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Integration of Economic Modelling and Pre-harvest Microbial Risk Assessment

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Preface

MED-VET-NET aims to develop a network of excellence for the integration of veterinary, medical and food scientists, in the field of food safety, at the European Level, in order to improve research on the prevention and control of zoonoses, including food-borne diseases. The Network will also take into account the public health concerns of consumers and other stakeholders throughout the food chain. Med-Vet-Net comprises 16 partners across Europe and over 300 scientists. The institutes involved consist of eight veterinary, seven public health institutes and one learned society from 10 European countries. All partner institutes have national reference laboratory-based responsibilities for the prevention and control of zoonoses. The Network officially commenced on 1 September 2004. It is funded for five years at a cost of €14.4 million (£10 million) by the European Union (EU) 6th Framework Programme, within the 'Quality and Safety of Food' Priority Area. More information can be found on the website www.medvetnet.org.

The intended audience for this review is primarily scientists within MED-VET-NET or other interested scientists. The executive summary addresses decision makers, both food safety risk managers but also those responsible for research funding and veterinary and public health surveillance.

This report results from the activities in Work Package 14. In addition to the authors of this report, the following colleagues participated in meetings and made an active contribution to discussions and generation of concepts: Michiel van Boven (Animal Sciences Group, Lelystad, The Netherlands), Juliane Bräunig (BfR, Berlin, Germany), Helen Clough (University of Liverpool, UK), Lüppo Ellerbroek (BfR, Berlin, Germany), Arie Havelaar (RIVM, Bilthoven, The Netherlands), Annemarie Käsbohrer (BfR, Berlin, Germany), Wilfrid van Pelt (RIVM, Bilthoven, the Netherlands), Marie Simon-Cornu (AFSSA, Maisons Alfort, France).

Executive summary

In food safety, the integration of pre-harvest risk assessment and economic models is an exciting, new and emerging area and, in addition to other information accumulated from other scientific areas (e.g. epidemiology, microbiology, social sciences etc.), can be used to form part of a Risk Manager's evidence base. The name 'economics of pre-harvest risk assessment' is rather new in the food safety MRA community, but the research discipline has already widely developed although under other names. When only focussing on animal production, this field is called 'Animal Health Economics'. Animal health economics is a discipline which makes use of economic techniques and data to support decision making with the objective to optimise animal health management at various levels, i.e. from the individual animal, the farm, the national herd and finally to international disease control strategies. The evaluation of alternatives includes the estimation of risks, i.e. the probability of uncertain events to occur and the (monetary) consequences of the outcome of uncertain events and the different alternatives that can be chosen. A sound economic analysis includes the identification and the comparison of different hazard control options in terms of their expected benefits and costs as well as the distribution of costs and benefits over time and over different social groups (i.e. *equity*).

Cost-benefit analysis is a generic term embracing a wide range of evaluative procedures, whereby identifying, quantifying and valuing all of the relevant *benefits* and *costs* that are relevant to program or policy alternatives. For some costs or benefits parameters, accurate values or amounts can be obtained for economic modeling purposes, while others are more difficult to quantify precisely. Economic parameters often are presented as fixed (certain) values, giving a false sense of accuracy to the evaluation. Both uncertainty and variability around parameters or factors are extremely important characteristics, particularly in the interpretation of the final risk estimates produced by MRAs. Risk managers need to know how much uncertainty there is associated with the risk estimate and also how much the risk estimate will vary due to natural phenomena. Taking uncertainty and variability into account will provide a more realistic insight in the range in which the actual costs and benefits lie, with an associated probability for each possible value within that range.

This report describes the various perspectives of costs and benefits of pre-harvest control options for the farmer and for the consumer. The focus on avoiding production losses vs. gaining public health benefits is associated with the disease/pathogen of concern. Each farm is considered to be an economic independent unit and most farmers aim for profit optimisation. Since many zoonoses do not affect the livestock, the losses that are saved due to a strategy to reduce or eradicate these zoonoses from a farm are small. When implementing measures in the food production chain to improve food safety and human health it is important to take the whole chain into account, and also to consider which part of the production chain that will bear the costs.

Economic analysis is a powerful tool to support decision-making. It provides a common denominator for evaluating diverse outcomes, ranging from public health outcomes to trade impacts. With benefits and costs in the same monetary units, the net benefits of alternative strategies to reduce risks can be compared directly. Though the discipline is

far more developed in animal health economics, the linkage between food safety risk assessment and economic analysis as a means of supporting decision-making is still a novel approach that is in development. In WP14, we performed an inventory pre-harvest MRA's performed in countries involved in the project. Though only 28% of the assessments in the inventory included some form for economic assessment, it showed that more than three out of four risk assessments consider that an economic evaluation should be part of a pre-harvest MRA. It is difficult to assess whether this is representative for all (pre-harvest) MRA being performed in Europe but it does indicate that adding an economic component to risk assessment is considered an important improvement of the risk model output by most risk assessors.

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1. Introduction

One of the main purposes of (pre-harvest) microbial risk assessment (MRA) is the evaluation of risk mitigation strategies. As risk model output should serve as decision support for risk managers, and not just satisfy academic interest, the incorporation of additional information that is considered in the decision-making process will make the assessment more complete. The expression of risk estimates in monetary and non-monetary effects by including economic modelling in the assessment will greatly improve the usefulness of MRA output.

In food safety, the integration of pre-harvest risk assessment and economic models is an exciting, new and emerging area and, in addition to other information accumulated from other scientific areas (e.g. epidemiology, microbiology, social sciences etc.), can be used to form part of a Risk Manager's evidence base. As a consequence it seems natural to combine these two areas in the area of zoonoses and, as a result of this, this is happening on a national level within the EU.

In the area of zoonoses, pre-harvest risk assessment models are particularly being used to investigate potential control/intervention options at the farm level. Although the *effectiveness* of any control strategy is important at a policy setting level, such information needs to be combined with information on the feasibility of implementing such an intervention. This feasibility is dependent on many things including the practicality, sustainability, farmer compliancy and the cost of the intervention, which can be summarised as the *efficiency*. Finally, particularly relevant in the area of veterinary public health because the hazard of interest may not cause clinical disease in livestock and hence *equity* is not gained, i.e. the farmer bears the cost of a public health benefit. It is therefore important that such costs (which may be direct and/or indirect) are quantified and used to inform the Risk Manager.

Although the aim of a potential control strategy may be to control a zoonosis at the farm level, interventions may also impact animal health status. Such impacts could be positive (reduces animal disease risks) or negative (increases animal disease risks). If the impact is positive then the farmer will bear the cost of the strategy but will also experience some of the benefit; if negative further indirect costs will be incurred. Economics of livestock production may not only be focused on veterinary public health and animal health but also animal welfare. Consumers and the media are having more and more interest in livestock production methods where such interest has been fuelled by recent issues such as BSE, antibiotic resistance, FMD etc. Although farmers will bear the cost of changes on farms, costs may not be recovered from the consumers due to unwillingness to pay an extra premium for such food types, especially if cheaper products (perhaps from other EU or third countries) are available on the market.

