Methodology

Short description

The steps followed for the risk analyses were as follows:

- Selection of most relevant contagious animal diseases in livestock: Classic Swine Fever (CSF), Avian Influenza (AI) and Foot and Mouth Disease (FMD)
- Selection of main determinant to estimate the risk of spread between farms: Density of holdings (holdings/ha). Once the first infected farm of an epidemic of FMD, CSF or AI has been detected, and subsequently certain intervention measures have been introduced to stop further spread between farms, the remaining spreading potential is determined to a large extent by the density of farms (number of farms/km^2). The density of farms depends on the number of farms and their spatial distribution.
- Selection of available variables at EU level:
  - Number of holdings with dairy cows, other cows, sheep, goats, pigs and poultry. We used holdings with pigs for CSF, with poultry for AI, and the sum of dairy cows, other cows, sheep and goats holdings for FMD
  - Land use area for arable land and permanent grassland
- Calculation of risk-analysis area. We selected the land uses whose area contribute significantly to the total area of the holding. We used arable land for CSF and AI, and the sum of arable land and permanent grassland for FMD.
- Analyses of between-farm transmission based on spatial transmission kernels estimated from recent epidemics of CSF and AI (NL) and FMD (UK). These kernels describe the transmission between-farms in the presence of animal-movement standstill and biosecurity measures.
- Calculation of risk areas based on the spatial analyses of transmission. A critical density, above which between-farm transmission is self-sustaining in the presence of biosecurity measures and a movement standstill, is calculated from the spatial kernel and from estimates of the infectious periods of farms: AI: 2.5 holdings/km^2 , CSF:5.5 holdings/km^2 and FMD:1.5 holdings/km^2. Regions with farm density exceeding the critical value are thus high-risk areas for epidemic spread.

Datasets

- Source: Farm Structure Survey (FSS, EUROSTAT New Cronos)
- Variables:
- Number of holdings with dairy cows, other cows, sheep, goats, pigs and poultry
- Land use: Arable land and permanent grassland
- Years: 1995 and 2000
- Coverage: EU 15
- Resolution: NUTS 1, NUTS 2

Results

Six maps with the risk areas of CSF, AI and FMD for EU15 at NUTS 1/2 level for 1995 and 2000.
The EURURALIS risk maps presented in the dynamic part of the presentation, estimate *quantitatively* the trend in the local transmission potential for FMD, CSF, between 1995 and 2000, based on regional farm densities.

Legend of the maps
Low risk
Medium risk
High risk
No data available

Future risk of spread of contagious animal diseases in livestock

Within the framework of the EURURALIS project, it was not possible to estimate *quantitatively* the future risk of spread of contagious animal diseases in livestock in a scientifically sounded way. The current knowledge and available scale of the data sets at European level (EU25) do not allow to link in a quantitative way the output of the models (GTAP, IMAGE and CLUE) and the 4 scenario's on international trade, development and cooperation with the risk of spread. Therefore a *qualitative* approach was made, identifying the key factors determining changes in the spreading of livestock epidemics. Consequently, links between these factors and the outputs of models were established in order to estimate changes in risk depending on the EURURALIS scenarios. Figure 1 shows the former links in a flow diagram, and could serve as a conceptual basis for future research aiming at obtaining more quantitative insight into these matters.

