safeguard measures implemented in case of a serious hazard to animal health, Annex II and Annex III.

With regard to semen:

- Council Directive 2004/205/EC: laying down transitional measures for intra-Community trade in semen, ova and embryos of the bovine, porcine, ovine, caprine and equine species obtained in the Czech Republic, Estonia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Slovenia and Slovakia, where semen must comply to:
    - Council Directive 88/407/EEC of 14 June 1988 laying down the animal health requirements applicable to intra-Community trade in and imports of semen of domestic animals of the bovine species;

  - Council Directive 89/556/EEC of 25 September 1989 on animal health conditions governing intra-Community trade in and importation from third countries of embryos of domestic animals of the bovine species(2); and
  - Council Directive 92/65/EEC of 13 July 1992 laying down animal health requirements governing trade in and imports into the Community of animals, semen, ova and embryos not subject to animal health requirements laid down in specific Community rules referred to in Annex A (I) to Directive 90/425/EEC.
- OIE Terrestrial codes
  - animal code appendix 3.2.1 about Bovine semen
  - animal code appendix 3.6.2, article 3.6.2.5 about inactivation of FMD virus in milk

With regard to intra-communitarian trade and importation of livestock and animal products from third countries:
- Council Directive 64/432/EEC on animal health problems affecting intra-Community trade in bovine animals and swine
- Council Directive 90/425/EEC concerning veterinary and zootechnical checks applicable in intra-Community trade in certain live animals and products with a view to the completion of the internal market
- Council Directive 92/65/EEC laying down animal health requirements governing trade in and imports into the Community of animals, semen, ova and embryos not subject to animal health requirements laid down in specific Community rules referred to in Annex A (I) to Directive 90/425/EEC

B2.2 FMD-specific regulations

With regard to FMD-free areas
Council Directive 64/432/EEC, Art. 2(l) defines 'epizootic free area' as an area 20 km in diameter in which, according to official findings, for at least thirty days prior to loading there has been: (i) no incidence of foot-and-mouth disease, in the case of bovine animals;
Animals introduced from third countries must originate from epizootic free areas according to this directive.

General legislation and particularly FMD:
Border inspection controls for imports of livestock and products of animal origin from third countries rely on documentary and identity checks, physical checks (including clinical inspections of the animals), sampling and laboratory testing for the early detection of FMD virus and are regulated by EU-Directive:

97/78/EC (Annex II) laying down the principles governing the organisation of veterinary checks on products entering the Community from third countries and safeguard measures implemented in case of a serious hazard to animal health and Council Directive 91/496/EEC (Annex A) laying down the principles governing the organization of veterinary checks on animals entering the Community from third countries and amending Directives 89/662/EEC, 90/425/EEC and 90/675/EEC.

(Others are: 72/462/EEC on health and veterinary inspection problems upon importation of bovine animals and swine and fresh meat from third countries, 89/556/EEC on animal health conditions governing intra-Community trade in and importation from third countries of embryos of domestic animals of the bovine species).

Physical checks for livestock imported from third countries are regulated by Council Directive 91/496/EEC laying down the principles governing the organization of veterinary checks on animals entering the Community from third countries and amending Directives 89/662/EEC, 90/425/EEC and 90/675/EEC.

Article 8, the official veterinarian must carry out a physical check on animals presented at the border inspection post. That check must include, in particular:
(a) a clinical examination of the animals in order to ensure that they conform to the information provided in the accompanying certificate or document and that they are clinically healthy.

Article 23 (b): any laboratory tests which it is thought necessary should be carried out or which are provided for by Community rules;
The control of products of animals origin is regulated by Council Directive 97/78/EC laying down the principles governing the organisation of veterinary checks on products entering the Community from third countries, Annex III includes the regulation about physical checks of products entering the Community from third countries.

B2.3 Regulations specifically for BTBC

Council Directive 64/432/EEC, ANNEX A
I. Tuberculosis-free bovine animals and herds

1. A bovine animal is considered to be tuberculosis-free if it shows no clinical signs of tuberculosis nor a reaction to an intradermal tuberculin test carried out in accordance with Annex B not more than thirty days before loading, nor any specific reaction, and when it is from an officially tuberculosis-free bovine herd within the meaning of paragraph 2.
2. A <u>bovine herd is considered to be officially tuberculosis-free</u> if: (a) all the animals are free from clinical signs of tuberculosis; (b) all the animals over six weeks old have reacted negatively to at least two official intradermal tuberculin tests carried out in accordance with Annex B, the first one six months after completion of disinfection of the stock, the second one six months later and the remainder at one- or two-yearly intervals in the case of Member States whose entire bovine herd is under official veterinary supervision and has a rate of tubercular infection lower than 1 %; (c) no bovine animal has been introduced without a certificate from an official veterinarian showing that the animal has reacted negatively to an intradermal tuberculin test

assessed according to the criteria set out in Annex B 21 (a) and that it comes from an officially tuberculosis-free herd.

Council Directive 92/65/EEC, Article 6

2. in the case of ruminants: (a) they must come from an officially tuberculosis-free and officially brucellosis-free herd in accordance with Directive 64/432/EEC or Directive 91/68/EEC and satisfy, as regards animal health rules, the relevant requirements laid down for the bovine species in Article 3 (2) (c), (d), (f), (g) and (h) of Directive 64/432/EEC or Article 3 of Directive 91/68/EEC; (b) where they do not come from a herd meeting the conditions laid down in (a), they must come from a holding in which no case of brucellosis or tubercolosis has been recorded in the 42 days preceding loading of the animals and in which the ruminants have, in the 30 days prior to their dispatch, undergone with negative results a tuberculosis reaction test.