This report considers further many of the issues identified above. In particular, it focuses economic modelling in pre-harvest risk assessment and animal health economics (chapters 2 and 3), types of economic analysis, costs and benefits (chapters 4 and 5), who bears the costs and who benefits (chapters 6, 7) and the current implementation of economic modelling in pre-harvest risk assessment (chapter 8).

2. Economics of pre-harvest risk assessment and Animal Health Economics

The name ‘economics of pre-harvest risk assessment’ is rather new in the food safety MRA community, but the research discipline has already widely developed although under other names. When only focussing on animal production, this field is called ‘Animal Health Economics’ (Dijkhuizen et al., 1991; Dijkhuizen et al., 1995; Dijkhuizen and Morris, 1997; Otte and Chilonda, 2000). When focussing on crop production, this field is called ‘Plant Health Economics’. Animal health economics has already a long tradition, while plant health economics is a relatively new discipline (Oude Lansink, 2003). Since this report focuses on zoonoses aspects of Animal Health Economics is discussed here.

3. Animal Health Economics

Economics is often qualified as the discipline that measures efforts and rewards in monetary units. This view is incomplete and therefore incorrect. Economics is concerned with making rational decisions to allocate scarce resources over alternatives, in which uncertain events and thus risk estimations are included. The monetary units are only used to compare different resources and goals involved in the decision to make. Also efforts and rewards that can not be quantified in to monetary values can be taken into account within an economic analysis.

Thus animal health economics is a discipline which makes use of economic techniques and data to support decision making with the objective to optimise animal health management at various levels, i.e. from the individual animal, the farm, the national herd and finally to international disease control strategies. The evaluation of alternatives includes the estimation of risks, i.e. the probability of uncertain events to occur and the (monetary) consequences of the outcome of uncertain events and the different alternatives that can be chosen.

Animal-health management involves often decisions regarding expenditures on preventive measures as well as the treatment of diseased animals. Animal health programmes have been shown to provide a very high return on investment, because the reduction of the impact of animal diseases increases directly the efficiency of production, often with only limited amounts of labour and money.

The importance of animal-health economics has increased over the last thirty years. This is because there have been some important changes that have affected the decision making to improve animal-health management. First, the major epidemic diseases are mostly controlled or eradicated in most developed countries, leaving the less important diseases to be tackled by the veterinary profession. Second, the (inter)national priority setting is now on zoonoses and food borne hazards that affect human well-being. Second, due to global international trade, the national policy gives less priority to self-sufficiency for livestock products. So less effort is taken in the national disease control. Third, the importance of agriculture in the national economy of developed countries had decreased. This has resulted in a stronger competition for funds by different sectors. Fourth, more and more responsibilities have been transferred from the public to the private sector. So the need for visible returns on investments increased.

4. Types of economic analysis

For any economic analysis it is important to state which point of view will be considered, i.e. to set the boundaries of the analysis. An economic analysis from a farmer point of view is not very complex. However the economic analysis becomes more and more complex as the focus moves from the individual animal to larger sectors of the society or the society as a whole. Different techniques have been developed to evaluate strategies at different levels. Methods of economic analysis include partial budgeting, enterprise budgeting, decision analysis, optimising mathematical models, (Monte Carlo) simulation, cost-benefit, cost-utility and cost-effectiveness analysis. The choice of the method to used depends on a number of factors: i) the nature of the problem; ii) the complexity of the system involved; iii) the availability of the data, iv) the research question that has to be answered, v) the preference of the model builder or the decision maker, vi) the recourses available (time, money and analytic tools).

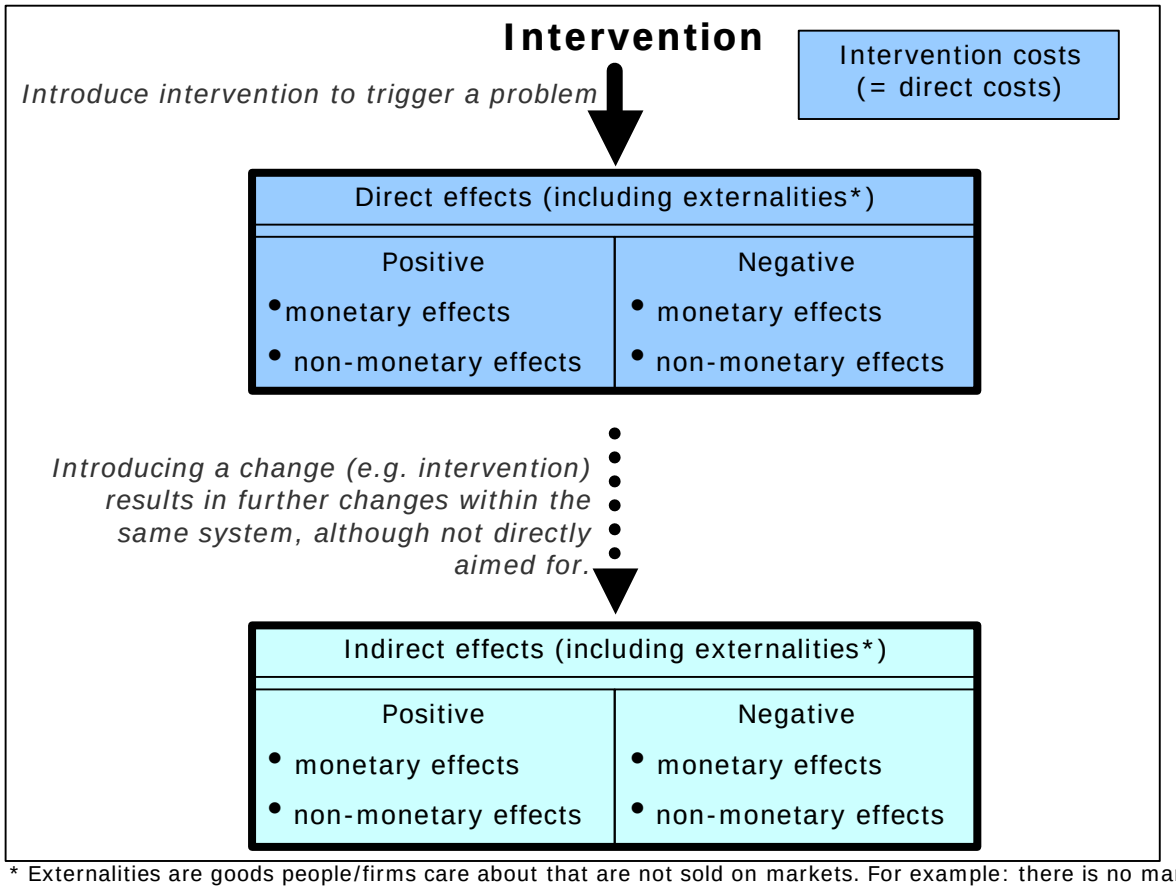
A sound economic analysis includes the identification and the comparison of different hazard control options in terms of their expected benefits and costs as well as the distribution of costs and benefits over time and over different social groups (i.e. *equity*).