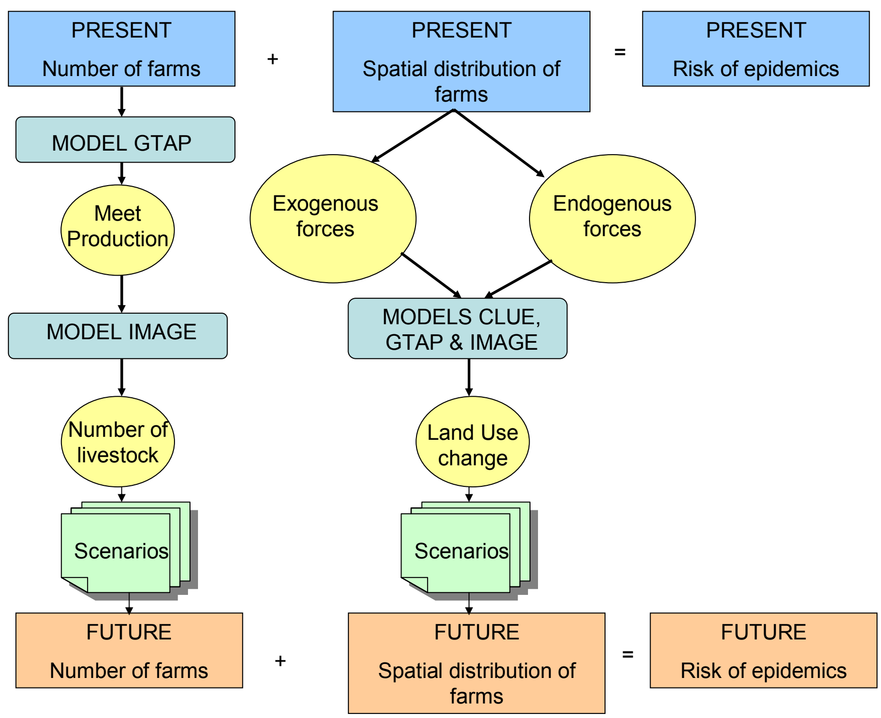

Figure 1. Qualitative links between main risk factors, models and scenarios in order to predict future risk of dispersal of contagious animal diseases in livestock.

Once the first infected farm of an epidemic of FMD, CSF or AI has been detected, and subsequently intervention measures have been introduced to stop further spread between farms, the remaining spreading potential is determined to a large extent by the density of farms (number of farms/km^2). The density of farms depends on the number of farms and their spatial distribution, which are the input variables in the flow diagram (Figure 1). Figure 2 shows the difference between the density of farms in a region and the density of neighbouring farms, which determines the local risk of spread.

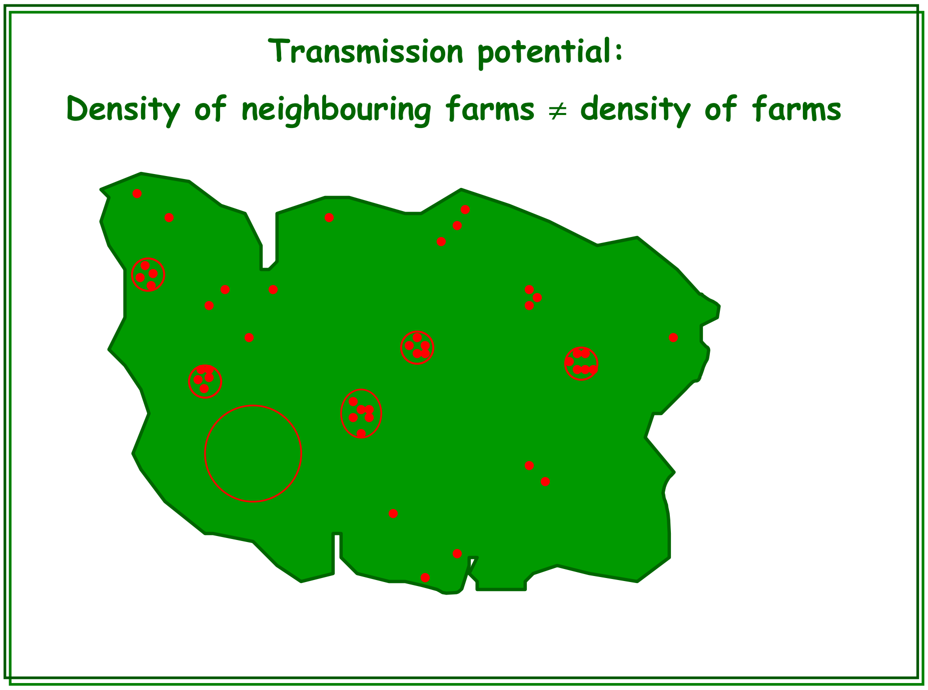

Figure 2. Density of neighbouring farms within a region differs from the density of farms in that region.

Future changes in number of farms will depend on changes in meat production, which in turn will result in changes in the number of livestock. Changes in the spatial distribution of farms are influenced by exogenous and endogenous forces, partially estimated by the models CLUE, GTAP and IMAGE, which result in changes in land use, that in turn causes changes in the density of farms in different regions. Endogenous forces are the pressures caused by the variation in the number of farms in the existing cluster, leading to areas with higher density or causing movement of farms to other areas. These forces are independent of the scenarios, e.g. economy of scale and regional facilities. Exogenous forces are agricultural and environmental policy, public opinion and farmer behaviour, and they depend on the scenarios. Figure 3 shows the qualitative influence of the scenarios on the exogenous forces, assuming that (i) the importance level of the exogenous forces opposing clustering of farms do not depend on the endogenous forces, and (ii) exogenous forces are weighed different depending on the endogenous forces. We consider the four EURURALIS scenario's (A!, A2, B1 and B2) and estimate qualitatively their effect on the exogenous forces.