B2.4 Regulations specifically for leptospirosis

It is not required by the EU regulation 64/432/EEC to ship leptospirosis-free cattle during the intra-communitarian trade. The directive states that animals must be BTBC-free, brucellosis-free and epizootic-free (such as FMD) and they must not show any signs of clinical disease.
Art 3, 2(iii) it shall, for a least thirty days prior to consignment, have been free from all other compulsorily notifiable diseases which are contagious or infectious for the animal species in question;

Leptospirosis is not on the list of the compulsorily notifiable diseases.

B2.5 Regulations for milk processing

Council Directive 2003/85/EEC: on Community measures for the control of foot-and-mouth disease repealing Directive 85/511/EEC and Decisions 89/531/EEC and 91/665/EEC and amending Directive 92/46/EEC (Annex IX, parts A or B) includes the regulations for the treatment of raw milk in the case of suspicion or an outbreak of FMD in EU member states. The treatments that ensure the destruction of FMD virus in raw milk are much more vigorous than the heat-treatment of raw milk intended for the human or animal consumption described under Directive 92/46/EEC.

From Council Directive 92/46/EEC, laying down the health rules for the production and placing on the market of raw milk, heat-treated milk and milk-based products (Annex C, Chapter 1, part 4):
(a) Pasteurized milk must:
(i) have been obtained by means of a treatment involving a high temperature for a short time (at least 71,7 oC for 15 seconds or any equivalent combination) or a pasteurization process using different time and temperature combinations to obtain an equivalent effect;

(ii) show a negative reaction to the phosphatase test and a positive reaction to the peroxidase test. However, the production of pasteurized milk which shows a negative reaction to the perioxidase test is authorized, provided that the milk is labelled as 'high-temperature pasteurized'; (iii) immediately after pasteurization, have been cooled to a temperature not exceeding 6 oC as soon as possible. (b) UHT milk must: - have been obtained by applying to the raw milk a continuous flow of heat entailing the application of a high temperature for a short time (not less than +135 oC for not less than a second) - the aim being to destroy all residual spoilage micro-organisms and their spores - using aseptic opaque containers, or containers made opaque by the packaging, but so that the chemical, physical and organoleptic changes are minimal, - be of preservability such that no deterioration can be observed by means of random sampling checks after it has spent 15 days in a closed container at a temperature of +30 oC; where necessary, provision can also be made for a period of seven days in a closed container at a temperature of +55 oC.

OIE Terrestrial animal code appendix 3.6.2, article 3.6.2.5:
describes the procedures for the inactivation of FMD virus in milk.

Treatment of milk to ensure destruction of foot-and-mouth virus
The following treatments are recognised to provide sufficient guaranties with regard to the destruction of the foot-and-mouth disease virus in milk and milk products for human consumption. Necessary precautions must be taken to avoid contact of the milk or milk products with any potential source of foot-and-mouth virus after processing.

Milk and milk products intended for human consumption:

1. Milk intended for human consumption must be subject to at least one of the following treatments:[1]
   - 1.1 sterilisation at a level of at least F03;
   - 1.2 UHT(1) treatment;
   - 1.3 HTST(2) treatment applied twice to milk with a pH equal to or above 7,0;
   - 1.4 HTST treatment of milk with a pH below 7,0;
   - 1.5 HTST combined with another physical treatment by:
     - 1.5.1 either lowering the pH below 6 for at least one hour, or
     - 1.5.2 additional heating to 72 °C or more, combined with desiccation.
2. Milk products must either undergo one of the above treatments or be produced from milk treated in accordance with paragraph 1.
3. Any other treatment shall be decided in accordance with the procedure referred to in Article 89(2), in particular in relation to raw milk products undergoing an extended period of ripening including a lowering of the pH below 6.

Milk and milk products not intended for human consumption and milk and milk products for animal consumption:

[1] UHT= Ultra-High Temperature treatment at 132 °C for at least one second. HTST= High Temperature Short Time pasteurisation at 72 °C for at least 15 seconds or equivalent pasteurisation effect achieving a negative reaction to a phosphatase test. UHT= Ultra High Temperature treatment at 132 °C for at least one second. TST= High Temperature Short Time pasteurisation at 72 °C for at least 15 seconds or equivalent pasteurisation effect achieving a negative reaction to a phosphatase test.

1. Milk not intended for human consumption and milk intended for animal consumption must be subject to at least one of the following treatments:

- 1.1 sterilisation at a level of at least F03;
- 1.2. UHT(3) combined with another physical treatment referred to in either paragraph 1.4.1 or 1.4.2;
- 1.3 HTST(4) applied twice;
- 1.4 HTST combined with another physical treatment by:
  - 1.4.1 either lowering the pH below 6 for at least one hour, or
  - 1.4.2. additional heating to 72 °C or more, combined with desiccation.

2. Milk products must either undergo one of the above treatments or be produced from milk treated in accordance with paragraph 1.

3. Whey to be fed to animals of susceptible species and produced from milk treated as described in paragraph 1 must be collected at least 16 hours after milk clotting and its pH must be recorded as < 6.0 before transport to pig holdings.

Appendix C Respondents to the interviews

The persons listed below were respondents to a formal interview or otherwise involved as expert person.

Name	Organisation
Tjeert de Boer	LNV-I&R
Jan Bergsma Rik van der Does	PVE (Productschappen Vee, Vlees en Eieren)
Debby van Son	TLN/SAVEETRA (Samenwerkende Veetransporteurs)
H.W.A. Swinkels	VanDrie Group
Piet Thijssen	NBHV (Nederlandse Bond van Handelaren in Vee)