5. Types of costs and benefits

Cost-benefit analysis is a generic term embracing a wide range of evaluative procedures, whereby identifying, quantifying and valuing (where possible) all of the relevant *benefits* and *costs* (advantages and disadvantages) that are relevant to program or policy alternatives (Sassone & Schaffer, 1978). Once the program or the policy has been clearly defined, the next major problem in performing a *cost-benefit* analysis is to properly identify and to quantify *costs* and *benefits* (Belli et al., 2001; Sassone & Schaffer, 1978).

5.1. Classification of costs and benefits

One obvious example of classificatory scheme is that of *benefits* and *costs*, whereby the effects of a project are divided into *positive effects* (*benefits*) and *negative effects* (*costs*). This definition does include both, *monetary* and *non-monetary effects.* Both the *direct effects* (positive and negative ones), that are directly related to the implementation of a policy, and the *indirect effects* (positive and negative ones) occurring in the society, should be taken into account when conducting a complete economic evaluation (see Figure 1). *Externalities*, which are goods firms/people care about but that are not sold on the market, are other effects, both positive and negative, that should not be neglected when performing an economic evaluation.



* Externalities are goods people/firms care about that are not sold on markets. For example: there is no market for a raps field located next to a beekeeper (*positive production externalities)*, or a chemical industry dumping pollutants into a fishery (*negative production externalities*), or loud music at 3 in the morning (*negative consumption externalities)*, or a neighbor who keeps a beautiful flower garden (*positive consumption externalities).*

Figure 1. The different effects to consider when applying an economic evaluation

Assigning to all effects a monetary value, will lead towards a *real* cost-benefit analysis (CBA). Whereas if it is not possible, or if it is not wanted, to express all effects in monetary values, the evaluation will be either a cost-effectiveness analysis (CEA) or a cost-utility analysis. In a CEA the outcome measure is a single non-monetary effect, such as for example the number of ill cases/year, or the number of fatal cases/year, or the number of pathogens per carcass. In a cost-utility analysis (CUA), or also sometimes called weighted cost-effectiveness analysis, we do have several effects as outcomes that are weighted and combined into one metric unit such as for example DALYs (Disability Adjusted Live Years), or QALYs (Quality Adjusted Live Years).

Based on Buzby et al. (1996), we have derived 3 major levels for the field of food borne illness control where *costs* and *benefits* are made, or at least linked with. These three levels are:

- Consumer/Citizen
- Industry (e.g. producer, processing plants)
- Government

Within each of these three levels individual costs and benefits have to be identified and quantified, whereby the chosen perspective (individual, sector or society) in an economic evaluation determines which of these potential '*costs*' and '*benefits*' are finally included in

an evaluation. Given that the society perspective is the most complete, we list in Table 1 potential costs and benefits related to an economic evaluation taken from a social perspective. By taking a narrower perspective, for example the perspective of farmers (producers) only, only a part of the hereafter listed costs and benefits would be considered.

Because an economic evaluation can never ever take in perspective all possible influences and effects, it is important to explain the issues that could not be fully integrated into the evaluation. However, with the implementation of MRA modelling tools, such as Monte Carlo simulation, several scenarios can be evaluated simultaneously, either separately or against each other.

5.2 Quantifying costs and benefits using MRA techniques

For some costs or benefits parameters, accurate values or amounts can be obtained for economic modeling purposes, while others are more difficult to quantify precisely. In addition, some factors may vary in size depending on the presence or absence of other factors. In MRA terminology, these factors are considered to have 'uncertainty' about them. There are two types of uncertainty that, in practice, are difficult to distinguish: 1.) uncertainty due to incomplete knowledge about the parameters or system, and 2.) variability as a (natural) function of the system (e.g. natural variation between individuals). In the first case, uncertainty might be reduced through further measurement or study, while this is not the case in the latter.

Economic parameters often are presented as fixed (certain) values, giving a false sense of accuracy to the evaluation. Both uncertainty and variability around parameters or factors are extremely important characteristics, particularly in the interpretation of the final risk estimates produced by MRAs. For example, we may know the benefit from each case of averted morbidity and mortality of production animals, but the exact number of averted cases due to an intervention is unknown. Risk managers need to know how much uncertainty there is associated with the risk estimate and also how much the risk estimate will vary due to natural phenomena. Taking uncertainty and variability into account will provide a more realistic insight in the range in which the actual costs and benefits lie, with an associated probability for each possible value within that range.

Table 1. General outline of costs and benefits to be included in food safety economic evaluations

Cost category [a, b]	**Examples**
CONSUMER/CITIZEN	
Costs related to illness	
Direct health care costs (often paid by health insurances)	Physician visits; hospitalization; rehabilitation and e.g. physiotherapy; drugs and other medications; …
Direct non-health care costs (paid by patients)	Travel costs; diapers; informal care; co-payments by patients; …
Indirect health care costs [c]	Potential future health care costs due to prolonged longevity
Indirect non-health care costs (paid by employers)	Days lost of paid work by patients; days lost of paid work by third person taking care of a sick person; …
Intangible costs	Reduced quality of life of patients following disease, pain, … Reduced quality of life of family members of patients, following fear and distress related to the patients disease; …
Costs (or benefits) related to the implementation of interventions	
Direct costs	Implementing intervention at consumer level, e.g. altered freezing practices; …
Indirect costs	Consumer price changes of products; …
INDUSTRY	
Direct costs related to animal production	Averted morbidity and mortality of animals on farms; reduced (increased) growth rate/feed efficiency and increased time to market; reduced number of animals per year; …
Direct costs related to control costs for pathogens at all links in the food chain	Altered and new farm practices (testing, bio security measures, disinfection / sterilisation, phage therapy, etc.); new slaughterhouse procedures (logistic slaughtering, decontamination, etc.); new processing procedures (pathogen test, logistic processing, decontamination, product development, altered shelf-life of products, etc.); …
Direct costs related to outbreaks	Herd slaughter/product recall; plant closings and cleanup; product liability suits from consumers and other firms; …
Indirect costs	Changes of product prices; Losses/expansion of market shares; …
GOVERNMENT	
Direct costs related to interventions	Information and education campaigns; …
Regulatory and public costs for controlling food borne pathogens	Disease surveillance costs: e.g. monitor incidence/severity of human disease by food borne pathogens; monitor pathogen incidence in the food chain … Outbreak costs: e.g. costs of investigating outbreak; cleanup costs; … Research: e.g. development of pathogen tests; risk assessment
Indirect costs	Fiscal impact on macroeconomic level …

[a)] Within the table we refer only to costs, but depending on the effect, costs will become benefits. For example a reduce mortality is a benefit, whereas increased mortality is a cost. Another example would be an increased consumer price is a cost to consumers, whereas a decreased consumer price is a benefit to consumers.