Scenario	Public opinion	Environmental policy	Farmer behavior
A1	++(+) (1)	+ (2)	+++ (3)
A2	+ (4)	+ (5)	++ (6)
B1	++ (7)	++ (8)	++ (9)
B2	+++ (10)	+++ (11)	+ (12)

Figure 3. Qualitative influence of EURURALIS scenarios on the exogenous forces causing changes in the spatial distribution of farms.
The three exogenous forces considered are:

- Public opinion: the arguments are most valid for intensive livestock holdings; much less for land dependent livestock (cattle, sheep and goats)
- Environmental policy: environmental legislation opposing clustering (e.g. regarding ammonia emissions, smells, possibilities for manure disposal etc.)
- Farmer behaviour: risk of the consequences of outbreaks as perceived by the farmer.

This depends on concerns regarding liability and the willingness of public authorities to bear (part of) the (financial) consequences.

The explanation of the estimation of risks is as follows:

(1) Because of 'claim culture' there is much resistance from citizens against clustering of livestock holdings. Citizens do not want to live next-door to pig- or poultry holders. They could claim financial compensation for happiness foregone or the declined value of their real estate. These arguments would be strongest in areas with a high proportion of people working in services or industries, which are not related to agriculture (i.e. densely

populated regions and rural areas near urban centres), as well as in remoter areas with many tourists, second houses, retired people migrated from urban centres etc.

(2) In this scenario free markets (i.e. international competition) and focus on private responsibilities prevent the accomplishment of stringent environmental legislation.

(3) High risks perceived by farmers. No government support for farmers means that they would have to seek private insurance. If not, they would have to cope with the financial consequences. In case of negligence they could even be hold responsible for damage or income foregone by colleagues and other sectors (e.g. tourist sector).

(4) In this scenario, intensive livestock holding is seen more as an economic pillar, sustaining jobs in rural areas than as a burden for society.

(5) In this scenario, any measures implying increased costs to producers encounter strong opposition. Free markets within EU and prevailing national interests prevent effective legislation at EU level.

(6) Farmers assume that risks are lower than in A1, due to protected market. Besides somewhat more government support for farmers in case of animal disease outbreak than in A1. Farmers are aware that if this happens they are considered victims rather than culprits.

(7) Same arguments as B2 and elements of A1, but somewhat less pronounced.

(8) In this scenario, environmental legislation is somewhat less stringent than in B2, because it is much more the result of international agreements. Due to free international markets and less funds available for farm support and agri-environment programmes than in B2, legislators would encounter stronger opposition from farmers against stringent rules.

(9) More government support in case of outbreak + more faith in stringent international legislation on sanitary measures to prevent outbreaks than in A1 and A2.

(10) In this scenario public resistance is more based on moral ground, i.e. the feeling that intensive animal husbandry is ethically wrong. The higher the density, the more people are confronted with this feeling. Besides, the public is well aware of the risk of spread of diseases in regions with a high density of livestock holdings and the traumatic consequences of culling.

(11) Political and societal conditions are favourable for stringent legislation. Stringent national and EU-legislation can be afforded thanks to protected markets and consumer preference for locally produced food.

(12) Same arguments as A2, but even more pronounced.

The recent Classic Swine Fever and Avian Influenza epidemics in The Netherlands, showed that in areas of high farm density, the remaining local transmission that occurs in the presence of movement standstills, bio-security measures and culling of infected farms can be self-sustaining. In this situation, additional culling (and/or vaccination) is necessary to achieve epidemic control.

Conclusively, there are many factors which can affect the outcomes from the scenario's, e.g. production levels, consumption levels and patterns (number of people, diet), consumer concerns regarding farm management and transport of animals, and regulation measures by authorities concerning spatial distribution of farms, (e.g. scale enlargement of farms, spatial concentration of production chain),. On one hand, the A scenarios, rooted in free market thinking and lower levels of intervention by governments combined with less conscious consumers, may increase risks of spread more than B scenarios. On the other hand, the A scenario's may stimulate a strong modernization of the sector, which could result in better control of diseases by (i) improvement of the hygienic control and (ii) scale enlargement of farms which in turn may result in larger distances between farms, i.e. overcome critical densities .. Vaccination to prevent further spread of the disease between farms is considered to be an issue independent of the scenario's.