[b)] We have tried to be as complete as possible, but there are certainly some lacunas. Furthermore, depending on the perspective taken not all cost categories will be required.

[c)] Indirect health care costs are to our knowledge not considered in economic evaluation studies. One reason for not considering these costs is the ethical question. The other reason is the lack of information about the potential future health care costs of a prolonged live.

5.3 Livestock productivity and the effects of diseases

Productivity is the efficiency of the conversion of inputs into outputs and defined as the rate of output devided by the rate of input. In livestock systems this is usually the economic value of each type of input and output expressed in monetary values. Figure 2 (McInerney 1996) shows the economic implication of an animal disease on livestock production.

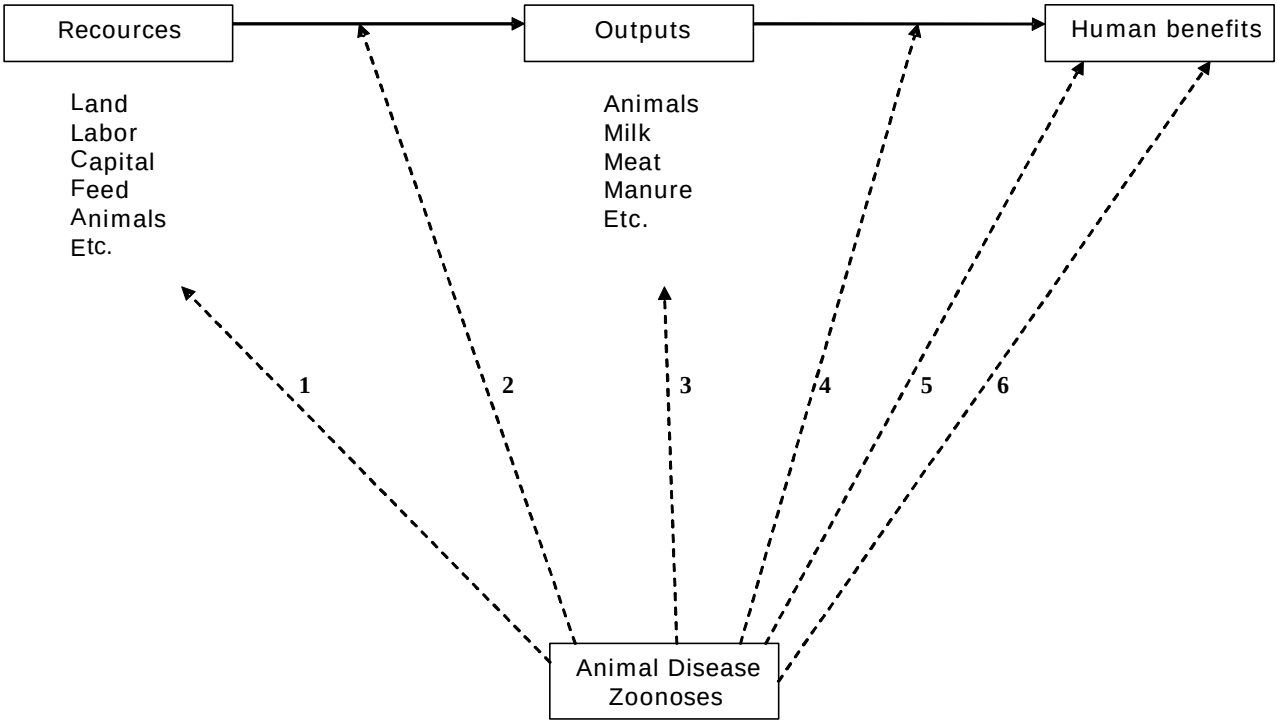


Figure 2. Animal diseases in livestock population systems (McInerney, 1996)

The effect of a disease is a reduction of the productivity. The effects can be classified as direct and indirect as shown in Figure 3. Direct losses may occur as follows:

1. at input level, disease destroys the basic resource of the livestock production process, e.g. through mortality of breeding or productive animals;
2. disease lowers the efficiency of the production process and the productivity of resources employed, e.g. through reduced feed conversion;
3. at output level, the disease may either reduce the quantity of output, e.g. drop in egg production, lowered milk yield or reduce the quality of output or the unit value of the product, e.g. reduced milk quality due to mastitis.

The indirect losses due to disease include the following:

4. Losses through additional costs incurred to avoid or reduce the incidence of disease or to treat cases;
5. detriment of human well-being directly through zoonoses, e.g. salmonellosis, brucellosis.

6. Sub-optimal exploitation of otherwise available resources through forced adoption of production methods, which do not allow the full exploitation of the available recourses, and/or through revenue foregone as a result of denied access to (better) markets, e.g. foot and mouth disease.

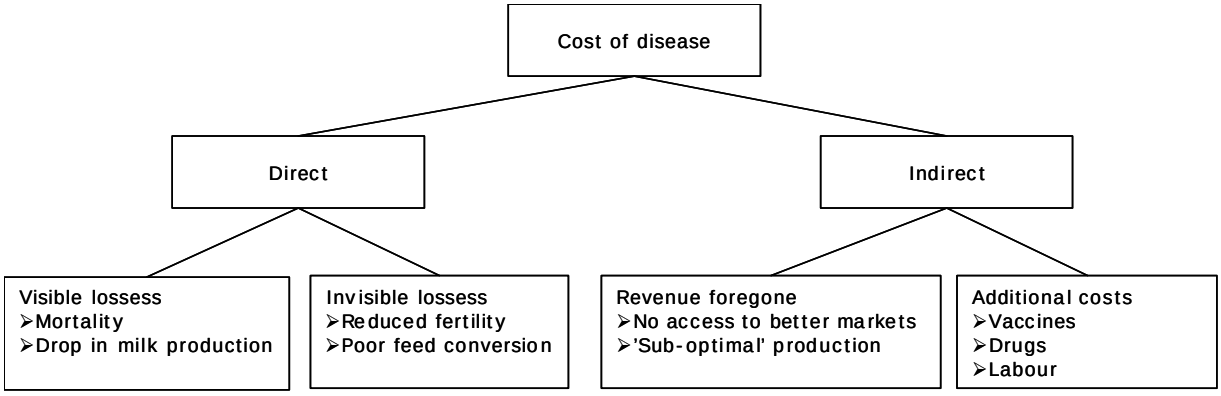


Figure 3. Direct and indirect losses due to animal diseases (source: Otte and Chilonda, 2000)

Thus animal diseases in general have different implications on the livestock production. Direct losses due to animal disease may occur at different levels. A disease may destroy the basic recourse of a livestock production process, e.g. mortality of breeding animals or productive animals. A disease lowers the efficiency of the production process, e.g. through a reduced feed conversion. A disease may reduce the quantity of the output, e.g. drop in egg or milk production or a disease may reduce the quality of the output, e.g. reduced meat quality or milk quality. The indirect losses due to animal disease occur also at different levels. Additional costs are made at farm, sector or national level to avoid or reduce the incidence of disease, e.g. vaccination or quarantine. At farm level additional costs are made to treat cases, e.g. medicines, labour, etc. At the society level (i.e. from a food safety point of view), indirect losses occur when animal disease negatively effect human well-being, i.e. through zoonoses, but also through veterinary drugs that remain in the food product. At the sector or national level losses occur due to export limitations, but also losses are made in other sectors related to the agricultural production systems, e.g. feed industry or agricultural tourism.

Disease prevention is one of various risk management strategies available to farmers (Martin and McLeay, 1998). Its relative value will be influenced by the attitude to and/or the perception of the level and nature of risks involved. A decision-maker will select the strategy that maximises his/her expected utility of profit, related to their current level of and preference for wealth (Hardaker et al., 1997). A major contribution from economics to animal health is to establish the control strategy that minimises total cost (output losses from disease plus control expenditure) (McInerney, 1996).

6. Costs and benefits of control and intervention options.

This section describes the various perspectives of costs and benefits of pre-harvest control options for the farmer and for the consumer. The focus on avoiding production losses vs. gaining public health benefits is associated with the disease/pathogen of concern. Ideally, both causes are served with intervention and control measures. In practice, this is rarely the case. Control programmes against one pathogen could provide cross-protection for another pathogen, but also potentially advance the establishment of another.

6.1 Who bears the costs / who has the benefits

Each dairy farm is considered to be an economic independent unit and most farmers aim for profit optimisation. So the measures taken at farm level to mitigate food safety zoonoses should add to the profitability and sustainability of the farm. In theory this means that there should be either mandatory regulations or financial incentives to get the compliance of the farmers.

Since many zoonoses do not affect the livestock, the losses that are saved due to a strategy to reduce or eradicate these zoonoses from a farm are small. Other benefits (financial incentives) should be there to get the compliance of the farmers. If the food safety programme does not add to the profitability or sustainability of the farm, mandatory regulation is unavoidable.

Food borne disease is a public health problem affecting all consumers. Proper food handling and preparation in the consumers´ kitchen, might help to reduce the problem. But most interventions to improve food safety, however, are taken on the producer side (including farmers, slaughterhouses and processing industry, wholesale and retailers). Consumers are outnumbering by far the producers. Therefore educating or restricting the producers and making the food ´consumer proof´ may be more efficient than educating all consumers. In addition, though pathogen control tends to be more cost-effective closer to the point of food consumption, this is only applicable in the short-run as the effects of consumer education wear off over a period of time. In the longer run measures for the control of foodborne illness (or livestock disease) which eliminate sources of infection, and may subsequently be discontinued, may ultimately be more cost-effective than measures of decontamination at a later stage in the food production chain, which may have to be retained indefinitely (Lo Fo Wong and Hald, 2000).

Improving food safety and selling pathogen(s) free products as an added value allows producers to distinguish themselves from other producers. By distinguishing their products, producers may get higher prices, allowing them to cover their additional costs. However, the product price and consumer risk perception have a large influence on consumer buying behaviour. Still, increasing benefits and market shares, as well as fewer recalls are driving forces for producers to initialise food safety programs. The benefit, e.g. fewer illnesses, will be limited to those consumers that are willing to pay for this additional value. Furthermore, in order for this mechanism to work the targeted food borne pathogen must be known to consumers. The fact is that the majority of food borne

pathogens is unknown to consumers. Another complicating factor is that the majority of consumers do expect their food to be safe. Consequently, governments take over the role of regulators in order to protect public health. By imposing stricter food safety rules, all producers in the concerned nation (could be a single country or the internal market of the EU) would be affected, without having the possibility to distinguish their products from each other. Imposing restrictions, mostly results in higher production costs for the producers. However, by imposing restrictions only on national producers (one country or EU), without imposing the same restrictions to the imported products, national producers might not be able to spill-through their additional costs to the next level. Consequently, the position of the national producers might weaken. Producers in importing countries are often less affected by national measures than producers in exporting countries, given that the latter can not apply measures solely to products destined for the domestic markets whilst exporting food of a lesser food safety quality. In recent years, a development is seen where pre-harvest production is relocated primarily towards central and eastern European countries due to lower production costs. As these production sites are not necessarily under the control of the national government, this may affect animal health, public health, economics and consumer-related issues (protection, awareness, demands).

If governments protect national producers by imposing restrictions on both national and imported food products, the additional costs for the producers will most likely end up as the costs of the consumers. Consumers experience the public health benefit, but might end up paying the additional costs. However, also consumers´ financial budgets have limits. The consequences of increasing costs of one product might be that consumers seek towards other products. If such a switch occurs, it has to be clarified in how far the replacing product(s) will be safer with respect to human health, compared to the non-treated product. Therefore, apart from public health issues, trade issues, eventually government costs, and the change in consumer welfare are all important issues not to be neglected when evaluating a policy. The following section shows an example of this.

6.2 Willingness to pay vs. consumer demand.

When implementing measures in the food production chain to improve food safety and human health it is important to take the whole chain into account, and also to consider which part of the production chain that will bear the costs. It is also important to consider international trade and if there are possibilities to require imported products to fulfil the same requirements as products produced within the country. If there are no such possibilities, a national intervention where the producers must take all the costs might instead increase import from abroad. Which could be products that might even be of lower standard than the national production before the intervention was implemented. The intervention could this way theoretically lead to decreased food safety.

One example mentioned here is the animal welfare legislation in Sweden, which is very strict when it comes to laying hens. The hens must be kept on free range or in special cages, which have nests, sticks for the hens to sit on and sand-baths in which the hens can practice their normal behaviour. Sweden has been on the frontline improving the conditions for the laying hens and there is a decision within the European union to follow the same direction, but not until 2012. The egg industry has made large investments in

the new housing systems and the farmers have taken the costs. Old cages have been destroyed, but also exported to Finland where they are still allowed. The current situation is that the Swedish farmers have a difficult economical situation, where the consumers are not willing to pay for the higher production costs for Swedish eggs and where the import of eggs is increasing. One large exporter of eggs is Finland. Thus, eggs that have been produced by hens living in cages that are forbidden in Sweden (and might even have been exported from Sweden after they were prohibited) are imported and sold in Sweden. There is an animal welfare gain for hens living in Sweden, but the industry is struggling to survive with the high costs and if this will lead to even increased import the total animal welfare gain can be questioned.

Appendix I contains 2 press-releases from the Swedish egg-producers, Svenska ägg, on this matter.

7. Two examples of pre-harvest cost and benefit

7.1 An example of benefit to the farmer – Brucellosis in Mongolia

In a case study Roth et al. (2003) estimated the economic benefit, cost-effectiveness, and distribution of benefit of improving human health in Mongolia through the control of brucellosis by mass vaccination of livestock for a period of 10 years. In order to present cost-effectiveness and cost-benefit ratios from different perspectives (health sector, agricultural sector, households, and society), the authors developed a tool that attributed costs and benefits to these different perspectives.

Especially in countries like Mongolia in which rural income relies largely on livestock breeding and dairy products Brucellosis can have a considerable impact on human and animal health, as well as wide socioeconomic impacts. Human brucellosis is caused by exposure to livestock and livestock products. Infection can result from direct contact with infected animals and can be transmitted to consumers through raw milk and milk products. In animals brucellosis mainly affects reproduction and fertility, reduces survival of newborns, and reduces milk yield (Roth et al., 2003).

Despite livestock vaccination available control strategies to prevent human infection are pasteurization of milk, and elimination of infected animals. Livestock rearing and milk production are important branches of the Mongolian economy. Approximately 50% of the population is employed here. In 1990 human brucellosis re-emerged as a major source of illness in Mongolia. The Mongolian authorities suspect that the high incidence of brucellosis causes significant economic losses. Therefore a whole-herd vaccination strategy over 10 years was initiated that started in 2000 (Roth et al., 2003).

The analysis of the potential benefit of livestock vaccination of Roth et al. (2003) is based on the vaccination scheme proposed in the Mongolian budget in 2000 for whole-herd vaccination. Three different alternative vaccination scenarios with different percentages for protection from transmission were therefore estimated and it was assumed that different vaccination coverage would not affect the budget for the intervention because the costs of personnel, transport, and vaccine cost would remain the same.

Within the study an incremental cost-effectiveness analysis was performed and the cost and health effects of the vaccination programme, both -for the human population and for the animal population were compared with the cost and health effects of the current practise. The benefit-cost analysis focused on the net monetary gain associated with different vaccination strategies (whereby considering only monetary effects and excluding intangible costs such as for example human illnesses). The net present value was used as a key evaluation criterion (Roth et al., 2003).

7.1.1 Benefit measurement

For the measurement of non-monetary health outcome, so called intangible costs, disability-adjusted life years (DALY) were used. For all three different sectors, agriculture, government and public health, monetary benefits were computed. Benefits of avoidance of losses in animals and animal products were considered for the agricultural sector. For the public health sector the benefit of avoiding costs and for private

households with patients suffering from brucellosis the benefits resulting from avoidance of out-of-pocket payments for treatment, loss of income and cost of coping were considered. The benefit for the society as a whole is considered to be the sum of all three mentioned benefits and represents a monetary valuation of the health benefit (Roth et al., 2003).

7.1.2 Costing

Roth et al. (2003) based the costing on the budget of the Mongolian Ministry of Agriculture for the 10-year vaccination campaign against brucellosis. Within this budget the number of animals to be vaccinated, cost of vaccines, service cost of vaccination, cost related to ear tagging, service costs for surveillance and diagnostic tests and costs for health education, training, and advocacy for herders are considered. In the case study it was assumed that the opportunity cost of breeders‘ time for being involved in the campaign was zero (Pearce, 1981). This was assumed because all breeders activities are shared within the family and therefore marginal product lost because of their involvement in the campaign was very low.

7.1.3 Sharing costs among sectors

Roth et al. (2003) explained that the allocation of costs of the intervention among different sectors had to be decided because the vaccination campaign improves human health through interventions in the veterinary sector. The benefit side was assigned to the breeders (benefits from livestock production), patients (reduced out-of-pocket expense and coping costs), and public health sector (avoidance of hospitalization and drugs). The authors declared that the arising costs could not be assigned wholly to the agricultural sector or to the health sector. To attribute the cost to the different sectors basic elements of the technique for joint cost allocation in multipurpose projects were applied. The applied method is known as the „separable costs – remaining benefits“ method (Gittinger, 1982).

All expenditure in the vaccination campaign against brucellosis was associated with animal health, while human health benefit was produced without separable costs. Roth et al. (2003) therefore used an adaptation of the method, in which all cost are regarded as joint costs and allocated the costs proportionally to the benefit. Out of this allocation, the cost-effectiveness of the intervention for human health could be derived, as could measures for economic benefit.

Roth et al. (2003) developed a cost-sharing scenario which considered the multisectoral effects of the intervention. A realistic ratio for cost-effectiveness and profitability of the interventions was derived where the costs of the intervention were shared in proportion to the benefit of each sector. The authors could show that mass vaccination of livestock against brucellosis in Mongolia would be cost effective and would result in net economic benefit for the society if interventions costs were shared between the different beneficiaries on the basis of an intersectoral economic assessement.

7.2. An example of no benefit to the farmer - Campylobacter in the Netherlands[1]

A few remarks must be made on this specific case study before discussing the results. First, one must realize that the production animals usually do not get ill from Campylobacter. Second, the Dutch situation is discussed, in which export is an important factor. Finally, it is only possible to achieve higher prices for pathogen-fee products as an extra income for the industry, if these are not produced by the whole industry and are therefore distinguishable from others on the market.

A number of measures that can be assumed to improve public health by reducing campylobacter levels on chicken meat can be taken in the slaughter house. However, the reduction of faecal leakage, the decontamination of scald tanks, the decontamination of carcasses, and crust-freezing are intervention measures that presume long-lasting investments for processing plants. Irradiation and freezing might force specialist industries to apply long-lasting investments. Once a long-lasting asset is purchased or constructed, it is often difficult or costly to change, alter or reverse a capital investment decision. It is also attractive to plan such investments far ahead, as they then can be integrated in normal investment projects and maintenance schedules. These facts should not be forgotten when deciding on potential interventions to implement in the chicken meat chain.

The average annual prevalence of campylobacter-positive tested broiler meat in the Netherlands is over 30%. Scheduled treatment and treating in general of only the positively tested flocks is far cheaper than treating all flocks, despite the additional testing costs incurred on the farm and in processing plants. However, when scheduled treatment would result in two different meat streams, whereby positively tested meat would be considered less valuable than negatively tested meat, the indirect costs due to e.g. reduced selling prices might be enormous.

It is the fresh broiler meat market in the EU in particular where the Dutch broiler meat sector gets its surplus value, and consequently its ability to compete with such nations as Brazil and Thailand. But with an average annual prevalence of over 30% positively tested broiler flocks in the Netherlands, some of the interventions - if treated meat is not recognized as fresh meat - result in a shortage of fresh meat, and consequently in the potential loss of market shares. Especially in the summer months, with an increase in prevalence of up to 60%, the supply of fresh meat cannot cover the demand. Therefore the recognition and acceptation of treated meat as ‘fresh’ meat is crucial for the Dutch broiler industry.

Furthermore, by rough estimations it could be shown that potential indirect costs due to e.g. potential price reductions for processing plants because of organoleptic changes, product changes and non-acceptance by consumers, would be far higher for the various intervention measures under study than the estimated direct costs, such as treatment and testing costs.

[1] Full details of the project can be found at the website: www.rivm.nl/carma. Havelaar et al. (2005) summarize the project, whereas technical details of the economic evaluation are given in Mangen et al. (2005 a&b)

Campylobacter control in broilers does not result in savings or a reduction of the production costs on farms and processing plants. Assuming no pass-on of increased production costs due to the implementation of interventions in the chicken meat chain to other stakeholders implies that the costs for interventions applied at farm level, processing level and consumer level would have to be borne by farmers, processing plants and government, respectively. In reality, however, costs occurring in the industry and at retail level are often spilled-through either to farmers or to consumers. But the resources of Dutch broiler farmers to bear higher production costs are rather limited. Furthermore, the level of price-based competition between countries in this sector is high. Therefore, if intervention measures would only be applied in the Netherlands, additional costs could not be spilled-through to consumers without losing market shares, letting processing plants and farmers bear them. Consequently, financial margins of processing plants and farmers would decrease.

One complicating factor is that over two thirds of all chicken meat produced in the Netherlands is exported. By carrying out a national action to control Campylobacter in chicken meat, the production costs for only Dutch-produced broilers and broilers slaughtered in the Netherlands would increase. It has to be recognised that Campylobacter is only one of several potential pathogens which might be found in chicken meat. If foreign and Dutch consumers are not willing to pay more for safer broiler meat, the competitiveness of the Dutch broiler processing sector both in and outside the Netherlands would weaken. In the long term, the Dutch broiler sector would undergo an important shrinking. Furthermore, increased demand for cheaper but not necessarily safer imported meat might be the consequence. The Dutch broiler sector might profit from such a national action if, and only if, it somehow succeeds in convincing consumers both in and outside the Netherlands that it is worth paying higher prices for safer broiler meat, and that Dutch broiler meat is safer than any other. This might be possible if Dutch broiler meat were to be recognised by consumers as being a high-quality rather than a bulk product. But before any pay-off from the efforts would be seen, large efforts - including monetary efforts - would need to be made, especially in product development and marketing. It is unlikely that all business involved can make this change in strategy and in an optimistic case a restructuring of the industry would happen. Focussing on public health, the Dutch broiler sector acts in an open economy with considerable imports and exports. Interventions at consumer-level are the only interventions tackling the problem in Dutch and foreign broiler meat sold in the Netherlands. By applying interventions at farm and processing level, huge exports of broilers and chicken meat leads to an export of a large part of the attained health benefits. Under the assumption that health risks, disease burden and cost-of-illness are similar for consumers in importing countries as for consumers in the Netherlands, the total reduced number of gastro-enteritis cases per year and the reduced annual disease burden, when considering all the consumers that do eat Dutch broiler meat, is a factor of 2.7 higher than when considering Dutch consumers only. Consequently the estimated CER (cost-effectiveness ratio) and CUR (cost-utility ratio) for the various intervention measures under study are becoming more positive when considering all consumers eating Dutch broiler meat. But the ranking of the most cost-effective interventions was in the current study not affected. Nevertheless, an economic analysis using an international perspective, e.g. the EU, rather than a national perspective would be more appropriate in order to take all benefits into consideration.

8. Current use of economic modelling in pre-harvest MRA

In WP14, we performed an inventory pre-harvest MRA's performed in countries involved in the project (i.e. Denmark, Germany, Hungary, Italy, The Netherlands, Spain, Sweden, United Kingdom) (Lo Fo Wong et al, 2006). Though this is by no means a comprehensive list of pre-harvest MRA activities in Europe, the trends observed may not be far off.

Out of the 18 studies that are included in the inventory in WP14, two (11%) indicated that the assessment included an economic evaluation. Both assessments were on Mycobacterium avium subsp. paratuberculosis, one from The Netherlands and one from Denmark. The Dutch assessment focussed on milk price differentiation and the Danish milk production losses caused by high-risk animals. Another three assessments (17%) indicated that the results were being used for economic evaluation by another (specialised) working group. These include two assessments on Campylobacter in broiler chicken from the UK and The Netherlands and one Salmonella in pigs from The Netherlands. Three other assessments (17%), two of which still in the planning stage, indicated that they are planning to include an economic evaluation. For six assessments (33%), the project group would consider including an economic assessment next time. For the remaining four risk assessments (22%), an economic assessment was deemed either not applicable or not important. This means that more than three out of four risk assessments consider that an economic evaluation should be part of a pre-harvest MRA. It is difficult to assess whether this is representative for all (pre-harvest) MRA being performed in Europe but it does indicate that adding an economic component to risk assessment is considered an important improvement of the risk model output by most risk assessors.

9. Concluding remarks

One of the applications of risk assessment modelling is to evaluate scenarios with and without alternative interventions for a specific pathogen. Risk managers can compare the baseline human health risk with the changes in risk for each of the hypothetical intervention strategies. Often, the problem is how to value the diverse range of human health outcomes ranging from mild illness to death.

Economic analysis is a powerful tool to support decision-making. It provides a common denominator for evaluating diverse outcomes, ranging from public health outcomes to trade impacts. With benefits and costs in the same monetary units, the net benefits of alternative strategies to reduce risks can be compared directly. Once the public health protection benefits have been estimated, changes in industry and government sector costs can be estimated for each intervention under consideration, both in the short and long term. The economic analysis can inform the risk manager about the size of the likely gains and losses by different groups for each intervention option. Though the discipline is far more developed in animal health economics, the linkage between food safety risk assessment and economic analysis as a means of supporting decision-making is still a novel and somewhat controversial approach that is in development. One recent example of this application is an economic analysis of the impact of labelling eggs with the objective of changing consumer behaviour, following a positive evaluation of this intervention in a risk assessment of Salmonella Enteritidis in eggs (FDA, 2000).

However, risk managers do not base decisions on risk outcomes and economic estimates alone. Other considerations may play an important role in the decision-making process, such as consumer risk perception, public acceptance and political climate. Therefore, control options with the largest net benefits (e.g. public health benefits vs. control costs) may not always be chosen. An example could be the European surveillance and control approaches for Bovine Spongiform Encephalopathy (BSE), where the estimated risk for acquiring new variant Creutzfeldt-Jacob Disease (vCJD) from contaminated beef is extremely low, but consumer risk perception and trade issues outweigh the economic consequences.

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Appendix I. Two press-releases from the Swedish egg-producing company Svenska ägg and links to website with more information.

2006-03-20

Lågt äggpris hotar näringen

Äggpriserna är för låga, svenska äggbönder får inte betalt för att värphönorna idag är frigående eller bor nya burar. Branschföreningen Svenska Ägg samlas idag fredagen den 10 mars i Jönköping för att diskutera hur man skall kunna få skäliga priser för bra djuromsorg och konsumenternas mattrygghet.

Omställningen av äggnäringen i Sverige har lett till att 62 procent av alla värphönor idag är frigående (sex procent av dessa är ekologiska) och att 36 procent bor i nya burar. De nya burarna är anpassade efter hönornas naturliga behov, och har sittpinne, värprede och sandbad. Två procent bor fortfarande i gamla burar, men även dessa är på väg att avvecklas.

Svenska äggproducenter är mycket stolta över resultatet och över att gå i spetsen för europeiska äggbönder. När det gäller djuromsorg och matkvalitet ligger svenskarna nämligen i världsklass. Den svenska omställningen genomfördes efter krav från både konsumenter och politiker. Dock lever cirka 85 procent av hönorna inom EU fortfarande i gamla burar, såsom till exempel i Finland. EU har beslutat att de gamla burarna ska vara avvecklade senast 2012, vilket gör att Sverige har svårt att konkurrera med priset på EU-marknaden.

- Svenska äggproducenter får inte betalt för de mervärden som produkten står för. Omställningen har inneburit stora investeringar för producenterna., säger Camilla Sandenskog, vd för Svenska Ägg.

- Det är anmärkningsvärt att handeln inte betalar mer för att svenska värphönor har bättre omsorg, och för att konsumenterna inte behöver vara oroliga för att få salmonella när man äter löskokta ägg eller rå äggula på pasta carbonaran. Den ensidiga fokuseringen på pris inom handeln kommer på sikt att drabba konsumenterna och det kommer att gynna producenterna i de länder där man inte bryr sig om hur djuren mår.

De svenska äggproducenterna ser alltså det låga priset som ett hot mot näringens existens. Däremot är man inte orolig för att fågelinfluensan ska drabba producenterna, risken att smittan kommer in i tamfågelsbesättning är ytterst liten. Dessutom har man näringen en lång tid en tradition av säker hantering för att slippa att få in smitta i stallen.

Vid frågor och kommentarer kontakta Camilla Sandenskog, vd, Svenska Ägg 070-579 07 64

Links

http://www.riksdagen.se/Webbnav/index.aspx?nid=410&doktyp=mot&rm=2005/06&bet=MJ410&dok_id=GT02MJ410

http://www.lrf.se/data/internal/data/05/48/1111562917517/GronaFramt_kap2a.pdf

http://www.konsumentverket.se/Documents/PM/PM2004_05_ekologiska_konventionella_agg.pdf

http://www.vasabladet.fi/lokalt.asp?docID=2757

http://www.svenskaagg.se/svenskaagg/default.htm

http://www.riksdagen.se/Webbnav/index.aspx?nid=410&dok_id=GS02Sk405

http://195.255.83.67/cgi-bin/mediaweb?Newsp=hbl&Date=020923&Model=juttu.html&depa=ekonomi&story=05552792.txt

2004-09-21

'Finnkamp med ägg och bacon på menyn' pressmeddelande

Sveriges Gris- och Äggproducenter anklagar Finland för illojal konkurrens.

Statssubventionerat griskött från Finland slår ut en del av den svenska produktionen av griskött på svenska gårdar. Skall finska, statssubventionerade ägg, producerade i mindre burar än de som nu förbjuds i Sverige, få konkurrera ut svenska ägg?

2004-09-22 EUs grundidé är lika konkurrens inom unionen. Det som nu pågår är emot EUs grundidé. När Sverige och Finland 1995 kom med i EU fick Finland tillåtelse av EU att stödja sitt jordbruk, med motiveringen att strukturen i lantbruket var dålig och landets nordliga läge med 'arktiskt klimat'. Delar av detta stöd skulle för länge sedan upphört men Finland har genom skickliga förhandlare lyckats förlänga stödet, nu till 2007.

- Det finska stödet ger den finske grisproducenten 25% extra i relation till mitt pris, konstaterar Lars Hultström, ordförande i Sveriges Grisproducenter.
- På grissidan har man med hjälp av kraftfulla stöd byggt upp en så stor och effektiv produktion att betydande export sker.

- Som äggproducent måste jag konkurrera mot ägg som både uppbär statstöd och som produceras med i Sverige förbjudna metoder säger Per-Olof Björnsson, ordförande för branschorganisationen Svenska Ägg.
-Det skulle vara klädsamt om jordbruksministern i debatten om 'olagliga' svenska burar också nämnde importen av 'olagliga' ägg från Finland, fortsätter Per-Olof Björnsson.

- Vi vill gärna konkurrera men det måste vara på lika villkor, menar Hultström och Björnsson.

Alla undersökningar visar att svenska konsumenter vill ha svenskt griskött och svenska ägg. Vi har som högsta mål att erbjuda svenska konsumenter svenska produkter. Även jordbruksministern uttalar förtroende för den svenska produktionen. Nu riskerar svenska producenter att bli utkonkurrerade av statssubventionerade finska produkter.

Vi anser att Finland bryter mot överenskommelsen med EU:
1. genom att kraftigt utöka sin grisproduktion, sedan 1995 med 16%. Även produktionen av ägg ökar nu.
2. importen av ägg och griskött från Finland ökar. Importen av griskött har ökat 58% 2004 jämfört med första halvåret 2003. Idag går 75% av den finska exporten av ägg till Sverige.
3. genom att exportera statssubventionerat griskött och ägg till Sverige som försvårar för svenska producenter att överleva.

Vi kräver att jordbruksminister Ann-Christin Nykvist
- tar upp Finlandsimporten med jordbruksministern i Finland och påtalar de problem som uppstår på svensk marknad.

- tar upp förhandlingar med EU om att få ett stopp på Finlands övergångsstöd till gris- och äggproduktionen så att vi kan konkurrera på lika villkor.

Lars Hultström ordförande Sveriges Grisproducenter 0708-702 551 Per- Olof Björnsson, ordförande Svenska Ägg 08-787 5487

Referens: Finnkamp i ägg och bacon
Långsam nedtrappning av omfattande bidrag till finska fjäderfäproducenter

Källa: Pressmeddelande 2004-09-21 från Svenska Ägg och Sveriges Grisproducenter